RADIO FIELD SERVICE DATA

COMPANION BOOK TO

(*MODERN RADIO SERVICING*)

BY

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RADIO FIELD
SERVICE DATA

PREFACE TO THE SECOND EDITION

Modern Radio Servicing, a 1,300-page textbook, has been prepared by the author of this book to furnish all the detailed information regarding test equipment, test methods, servicing procedures, etc., which the progressive radio service man of today should know and use if he is to perform service work quickly and effectively by the most modern methods. This *Radio Field Service Data Book* has been prepared to supplement Modern Radio Servicing for the purpose of presenting, in as convenient and useful a form as possible, practical radio reference data which the author has found to be exceedingly useful to radio service men daily, when they are actually on radio service jobs *in the field*. Therefore, it has been called *Radio Field Service Data*.

The enthusiastic manner in which the first edition of this Radio Field Service Data reference book has been received by practicing radio service men everywhere is extremely gratifying. The many letters which the publishers have received from men who have been using the book in their daily work for months indicate that it has successfully passed the acid test of practical everyday field use and has proved to be an important, extremely helpful and handy reference book of useful information and data for the radio service man. It is for these reasons that the book has now been revised throughout and greatly enlarged in an effort to bring all of this reference data up to date and to provide more of it. It is hoped that this revision will make the book still more helpful and valuable. The same style of presentation of the data has been maintained, as it has proved satisfactory in practice, but the book is now issued in loose-leaf form in order that it may be kept up to date by a regular periodic supplement sheet service. It has been prepared in a convenient size so that the service man can use it at his service bench and also carry it along in his tool bag on all jobs.

The Intermediate Peak Frequency listings in Section 1 supply data which is essential in i-f amplifier alignment work. This section has been brought up to date to include this important alignment data for all new superheterodyne receivers (including the current models)—and also for many additional older sets. The total number of sets listed has been increased from 3,300 to over 5,200 models—representing the products of 154 reeciver manufacturers.

A new section which presents a cross-index of the model numbers of American RCA-Victor with the corresponding American G.E., WHS'E. and Graybar receivers, and one presenting a cross-index of American RCA-Victor with the corresponding Canadian RCA-Victor, G.E. and WHS'E. receivers, has been added for reference.

The Receiver "Case History" section is a time-saving adjunct to the service man's test equipment and experience, for it represents the accumulated servicing information gained by thousands of hours of actual service work on many different receivers of each model and make listed, under all sorts of installation and operating conditions. It has proved so useful to service men that it also has been greatly enlarged. The "Case Histories" of 750 models of receivers have been added to the original compilation—bringing the total number now listed up to over 1,500 models in all.

The field of auto-radio installation and service work is rapidly assuming such large proportions that it was considered necessary to add considerable data on this phase of service work. Many valuable, time-saving service hints have been added to Section 3 on the Remedies for Stubborn Cases of Ignition Interference in Various Makes and Models of American Cars. Complete data on 29 makes of cars is now presented. The electrical wiring diagrams of many recent models of automobiles have also been added in Section 4, and the compilation of Car Battery Polarity, Breaker-point, Spark-Plug gap and Auto-Radio Antenna data for American cars in Section 5 has been brought up to date by the addition of much new material.

The Tube Characteristic and Socket Connection charts in

Sections 9 and 10 have also been brought up to date with data on all the new "glass", "all-metal" and "G" type tubes. A Tube-Type Index and chart listing Replacement Tube Types have been added in Sections 11 and 12.

A new and improved chart for resistor and power rating calculations has been put into Section 16. In Section 17, the RMA Standard Color Codes for power transformer leads, i-f transformer leads and audio transformer leads have been added. RMA Standards data on standard panel- or dial-light bulbs has been added in Section 18. An explanation of the special fixed resistor color-code numbering system employed by PHILCO has been presented in Section 19.

Practically every Section in the book has been improved in some manner, and the index has been completely rearranged to conform with the new contents and page layout. It will be noticed that a preliminary explanation of the nature and purpose of the data, together with a typical example illustrating the correct way to use it (when necessary), has been included before each section. It is felt that this will enable all classes of readers to more thoroughly understand just how to use these charts and tables and therefore employ them more frequently and to greater advantage in their work.

Grateful acknowledgement is made to Mr. Bertram Freed for his assistance in the preparation of the old edition of this book and to the many radio service men who have cooperated so enthusiastically and unselfishly with the author by offering their unbiased criticism of the first edition and constructive suggestions for new material contained in this new book. The author is also indebted to the many radio receiver manufacturers for their cooperation in making the compilation of the Intermediate Peak Frequency listings possible; to the editors of *Radio Retailing* magazine for permission to reprint data which appeared originally in its pages; to the Raytheon Production Corp. for permission to publish the tube data charts in Sections 8 to 12; to the RCA Radiotron Co. for permission to reprint the special tube data in Section 13; to Mr. Leonard Fischer for preparing the final drawings; and to Mr. I. Ellin for his assist-

ance during the preparation of the rearranged and new data for publication, and the reading of the proofs.

It is my sincere hope that the data in this book will prove useful to radio service men both because of its convenient form and its content. If it is at all helpful in making their highly specialized tasks less burdensome, and less time-consuming, I shall feel amply repaid for the work. Suggestions for increasing the usefulness of the book will be gratefully received at any time.

ALFRED A. GHIRARDI

NEW YORK CITY
Oct. 1936

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INTERMEDIATE PEAK FREQUENCIES EMPLOYED IN SUPERHETERODYNE RECEIVERS

(154 MANUFACTURERS — OVER 5,200 MODELS)

For best performance of a superheterodyne receiver, it is essential that its intermediate-frequency amplifier stages be correctly adjusted to tune to the frequency intended by the designer. Since the i-f which the receiver is designed to employ must be known before satisfactory alignment can be attempted, the following compilation of the intermediate peak frequencies of all superheterodyne receivers of American and Canadian manufacture is presented here with the hope that it will prove helpful as a reliable source of i-f information in the work of the radio service man. For a comprehensive presentation of the principles involved, and the actual procedure to employ, in the alignment of superheterodynes, see Chapter XXV in *Modern Radio Servicing.* The use of the Cathode-Ray Oscilloscope in all superheterodyne alignment work is also explained in this chapter.

The receivers are listed here alphabetically according to manufacturer's or trade names (154 in all) and alphabetically and numerically according to model numbers (over 5,200 models in all).

ACRATONE

(See Federated Purchaser)

AERO-CHARLES HOODWIN

(See Hoodwin Co., Charles)

AERONAUTIC

(See Mission Bell)

ADMIRAL

(See Continental Radio & Tel.)

AIR KING

Model	kc
11F, 16F	456
27	456
37	456
39	456
52	456
54, 66	456
260	456
400	175
500	175
528	456
3360	456

AIRLINE

(See Montgomery Ward)

ALL-AMERICAN MOHAWK CORP.

Model	kc
B-80, DC-65	175
S-6, S-7, S-8	175
S-10	175
S-50	175
S-60	175
S-63	175
S-65	175
S-80	175
SA-65	175
SA-90	175
SA-91	175
SA-110, SA-130	175
SW-8, SW-80	485
U-50, U-55	485
U-500	456

ALLIED RADIO

Model	kc
Knight 6 tube	175
Knight 7 tube	175
Knight 12 tube	177.5
Knight 118 AVC	175
Knight E-9830	177.5
Knight E-9831	177.5
A-47HS, A-56	456
A-60, A-60B	456
A-81	465
A-321, A-681	465
A-3281	456
A-6372	465
AZ-2, AZ-4	456
AZ-282, AZ-482	456
B-101	456
B-102	175 or 262
CL-5, CL-6	456
CL-583, CL-684	456
F-9501, F-9503, F-9505	456
F-9511, F-9515	456
F-9531	456
F-9541	175
F-9571	465
F-9591	456
F-9610	485
F-9616	175

ALLIED RADIO (Cont'd)

F-9631	456
F-9640	177.5
F-9660	177.5
L-4	456
L-7	456
L-477	456
L-481	456
L-567	456
L-767	456
L-783	456
M-169	456
ML-2	456
ML-4	456
ML-215A, ML-266	456
ML-477, ML-481	456
P	175
U-6	456
X-6	456
X-641	456
X-718	456
X-813	456
Z-242, Z-442	456
19A-68	465
30A-99	175
37B-71	465
39B	465
39B-71	465
39B-77	465
39B-80X	465
39B-81	465
46A	465
46A-95	465
46A-106	465
46A-108	465
47A-72	465
47A-90	465
60BX-44	465
99, 99T	465
101	456
102	175
320-83	465
680-T	465
680-47	465
680-71	465
3280-T	465
3280-47	465
3280-71	465
4052	465
4053-M2	465
6055	465
6370-T	465
6370-72M	465
6370-82M	465
9139, 9172	465

AMERICAN BOSCH

(see United Amer. Bosch)

AMERICAN TELEV. & RADIO CORP.

Model	kc
Duo. 61	175

ANSLEY RADIO

Model	kc
B-1	456
D-3, D-4	175
D-6	175
D-7	456
D-9, D-10	456
D-17, D-18	456
U-3, U-8	175
U-10	456

APEX

(see U. S. Radio & Television)

ARKAY (R.K. RADIO LABS.)

Model	kc
RKS-5	175
50, 60, 60-D	175
501	465
510	465
521, 523	465
534	465
600	175
610	465
631	465
633, 634, 635	465

ARVIN (NOBLITT SPARKS)

Model	kc
7	170
10-A	175
15	175
16, 17, 17A	175
18	175
20-A	181.5
20-B	175
25, 27	175
28	175
30-A	181.5
33	175
35, 37, 38	175
41	456
45	175
51, 51B	456

ARVIN (Cont'd)

61	456
61B	175
61M, 62	456
62B	175
62M	456
81, 81M	456
417, 467	456
507	456
517, 517B	456
527, 527B	456
617, 617B	456
627, 627B	456
927, 1127	456

ATWATER KENT

Model	kc
H-1, H-2	130
72	130
80, 80-F, 81	130
82, 83 (all)	130
84, 85 (all)	130
86, 87 (all)	130
89, 90 (all)	130
91, 91-B, 91-C	260
92 (all)	130
93	1,000
94, 96, 99 (all)	130
112, 112-N, 112-S	472.5
126, 126G	264
136, 136G	264
135	264
137	125
145	264
155	262.5
165 (early)	262.5
165-Q (1656 late)	264
184	450
185, 185-A	264
188 (all)	130
200	472.5
206, 206-O	472.5
215, 215-E	264
217, 217-D	264
225	450
228 (all)	130
237-Q	472.5
246	262.5
260 (all)	130
266	262.5
275	264
285-Q	450
286	472.5
305-Z	264
310	130

ATWATER KENT (Cont'd)

317	472.5
318	472.5
318-K, 318-N	472.5
325, 325-E	264
328	472.5
337	472.5
356	472.5
376	472.5
376-D, 376-DE	472.5
376-E, 376-KX	472.5
385-Q	264
387	264
412	472.5
415-Q	450
416, 416-G	264
424, 425	264
427, 427-D, 427-Q	264
435	450
447	472.5
448	130
456	264
465-Q	264
467-Q	472.5
469 (all)	130
475	264
480	472.5
485-Q	450 or 472.5*
509	472.5
510	130
511, 511-W	472.5
515-Q	450 or 472.5*
525, 525-Q	264
534, 535	450
545	450 or 472.5*
555	262.5
556	264
558, 558-D, 558-Q	130
559, 559-N, 559-S	472.5
565-Z	264
567 (all)	130
612	130
625-Q	264
627	130
636	262.5
637	472.5
649	472.5
655-Q, 655-QE	264
657-Q	472.5
665, 666	264
667, 667-D	264
676	264
708	472.5
711, 711-R	472.5
717	472.5
725	450

ATWATER KENT (Cont'd)

735	264
747-Q	472.5
756 (all)	262.5
768-Q	472.5
776	264
788, 788-J, or T, 788-R	472.5
808, 808-A	472.5
810	472.5
812	130
816	264
825	264
856	264
926, 936	264
944	450
976	264
978-A, 978-QK	472.5

* Look for label on rear of chassis for correct i-f. If label is not there, set the test oscillator at each of these frequencies, in turn. The one which results in the greater receiver output will be the correct i-f.

AUBURN AUTOMOBILE CO.

Model	kc
A5A3	181.5

AUDIOLA

Model	kc
A-6, S-6	177.5
B-7, S-7	177.5
7 Tube Super Pent., '31	177.5
8 Tube Super. Pent., '31	177.5
9 Tube Super Pent., '31	177.5
10 Tube Super	177.5
6, 7	177.5
9-T-45	177.5
23-S-7, 23-S-8, 23-S-12	177.5
23-T-8-LW	177.5
33-A-6, 33-S-6	177.5
33-S-5	456
33-S-6-B, 33-S-7	456
33-S-10-SW, 33-T-4	456
34-C-5, AC-DC	456
34-S-5 AVC	456
34-S-5-LW	456
345	456
346, 347	177.5
1931 Super.	175

AUTOCRAT RADIO CO.

Model	kc
Dictator 5	456
4, 6	175
90 SL	175
505	456
518	456
618	175

AUTOMATIC RADIO MFG. CO.

Model	kc
A1, A5	480
E6	456
F10	480
J50	480
J80	456
R61, R62	456
S6	456

AUTO-VOX RADIO CO.

Model	kc
75	175
80	262

BALKEIT

Model	kc
L-7	175
L-8	456
6-7	456
55, 70, 85	175
100	456

BELMONT

Model	kc
51-B, C	175
55-B	175
71AC, 81	175
100	175
110	175
404	465
522	465
525	456
530, 540, 550	456
566	465
575	175
578	465
580	175
585 A, B	370
585 C, D	465
586, 587	465
601 A, B	465
625	175

BELMONT (Cont'd)

650, 660	175
666	465
670	175
675, 675-E	370
680	175
685, 686	465
690	175
746	465
750	175
770	465
775	370
777 A, B, C	465
778	465
786, 787	465
845	465
856	465
880 A, B	175
880 C, D	465
1050	175
1070 A, B	465
1170	465

BOSCH

(See United Amer. Bosch)

BROWNING DRAKE

Model	kc
40, 80	175

BRUNSWICK

Model	kc
AVC-D	175
D	175
3 NC 8, 3 NW 8	180
5 NC 8	180
11, 12	175
16, 17	175
24, 25	175
33, 33 AC	175

BULOVA

Model	kc
C-751	175
G-781	175
M-701	175

CADILLAC MOTOR CAR CO.

Model	kc
O6W, 072, 56-VI	262

CAPEHART

Model	kc
400-A	180
400-B	180
400-C, 400-D	465
400-E	465

CARUSO-LAUREHK RADIO MFG. LABS.

Model	kc
AE-79	175

CASE ELECTRIC CORP. (CASE "TELL-TIME")

Model	kc
Chassis 16, 16A	262.5
Chassis 17	262.5
Chassis 19, 19A	262.5
Chassis 27, 27A	262.5
Chassis 110, 110A	262.5
610, 610R	262.5
618	262.5
710A, 710AR, 710E	262.5
713A, 713AR	262.5
714A, 714AR	262.5
715A, 715AR	262.5
716A, 716AR	262.5
718A, 718AR	262.5
719A, 719AR	262.5
915, 916	262.5
917, 918	262.5
1015, 1015R	262.5
1016, 1017, 1017R	262.5
1017-3, 1017R-3	262.5
7113, 7113R	262.5

CENTRAL RADIO CORP.

Model	kc
261	175
560, 561	256

CHAMPION RADIO CORP.

Model	kc
500, 501	456
600, 601	175

CLARION

(See Transformer Corp. of America)

CLIMAX RADIO & TELEVISION CO.

Model	kc
D-8	456
G-4, H-5	456
J-6, JE-7	456
K-6, L-91	456
M-8, ME-9, ME-17	456

COLONIAL

Model	kc
C-90A, C-90B	175
C-695, C-995	175
C-1495	175
T-345, T-397, T-399	175
44, 47, 48, 50, 51, 52	175
55	1,000
56	175
62, 69, 71, 73, 76	175
*90A, *90B	175
106-B	175
150	480
164, 164-B	175
182, 182-B	175
240 AC	490
250 Chassis 128-A, 128-B	175
250 AC	175
279 Chassis 128-A, 128-B	175
279 AC	175
300 Chassis 128-A, 128-B	175
300 AC, 301 AC	175
†345	175
†397	175
*399, 400	175
500, 500 AC	175
501, 501 AC	175
*595	175
600, 600-A, 601, 602	175
603	480
604	445
605, 650	175
651, 652, 653, 654, 655	480
656	175
657, 658	480
659	175
662	480
*695	175
700, 701, 702	175
*995	175
1495	175

* See also the corresponding listings under letter "C" models, such as C-90A, C-90B, etc.

† See also the corresponding listings under letter "T" models, such as T-345, etc.

COLUMBIA

Model	kc
C-25B	175
C-53, C-54, C-55	175
C-59	175
C-80	175
C-80-A, C-80-B	175
C-81	175
C-83, C-84, C-85	175
C-90, C-90 A, C-90 B	175
C-93, C-94	175
C-120, C-120-B	175
C-123	175
C-220, C-223	175
C-256	175
C-550	175
C-559	175
C-800	175
32, 34	175

COMMONWEALTH RADIO MFG.

(COM-RAD)

Model	kc
A-60	456
150, 160, 180	456
260	456
550, 660	456
880	456

CONTINENTAL RADIO & TELEVISION CORP.

(ADMIRAL)

Model	kc
A31, A32	465
A90, A126	465
AM387	465
AM587, AM688	465
B125, B127	465
B225, B227	465
B325, B327	465
CL583, CL684	465
L567, L668	465
M351, M551	465
ML215A	465
ML266	465
ML477, ML481	465
MX218, MX239	465
MX240, MX241	465
X140, X141	465
X423	465
X641, X718	465
X813, X821	465

CONTINENTAL (Cont'd)

U6, U6W	175
Z242, Z282	465
Z344, Z393	465
Z442, Z482	465
Z544, Z593	465
100C	465

CROSLEY

Model	kc
Buccaneer	450
Chief	181.5
Clipper	450
Constitution	450
Corsair	450
Cruiser	450
Fiver	450
Galleon	450
Merrimac	450
Monitor	450
New Travid	450
Privateer	450
Roamio	456.0
Viking	450
A156, A166	262.5
A266, A366	262.5
Bat-4, 5, 6, 8	450
Bat-46	450
Bat-62, 62A	450
50, 50 Lowboy	456.0
4A1, 4C1	456
5A1, 5A3	181.5
5B2	476
5C2	181.5
5H1	456
5M3	456
5V1, 5V2	181.5
6B1	456
6H2, 7H2	456
7V2	181.5
8H1	456
10P3	181.5
Dual 60, Dual 60 Lowboy	181.5
61, 61 Lowboy	456.0
Dual 70, Dual 70 Lowboy	181.5
72, 72 Lowboy	456.0
80-AW, 80-AW Lowboy	456.0
95, 96	181.5
98, 99	181.5
102, 103	181.5
119	181.5
120, 121, 122	175

CROSLEY (Cont'd)

123	175
124 (all)	175
125	175
126, 127 (all)	175
128	175
129 (all)	181.5
130	181.5
131	175
132-1	181.5
133	181.5
134 (all)	181.5
135	181.5
136 (all)	456
137	181.5
141, 143	181.5
146 (all)	181.5
148	456
150	181.5
154, 155	456
*156	456
157, 158	181.5
159	456
160	181.5
163	456
*166, 167	456
168	181.5
169	456
170, 171	181.5
172, 173, 173-5	456
174	456
175	181.5
176, 178	456
179, 180	181.5
181, 182, 184	456
*266, *366	262.5
415, 425, 435	450
515-5515	450
516	450
525-505	450
526-5526	450
534	456
535	450
536-5536	450
545, 546	450
555-5555	450
556, 605	450
615, 616	450
626. 635, 636	450
645, 646, 655	450
715, 725	450
815, 816	450
855, 865	450
915, 916	450
955	450
1014	456
1016	450
1055, 1155	450
1316	450
5516-6515	450
6615, 6625	450

* See also the corresponding listings under letter "A" models, such as A-156, A-166, etc.

DE FOREST CROSLEY RADIO

Model	kc
140	175
405A, 405B, 405C	175
405D, 405E, 405F	175
500, 501	175
607	175
608A, 608C	175
705A, 707A	175
801	175
840, 850	175
851A, 851C	175
853, 855, 855B	175
902, 905, 907	175

DELCO RADIO

(See United Motors Service)

DETROLA RADIO CORP.

Model	kc
Roadmaster	456
Warwick	456
5B3	370
5D1	455
5W Models	370
5WG1	370
5X Models	370
6A, 6M, 6R	262
6W Models	370
6XM, 6ZM Models	370
7A3	262
7ZM Models	370
10ZM Models	456
100, 100A	456
101, 101A	456
102A, 103A	456
105A, 106A	456
108A, 109A	456
110A, 114A, 116A	456
134A	456

DEWALD-PIERCE AIRO, INC.

Model	kc
AC746-7M	175
BAH	175
BLG	115
52	175
55-X	456
58-EX, 58-R	456
59, 60	456
61	456
62	175
80	456
81, 81-R	456
100	456
440	456
500-A	130
501-A, 501-B	456
503, 504	456
505, 505R	456
507, 510	456
517, 517-R	456
520	456
553	456
570	456
600-A	456
600A-R	456
601	460
602	456
603	455
605, 606	175
607	456
608	177.5
609, 610, 610-LW	456
611, 611-LW	456
612, 612-LW	456
614	455
615, 615-LW	456
616	456
617	175
618, 619	456
620, 620-LW	456
621, 621-LW	456
622	456
630	456
640	175
800	456
802, 803, 804, 805	456
811, 811R	456
1000	456
1100	456

DYNAPHONE

(See Ansley Radio)

ECHOPHONE

Model	kc
S-5	175
5	175
10	175
12	175
14, 15	175
16, 17, 18	175
20	175
35, 36	175
38	175
50, 55	175
60	175
62	115
65	175
70	175
72	115
75	175
80, 90	175
92	115
112	456
119	456
124, 125, 126	456
130	456
133	175
143	456
160	456

EDISON BELL CO.

Model	kc
43, 44, 45	175
53	175
53-LW	115
55-AW	456
63	175
63-LW	115
64	456

ELECTRIC AUTO LITE

Model	kc
062-A	262
072-A	262
3722	262

ELECTRICAL RESEARCH LABS.
("ERLA" — "SENTINEL")

Model	kc
7M	262
10M	370
30	175
31B, 32B	465
33B, 34B, 35B	465
36L	465

ELECT. RES. LABS. (Cont'd)

37B, 38B, 39B	465
40A, 44A	465
46A, 47A, 48A	465
49B, 50B	465
51U	465
52A, 53A	465
55	465
56U	465
57A, 58A	465
59U	465
60B, 63B	465
61, 62, 63	175
65B, 66B	465
67L	465
68B	465
69U	465
70A	465
71U	465
81, 81-P	175
82 (245), 82-P	175
106B	175
108, 108A, 109	175
110, 114, 261	175
501, 502	465
513	175
521	175
550	175
560, 561	265
570	465
599	262
600	265
601, 602, 603	265
614	175
623, 624	465
634, 635	465
660	465
1020A, 1030A	115
1046	465
4400	370
4500	465
5000, 5100	465
5211	465
5500	370
5600	265
5628	465
5721	465
6000	265
6101, 6102	465
6232, 6241	465
6315	465
6317	465
6321, 6323	465
7732	465
7741	465

ELECTROTONE

(See Harris Mfg.)

EL RAY RADIO MFG. CO.

Model	kc
A, B, C	465

EMERSON

Model	kc
Chassis A, B, C, D	456
Chassis E-5, F, F-5, F-7	456
Chassis H, J, K, L	456
Chassis U4A, U5A	456
Chassis U6A, U6B, U6E	456
A-130, A-132	456
B-5	456
B-10	172.5
B-AC-10	175
B-131	456
C-134, C-134-LW	456
C-136, C-136-LW	456
C-138, C-138-LW	456
C-139, C-139-LW	456
C-140, C-140-LW	456
C-142, C-142-LW	456
CS	175
D-55	456
D-134, D-134-LW	456
D-136, D-136-LW	456
D-138, D-138-LW	456
D-139, D-139-LW	456
D-140, D-140-LW	456
D-142, D-142-LW	456
D-146, D-146-LW	456
E-128	172.5
F-117, F-122	456
F-133, F-135, F-141	456
G-127	456
H-5, H-5A	172.5
H-5L	132
H-5S, H-6A	172.5
H-130, H-137	456
JS	175
J-106	456
KS	175
K-116, K-121, K-123	456
LA	172.5
L-117, L-117-LW	456
L-122, L-122-LW	456
L-133, L-133-LW	456
L-135, L-135-LW	456
L-141, L-141-LW	456
M-134, M-136	456
M-138, M-139	456

EMERSON (Cont'd)

M-140, M-142, M-146	456
P-117, P-135	456
S-147	456
M-AC-7	175
23, 26, 28	456
30-AW	456
30-LW	132
31-AW	456
33-AW	456
33-LW	132
34C	456
35	172.5
36	456
38, 38-LW	456
39	456
40	175
42	456
45	456
45-LW	456
49	456
50-L	115
50-M	175
50-S	465
52-CS	175
53-JS	175
55-AW	445
55-L	115
55-S	175
59	456
70-KS	175
71	456
77	172.5
80-KS	175
101	456
101U	456
102	456
104	456
105	456
108	456
108-LW	132
109	456
109-LW	132
110	456
110-LW	132
111	456
112, 113	456
114, 115	456
116	456
117-LW	132
250	172.5
250-AW	456
250-LW	132
300	172.5
321-AW	456

EMERSON (Cont'd)

321-LW	132
350-AW	456
350-LW	132
375	175
375-LW	125
450	456
667	172.5
678	172.5
755	175
755-L	115
770	456
775-L	115
775-M	175
775-S	465
965	172.5

EMPIRE ELECTRICAL PRODUCTS

Model	kc
30	175
30-L	115
40	175
40-L	115
40-SW	456
45-SW	456
51, 52	175
60	175
71	175
74	462.5
450-A, 460-B	456
470-C, 480-C	456
575	175

ERLA

(See Electrical Res. Labs.)

ESPEY MFG. CO. (ENSIGN)

Model	kc
451, 458, 459	456
464, 467	456
472	460
481, 555	456
560, 564, 565	456
671, 674, 675	456
5101, 5111, 5181	456
6101, 6141	456

FADA

Model	kc
NA, NE	265
RN	470
RP	175
RS	470
RU	265
RV	175
RW	265
RX	125
RY	470
9	456
45 (KU), 45-Z (KU)	175
48 (KW), 49 (KW)	175
51 (KO)	175
53 (KOC), 55 (RG)	175
57 (KOC)	175
61 (KX)	175
63 (KX)	175

FADA (Cont'd)

66 (KY)	175
73 (RE), 74 (RA)	175
76 (RA)	175
78 (RC)	175
78-10	265
79 (RC)	175
79-10	265
83 (RA)	175
85 (RE)	175
87 (RA)	175
88 (RA)	175
89 (RA)	175
93 (RX), 95 (RX)	125
99-10	265
101 (RK)	175
102, 102 (RP)	175
104	470
104-B (RV)	175
105 (RN), 106 (RN)	470
107 (RN)	470
112 (RS)	470
131 (RU), 132 (RU)	265
133, 134, 135	265
141 (NA)	265
150C, 150T	456
151 (NE), 152 (NE)	265
155, 156, 157	456
160C, 160T	456
161C, 161T	456
166	175
170C, 170CK	456
170T	456
171C, 171CK, 171T	456
172	456
190C, 190CK	456
190T	456
191C, 191CK, 191T	456
192C, 192CK, 192T	456
193C, 193CK	456
193T	456
211C, 211CK, 211T	456
212C, 212CK, 212T	456
216C, 216CK, 216T	456
250 C, T, U, W	456
260, B, D, G, T, V, W	456
262 G, D, T, U, W	456
266	175
270 C, CK, T	456
272 V, W	456
280 C, T	456
290 C, CK, T	456
732 (RF)	470
852 (RF)	470
1462D, 1463D	456

FAIRBANKS MORSE

Model	kc
B-6	175
C-6	175
40, 41	456
42, 43	456
54, 55	456
56, 57	456
58, 63	456
64 Auto Radio	175
64 Batt.	456
65, 66	456
67, 68	456
69, 72, 73	456
74	175
81, 82	456
90, 91	456
100, 110, 120	456
346, 346-S, 347	175
516-2V	456
541-2V	456
814	175
816	175
840, 841	175
1014	175
1040	175
5106	456
5107	456
5112, 5212	456
5241	456
5312	456
5341	456
6010	456
7014	456
7040	456
7042	456

FEDERATED PURCHASER (ACRATONE)

Model	kc
6B, 7B	456
7C Late	456
7C Early	456
8B, 9B	456
11B, 12B, 13B, 14B	456
16B, 17B	456
18B, 19B	456
20B, 21B, 22B, 23B	456
24B	456
26C, 27C, 28C, 29C	456
30C, 31C	456
31-40	175
32C, 33C, 34C	456
40D	460

FEDERATED PURCH. (Cont'd)

42-D, 43-D, 44-D	175
52-F, 53-D, 54-D	456
55-D, 56-D, 58-D	456
60E	460
61E	456
62E	175
64F, 65F	456
66F, 67F, 68F	456
75, 77, 83	456
86, 87	485
92	175
93, 94	370
104	465
117	456
118	456
146B	456
167B, 168B, 169B	456
179B	456
260B	262
266F, 268F	456
336B, 337B, 338B, 339B	456

FIRESTONE-STEWART WARNER

Model	kc
R-1322	177.5

FISCHER & SMITH

Model	kc
72, 74	262

FORD MOTOR CO.

Model	kc
V-8	175

FORDSON

Model	kc
FP (All models)	456
FP-32-V	456
FT (Auto)	175
FT (Police)	175
FU (540-1500 Kc tuning range)	456
(6775-20,000 Kc tuning range)	456
FU (150-1500 Kc tuning range)	456
FW (Midget 115-2300 tuning range)	456
FW (Console 115-2300 tuning range)	456

FRANKLIN

Model	kc
45E32V	465
53, 54-L	456
55-CU	250
55-D	465
55-EU, 55-GU	250
63-L	130
65-HU, 65-HU32	250
65-VU	250
94	450
100	175
102	175
105-C, 105-PC	450
200	175

FREED MFG. CO. (FREED-EISEMANN)

Model	kc
A-7, A-9	456
MB-7	175
51 DC	175
55, 56	456
56-L	115
58, 60, 62	456
66, 67	456
70, 74	456
76	115
77	456.5
78	462.5
94	456.5
353	132
354, 355	456
360, 360-X	175
365, 365-X	456
366	462
366-LW	115
367, C-367	462
368	115
406	456
432	456
466, 467	462
469	462
475-X	462
482, C-482	462

JESSE FRENCH

Model	kc
U-1	175

GALVIN

(See MOTOROLA)

GAROD RADIO CORP.

Model	kc
G-6, G-15	175
G-35	456
G-37, G-38	456
G-61	456
35-LW	132
35-SW	456
*37, *38	175
58	456
*61	456
66	456
237, 238	456
250	456
337	456
370, 370C	456
370D, 370KC	456
371, 371C	456
371D, 371KC	456
380, 380D	456
380KC	456
381, 381D	456
381KC	456
600, 620	456
830, 830C	456
830D, 830KC	456
831, 831C	456
831D, 831KC	456
930, 930D	456
930KC	456
931, 931D	456
931KC	456
1240, 1240E	456
1240LC	456
1650, 1650H, 1650LC	456
4110, 4110E, 4110LC	456
5140, 5140H, 5140LC	456

* See also the corresponding listings under letter "G" models, such as G-37, G-38, etc.

GAYLORD MFG. CO.

Model	kc
510S, 510U	456
520S, 520U	456
610S, 610U	456
620S, 620U	456
710S, 710U	456
720S, 720U	456
800, 801	456
900	456
1010S, 1010U	456
1100	456

GENERAL ELECTRIC (U.S.A.)

Model	kc
A-52, A-53, A-54	465
A-55, A-56, A-60	465
A-63, A-64, A-65	465
A-66, A-67	465
A-70, A-75	465
A-81, A-82, A-83, A-85	465
A-86, A-87	465
A-88	465
A-90	175
A-125	465
A-205, A-206	465
A-208	465
B-40, B-52	175
B-81, B-86	175
BX-41	175
C-41, C-60	175
C-61	175
C-62	460
C-67	175
C-70, C-75	460
D-50, D-51	175
D-52, D-72	175
E-50, E-52	465
E-61, E-62, E-68	465
E-71, E-72	465
E-76, E-79	465
E-81, E-86	465
E-91, E-95	465
E-101, E-105, E-106	465
E-126, E-129	465
E-155	465
H-31, H-32	175
H-51, H-51-R	175
H-71, H-71-R	175
H-72	175
H-91, H-91-R	175
J-70, J-72	175
J-75, J-80, J-82	175
J-83, J-83A	465
J-85, J-86	175
J-87, J-88	175
J-100, J-105	175
J-107, J-109	175
J-125, J-125A	175
JZ-822A	456
JZ-835	175
K-40, K-41, K-43	175
K-50, K-50-P	175
K-51, K-51-P	175
K-52	175
K-53, K-53-M	175
K-54-P, K-55	175

GEN. ELEC. U.S.A. (Cont'd)

K-58	175
K-60, K-60-P	175
K-62, K-63	175
K-64, K-64-D	370
K-65, K-65-P	175
K-66, K-66-M	175
K-78, K-79	175
K-80, K-80-X	445
K-82	465
K-85	445
K-88, K-88-X	445
K-105, K-106, K-107	175
K-126	175
KZ-62-P	175
L-51, L-52, L-53	175
M-41, M-42	460
M-49, M-50	460
M-51, M-51A, M-52	460
M-55, M-56	460
M-61, M-62, M-63	460
M-65, M-66	460
M-67, M-68, M-69	460
M-85, M-86	175
M-89	460
M-106, M-107	460
M-125	460
M-128, M-128-R, M-129	175
M-655	460
N-60	175
S-22, S-22A, S-22-D	175
S-42, S-42-B, S-42-D	175
S-132	175
SZ-42-P	175
U-50	175
U-51, U-55	456
U-70, U-75	456

GENERAL ELECTRIC (CANADIAN)

Model	kc
B-40, B-52	175
C-41, C-61	175
H-31, H-32	175
H-51	460
H-71, H-72, H-77	175
J-72, J-76	175
J-82, J-85	175
J-105, J-107, J-125	175
JB-83, JB-87	175
K-8-B, K-8-CB	175
K-50, K-52, K-53	175
K-57, K-59, K-60	175

GEN. ELEC. CAN. (Cont'd)

K-62	175
K-64	370
K-80, K-85	445
M-7-B, M-7-CB	460
M-41, M-42	460
M-51, M-52, M-56	460
M-61	460
M-62	370
M-67	460
M-69	370
M-81, M-86	460
M-106, M-107	460

GENERAL HOUSEHOLD UTILITIES (GRUNOW)

Model	kc
410, 411	465
450, 451—Chassis 4A	455
460, 461—Chassis 4B	455
470—Chassis 4C	465 or 490*
500—Chassis 5A	455
501—Chassis 5B, 65B, 65C	455
502—Chassis 5C	455
503—Chassis 5C	455
520—Chassis 5A	455
530—Chassis 5B	455
532—Chassis 5H	465
542—Chassis 5J	465
550—Chassis 5B	455
551—Chassis 5K	465
560—Chassis 5E	455
564—Chassis 5R	465
566—Chassis 5S	465
570, 571—Chassis 5D	455
572—Chassis 5L	465
573—Chassis 5Q	465
580, 581—Chassis 5G—	465 or 490*
614, 618	262
620, 621—Chassis 6HB	465
625	262
631 Chassis 6M	465
640, 641—Chassis 6J—	465 or 490*
643—Chassis 6M	465
650, 651—Chassis 6A	262
660, 661, 662—Chassis 6C	262
670, 671—Chassis 6D	455
680, 681—Chassis 6G—	465 or 490*

GEN. H'S'HLD. UTIL. (Cont'd)

700, 701—Chassis 7A	262
711	465
720, 721—Chassis 7DB	465
721, 731—Chassis 7M	465
733, 735—Chassis 7M	465
750, 751, 752—Chassis 7B	262
753—Chassis 7B	262
760, 761—Chassis 7C	455
801—Chassis 8A	262
823—Chassis 8H	465
831, 835—Chassis 8H	465
871—Chassis 8E	455
901, 902—Chassis 9A	262
941—Chassis 9E	465
1101	262
1151, 1152	262
1171—Chassis 11C	455
1191—Chassis 11G	465
1241—Chassis 12A	455
1291—Chassis 12B	465
1297—Chassis 12W	465
1541—Chassis 15W	455

* If local code interference is about 455 kc, the i-f is 490 kc. If it is about 500 kc, the i-f is 465 kc. The correct i-f is stamped on the chassis.

GENERAL MOTORS

Model	kc
210 (S-1A, S-1B)	175
211	175
216, 217 (S-1A, S-1B)	175
219, 220 (S-1A, S-1B)	175
250 (S-1A, S-1B)	175
251 (S-2A, S-2B)	175
252	175
253	175
254	175
255	175
256	175
257	175
258	175
281	175

GENERAL TELEVISION AND RADIO

Model	kc
7, 7-C	456
9	456
9 (Auto Comb.)	456
10	175
12	175

GILFILLAN BROS.

Model	kc
X	460
5-C, 5-M, 5-T	175
5-X	456
6-C, 6-T	262.5
7-A	175
8-C, 8-T, 8-X	262.5
35	175
52-A, 54-A	460
63-B, 63-X	460
76-A, 77-A	460
78-B, 78-X	460
96-B, 96-X	460
97-B, 97-X	460
116-B, 116-X	460
117-B, 117-X	460
200	175
250	175

GRAHAM-PAIGE MOTORS

Model	kc
ATP-101, ATP-102	175

GRAYBAR ELECTRIC

Model	kc
GB-8, GB-8-A	175
GB-9	175
GB-100	175
GB-700, GB-770	175
GB-900	175
GB-989	175
GC-13	175
GC-14, GC-15	175
GT-7, GT-8	175
GT-8-56	175
GT-8-69	175
GT-10-69	175
GT-10-88	175
GT-10-99	175
340	180
600	175

GREBE

Model	kc
HS-3, HS-4, HS-5	175
HS-6, HS-7, HS-8	175
HS-12	175
61-R	456
250	456
360, 361	456
370, 370C, 370D	456
371D	456
380, 380D	456

GREBE (Cont'd)

381, 381D	456
620	456
730, 731	456
830D	456
831	456
930, 930D	456
931, 931D	456
1240, 1240E, 1240LC	456
1650, 1650H, 1650LC	456
2150	456
4110, 4110E, 4110LC	456
5140, 5140H, 5140LC	456
5240	456

GRIGSBY GRUNOW (MAJESTIC)

Model	kc
7-B Chassis	262
9-A	262
10	1,000
11-A	262
15, 15-B	175
20, 21, 22, 23, 25, 25-B	175
35	175
44, 49 (440 Chassis)	456
50, 52, 55	175
55, 59	456
60. 61, 62	175
66, 67, 68, 69	175
75, 85, 86 (800 Chassis)	456
85, 86	175
95	175
105, 114	175
116, 116-A	175
120, 150	175
160, 163	175
194, 195	456
194, 195 (440 Chassis)	456
196	175
200, 210	175
220, 290	175
300	175
310-A, 310-B	175
320, 330	175
340	175
351, 353	175
360	175
370	456
390	175
400	456
411, 413	456
440	456
450	455

GRIGSBY GRUNOW (Cont'd)

460, 461, 463	175
490, 491, 493	175
520	175
550	455
560, 566	456
650, 651	262
660, 661, 662	262
666	175
670, 671	455
776, 886, 996	175
998	175
1101	262
1151, 1152	262

GRUNOW
(See General Household Utilities)

GULBRANSEN

Model	kc
V6Z2, Z6Z1	262
06-W	262
062	262
092	175
10, 13	175
20, 23	175
53, 92	175
93, 130	175
135, 235	175
236, 237	175
322	175
352, 362	262
530, 535	175
925	175
3225, 3226	175
3521	175
3525	262
3622	262
3925	175
8726	175

HALLICRAFTERS INC.

Model	kc
Super Skyrider (25,000-540 Kc tuning range)	465
Super Skyrider (25,000-1500 Kc tuning range)	465
Super Skyrider (43,000-1500 Kc tuning range)	465
S10	1600
S11	465

HALLICRAFTERS (Cont'd)

S12	1600
S14	465
5T	465

HALSON

Model	kc
Roadmaster	456
AW6	456
CW6	456
CW7, CW8	456
MA53, MA63	456
NS 50	456
NS 60	262
6L6	456
20-B	456
50M, 50R, 50RL	456
50S, 50V	456
50X	456
53C	456
56U	456
60L, 60M	456
66 AW	456
72, 75, 78	456
100, 100M, 101	456
505	456
520, 530	456
535, 536, 540	456
560	456
570, 580	456
606	456
610, 620, 630	456
770 AW	456
1200	456
1500, 1900	456

HAMMARLUND (COMET)

Model	kc
Comet All-Wave	465
Comet, Dec. '31	465
Comet, July '32	465
Comet Pro	465
Super Pro	465

HARRIS MFG. CO. (ELECTROTONE)

Model	kc
500, 600, 700	465
800, 900, 1000	465
501W, 701W	465
1201W	465

HOODWIN CO., CHARLES (AERO-CHARLES HOODWIN CO.)

Model	kc
International Aero	485
6-Tube Batt.	175
6-Tube DC	175
970	175

H. H. HORN

Model	kc
Riviera 66, 66PR	465
5A, 5AD, 5AC	465
5AVC, 5AW	465
5M, 5MB	465
5MT, 5MTC, 5MTD	465
5MTW, 5MW	465
7C, 7MT, 7MTC	465
8MT, 8MTC	465
9MT, 9MTC	465
10MT, 10MTC	465
16MTC, 17MTC	465
24, 36	465
50PR	465
51, 51C	465
52, 52C	465
56	175
58	465
59	175
62, 62C	465
63	465
66, 66C	465
66MT, 66MTC	465
69, 70, 71	175
73C, 76MT	465
83, 83C, 83W	465
90	175
101. 101-B	175
102	175
110	175
112-A	465
136	465
156, 156-C	465
158, 158-C	465
419	465
535, 536	465
537, 538	465
611	465
612, 639, 710	465
1934	190

HOWARD

Model	kc
Grand	465

HOWARD (Cont'd)

Howard "Highwayman"	175
A (S-W Converter)	680
B-13	465
C-14	456
D-15, D-16	465
EX	175
E-57	456
F-17, F-18	465
HA1	175
HA2	456
HA6-1, HA6-2	465
J-3	456
M	175
S-2	175
S-3	456
S-7	175
V-11	135
W-6	465
W-18, W-19	465
X-2, X-3, X-8	175
Y-3	175
Z-4, Z-8	175
6A, 8A	465
20, 25	175
30, 32 (O)	175
35, 35-A (AVO)	175
40 (H)	175
45	175
57-AU, 57-AUS	456
58A, 58B	465
60, 60-SW	456
60 (AVH)	175
67	465
68C, 68CA	465
68T, 68TA, 68TB	465
77C, 77T	465
88C, 88T	465
99C, 99T	465
400 (K), 420, 420 (L)	175
500, 501 (DL)	175
626	465
1626, 1627	465

HUDSON-RCA VICTOR

Model	kc
H-6	260

HUPP MOTOR CAR CORP.

Model	kc
HAD, HT-2	260

ICA EXPORT CORP.

Model	kc
Classic	132
Elite	132
Envoyette	132
Hy Power No. 450	470
ICA-Six-Midget (all)	462.5
ICA Six No. 210	470
ICA Six No. 250	470
Magicolor (all)	462.5
Super-Six-Broadcast	175
Super Conqueror	175
Super-SixLong Wave	115
Superba	470
Ultra No. 1000	470
Ultra No. 1050	470
Una Fives: (including)	
Bijou	132
Gnome	132
Pacific	132
Atlantic	132
Transatlantic Midget	1580
Transatlantic Console	1580
Transatlantic Phono Comb.	1580
Transpacific Midget	1580
Transpacific Console	1580
Transpacific Phono Comb. Console	1580
Universal No. 550	470

INSULINE

Model	kc
AVC Super Six	175
AVC Super Six LW	115
AVC Super Seven LW	115
Classic	132
Elite	132
Super Conqueror	115
Super Six LW	115
Super Seven	175
Unaradio 5-Tube	132
Uni-nine	115

INTERNATIONAL (KADETTE)

Model	kc
A-7, A-8, A-9, A-10	262.5
AW-55	445
BW	262.5
CB, CD, CM, CMS	175
CS	175
D-11, D-12, D-14	262.5
ES-19, ES-20	262.5
ES-25	262.5

INTERNATIONAL (Cont'd)

JS, KS	175
K-6, K-60	262.5
52	448
60	262
61	448
65	262
66, 66X	448
70	262
71, 71C	456
72, 77	448
85 (Serial No. 5950)	456
85 (Serial No. 5951)	262
85 (Serial No. 185498)	456
85 (Serial No. 185499)	262
85, 90 (Serial No. 6500)	456
85, 90 (Serial No. 6501)	262
86, 87, 96, 120	448
105	456
400 Series	448
777, 778, 779	448
1050	456
1200, 2200	448

JACKSON BELL CO., Ltd.

Model	kc
24	456
25, 27, 28, 29	175
33	840
89	175
205	465
406, 456	456
506, 506M, 556	456
606, 606M, 606U, 606UM	456

KADETTE

(See INTERNATIONAL)

KARADIO CORP.

Model	kc
50	465
56, 57, 57S	456
65	456
66 6-Tube	262 or 456
66 7-Tube	456
67-S	456
75, 76	456
77, 77-X	456
88 8-Tube	262
150	456
160, 180	175
667 Farmsette	175

KAYO MANUFACTURING CO.

Model	kc
Super 4	175
Super 5	262.5

KELLER-FULLER MFG. CO., LTD.

(RADIETTE)

Model	kc
50S	175
70, 80, 90	175
120	175

KENNEDY

Model	kc
52	175
52 Export	135
53-SW	1000
54	1525
54-SW	1000
56	175
62 (all)	175
63	175
64 (all), 66 (all)	175
67 Export	110
72	175
164-B	175
266-B	175
366-B	175
563-A, 563-B	175
882-62-D	175
882-64C	175

KINGSTON RADIO CO., INC.

Model	kc
55	456
500-A	456
600-A, 600-B	172.5
700-A, 700-B	456
Gypsy Model 5-T ac-dc	456

KNIGHT

(See Allied Radio)

KOLSTER

Model	kc
K-JJ	175
K-55	175
K-60, K-62, K-63	175
K-65, K-66	175
K-70	175
K-72, K-73	175

KOLSTER (Cont'd)

K-75, K-76	175
K-80, K-82, K-83	175
K-85, K-86	175
K-90, K-92	175
K-93	175
K-95, K-96	175
K-100	175
K-102. K-103	175
K-105, K-106	175
K-110	175
K-113, K-114	175
K-120	175
K-122, K-123	175
K-125	175
K-130	175
K-132, K-133	175
K-135	175
K-140	175
K-140, K-142 (Flat Topped)	170-180
K-143	175
K-145, K-165, K-195	175

LAFAYETTE

(See Wholesale Radio Co.)

LANG

Model	kc
MA-7, MD-7	175
MA-8, MD-8	175
SA-7, SC-7, SD-7	175
SA-8, SA-9	175
SD-8	175
41-UP	470
50-AS	470
50-UP	470
50-US	456
51-AS	470
52-PC	456
60-AA, 60-UP	470
66-AA	470
70-AA, 70-UA	470
80-AC	175
81-UA, 81-VA	470

LARKIN COMPANY

Model	kc
90, 91	175

LAUREHK RADIO MFG.

Model	kc
AE-5	456

LAUREHK (Cont'd)

AE-5-B	465
AE-6	175
AE-42 (car radio)	175
AE-79 (car radio)	175
AM-6	177
L-5-C, L-5-S	456
L-8-AW	456
L-19	456
L-26	175
66	175

LEHMAN RADIO SALON (PORT-O-MATIC)

Model	kc
10, 12 Series 1935	175
10, 12 Series 1936	470

LEUTZ

Model	kc
C-10	450

LEWOL MFG. CO.

Model	kc
Deluxe 6	177.5
12A	456
101B	456
102B	177.5

LINCOLN

Model	kc
R-9	480
SW-10 (D.C.)	480
SW-33	480

L'TATRO MFG. CO.

Model	kc
A-525	456
AK-54, AM-54	177.5
B-525	456
C-625, D-625	177.5
EN-6-4	457
F-725	177.5
FN-66, GN-66	457
H-465, I-465	456
IN-2-5	457
J-665, K-665	177.5
L-74	177.5
L-525	456
M-4616	456
N-74	177.5
O-84, O-94	177.5

L'TATRO MFG. CO. (Cont'd)

P-54	177.5
T-4626	456
T-5226	456
T-5636	456
T-6216	177.5
T-6236	456

LYRIC

(See Wurlitzer)

McMURDO SILVER, INC.

Model	kc
Masterpiece I	465
Masterpiece II	465
Masterpiece III	465
Masterpiece IV	465
Masterpiece V	465
World Wide Nine	465
Prof. 5C	465
Prof. 5-D	465

MAJESTIC

(See Grigsby Grunow)

MELBURN RADIO MFG. CO.

Model	kc
23	465
31	465
40	465
45	465
50	465

MIDWEST

Model	kc
H-6	456
D-7, E-7, HH-7	456
F-9, G-9	456
R-9, RT-9	456
F-10, G-10	456
M-10, R-10	456
G-11, GG-11, J-11	456
JT-11, K-11, L-11	456
M-11, R-11, RT-11	456
C-12, CT-12	450
K-12, L-12, M-12	450
AA-14, BB-14	456
CC-14, DD-14	456
M-14, MT-14	456
P-14, Q-14	456
R-14, RT-14	456
A-16, AA-16	456
B-16, BB-16	456
C-16, CC-16	456
C-16 (1933 Model)	450
CT-16	450
D-16, DD-16	456
K-16	450
KP-16	456
L-16, M-16, PR-16	450
R-16, M-16, RT-16	456
S-16, T-16, U-16	456
AA-18, BB-18	456
CC-18, DD-18	456
EE-18, FF-18	456
V-18, VT-18	456
W-18, X-18	456
Y-18, Z-18	456

MISSION BELL (AERONAUTIC)

Model	kc
10-A, 11	252
14	456
19, 19-A	252
25-A	252
40	456

MONTGOMERY WARD (AIRLINE)

Model	kc
7GM	456
13, 15, 16, 16-X, 17, 18, 18-X	262
17, 62	175
62-1	175

MONTGOM. WARD (Cont'd)

62-2	175
62-7, 62-8	175
62-9	175
62-11, 62-12, 62-14, 62-19	175
62-20, 62-20-X, (62-25)	175
62-21, 62-22	262
62-27	175
62-29 (11-12)	175
62-30	262
62-38, 62-40	262
62-50	262
62-89	175
62-91, 62-93	175
62-96	262
62-97, 62-97X	262
62-99, 62-99X	262
62-101, 62-101X	262
62-103	175
62-104	262
62-105	175
62-106, 62-107	175
62-121	175
77	175
87	262
95	175
106, 107	175
120, 121, 122	175
123, 124	456
125, 126, 128	175
129, 131	456
132, 133, 134	456
135	370
136	175
137	456
138	175
139	456
141	175
142	456
143	175
144, 145, 146	456
147	370
148, 149	175
150	370
151	175
152, 153	456
154	370
155	175
156	370
157	175
158, 159	456
160, 161, 162	175
163	456
164	370

MONTGOM. WARD (Cont'd)

165	456
166	175
167	456
169	465
171	465
173, 175, 176, 177	456
178	175
179	456
181, 183	175
186, 187, 188	456
189	175
190	456
191	175
192, 193, 194	456
195, 196, 197	456
198	465
202	175
203, 205, 206	456
207, 208, 209	456
211	178
212	456
213	178
214	465
215, 216, 217, 218	456
219, 220, 221	456
223	456
224, 225	465
226, 227, 228	456
229	175
230, 233, 235	465
236, 237, 239	175
240	465
241	456
242	175
244, 245, 247	456
248, 249, 251	465
253, 255	465
259	456
307	465
308, 310	456
311, 313	456
315, 316, 317	465
318	456
326	465
327	456
328	465
332	456
338	465
407	465
408	456
410, 411, 413	456
415, 416	465
418	456

MONTGOM. WARD (Cont'd)

426	465
427	456
428	465
670	175
811 (62-1711)	175
1111 (62-1611)	175
1238 (62-1838)	262
1355 (62-1955)	262
Auto Radio	262
Airline Series 1355 & 1955	262

MOTOROLA (GALVIN)

Model	kc
Golden Voice	262
Super 6	456
D-6	262
J-8	175
T-8	262
T-77	456
S-10	175
7-T-47-A	175
34	262
44	456
50	262
55, 57	456
60	262
61	175
62	456
66	456
75	262
*77-A, *77-AB	456
79	262
80	262
88	175
100	262
110	262

* See also the corresponding listing under the letter "T" model such as T-77, etc.

MOTO-METER GAUGE & EQUIP. CO.

Model	kc
Moto Vox 10-A	175

NATIONAL

Model	kc
AGS	495
AGSX, FB-7A, FBXA	495
HRO	456

NOBLITT SPARKS
(See ARVIN)

NORCO

Model	kc
4 Super	250

OZARKA

Model	kc
93, 93-A, 93-B, 94-AVC	175

PACIFIC RADIO CORP.

Model	kc
Z2	456
61	456
102B	262.5
320	465
481	456
681	465
6320, 6322XE	465
7370	465
14370	465

PACKARD-BELL

Model	kc
5, 7	465
25, 35, 35A	460
36, 45, 46	460
47	458
48, 50	460
55, 65	460
66, 67	460
76	465
77	460
86	460

PACKARD MOTOR CO.

Model	kc
12	260

PACKARD RADIO CORP.

Model	kc
4-Tube Super 5	465
6-Tube Auto Radio	470
4	235
5	470
24, 24-C	235
46, 85	470

PATTERSON

Model	kc
PR-10	432.5
PR-12	262.5
PR-12C	262.5
R-16	458

PATTERSON (Cont'd)

60 series	465
65-AW	262.5
65-LW	130
65-SW	262.5
70-AW	262.5
74-AW, 75-AW	262.5
80-AW	262.5
84-AW, 85-AW	262.5
104-AW, 105-AW	262.5
107-AW	262.5
175-AW, 185-AW	262.5
207-AW	262.5
210-AW	262.5
275-AW, 285-AW	262.5
508-AW	262.5
510-AW	262.5
1105-AW	262.5
2105-AW	262.5
3105-AW	262.5
4105-W	262.5

PETER PAN CO.

Model	kc
6M	256
45	465
56M	465
67M	465
555	465

PHILCO RADIO & TELEV. CORP.

Model	kc
FT-6, FT-9	260
G	260
4	1,000
5	460
*6, 6-F (Code 122)	260
7, 8 (Code 121)	175
*9, (Code 122)	260
10, 11, CT-11	260
12, (Code 121)	175
12, (Code 122)	260
14, (Codes 121, 122, 123)	175
14 (Codes 221, 222)	260
15, 15-X, 15-DX	175
16, 16-B, 16-X, 16-L	460
17, 17-22	175
18, 18-B, 18-H, 18-MX	260
18 (Code 124)	260
19	260
22, 22-L, 23, 23-X	260
25	460

PHILCO (Cont'd)

26	260
28	460
29, 29-TX, 29-X	460
32, 32-B, 32-L	260
34, 34-A, 34-B, 34-L	460
35, 36	260
37	175
37-60B, 37-60F	470
37-61B, 37-61F	470
37-84 (Code 122)	470
37-89	470
37-600	470
37-602	470
37-604	470
37-610 (Codes 121-122)	470
37-611	470
37-620	470
37-630	470
37-640	470
37-641	470
37-650	470
37-660	470
37-665	470
37-670	470
37-675	470
37-690	470
37-2620	470
37-2650	470
37-2670	470
38, 38-A, 38-B, 38-L	460
39, 39-A	460
43	450
44	460
45, 45-L, 45-C	460
47 (121-122)	260
47-DC (121-221)	260
48	175
49 (DC)	260
49-B, 49-D, 49-H	260
49-X	260
51, 51-A, 52	175
53	460
54, 54-C, 54-S	460
57	460
58	460
59, 59-C, 59-S	460
60, 60-L, 60-B	460
66, 66-B	460
70, 70-A	260
71, 71-221	260
80	450
81	460
84, 84B	460
89, 89L, 89B	260

PHILCO (Cont'd)

90 (with 2-45)	175
90, 90-A (with 2-47's)	260
90 (with 1-47)	260
90 (above serial No. 237,001)	175
90 (above serial) (No. 237,001	175
90 (above serial No. 353100)	260
91 (121-221)	260
97	460
111, 111-A	175
112, 112-A	175
116, 116-A	460
116-X	460
116-X (Codes 122)	460
118, 118-B, 118-D, 118-H	260
118-MX, 118-RX	260
118-X	260
144, 144-B, 144-H, 144-X	460
200, 200-X	175
201	260
211, 211-A	175
212, 212-A	175
270, 270-A	260
470, 470-A (SW-IF)	1,000
470, 470-A (Broadcast IF)	260
490, 490-A (SW-IF)	1,000
490, 490-A (Broadcast IF)	260
500, 501	460
503 (code 122)	260
504, 505	460
506	460
507	260
509	260
600	460
602, 604	460
610, 611	460
620, 623	460
624, 625	460
630, 635	460
640, 641	460
643, 645	460
650, 655	460
660, 665	460
680	460
700, 800	260
805, 806	260
808, 809	260
816, 817	260
818, 818K	260
819, 819H	260

* See also the corresponding listings under letter "FT" models, such as FT-6, FT-9, etc.

PIERCE-AIRO, INC.
(See DE-WALD-PIERCE-AIRO)

PILGRIM ELECTRIC CORP.
(PILGRIM)

Model	kc
AA	456
D, DA	456
G, GBE, GH	456
NT, NTS	456
Q	175

PILOT

Model	kc
Dragon 10, 11	115
SW Converter	550
A-6	456
B-2	456
C-63	456
C-114	456
C-153, C-154	175
C-162, C-165	175
C-183	456
C-203	456
C-213, C-215	456
C-243	456
C-293, C-298	456
C-304	456
C-403	456
D-3	456
F-14	456
P-63	456
P-393	456
S-148	175
S-164	175
X-41	456
X-63	456
X-65, X-68, X-69	456
X-73, X-75	456
X-105	456
X-114, X-115	456
Y-41, Y-43, Y-48	456
2	456
8, 81	115
10-AC	115
11	115
18	456
20	456
23	456
28	115
33	456
39	115
‡§41	456

PILOT (Cont'd)

§43	456
45	456
48, Y-48	456
53, 55	456
*†‡63	456
‡65	456
‡68, ‡69	456
‡75, ‡75	456
81	482
84, 88	115
92, 93, 94	115
103	456
†105	456
108	456
*‡114	456
‡115	456
123, 125	456
148	456
*149	175
*153, 155	456
*183, 185	456
193, 195	456
*203, 205	456
*213	456
*215	456
223	456
*243	456
253, 255	456
268, 269	456
290	456
*293	456
295	456
*298	456
*304	456
305	456
364	456
390	456
†393	456
*403	456
405	456
423	456
605	175
1010	115
2108, 2109	456
2203, 2205	456
2253	456

See also corresponding listings under:
* letter "C" models, such as C-63, C-114, etc.
† letter "P" models, such as P-63, P-393, etc.
‡ letter "X" models, such as X-41, X-63, etc.
§ letter "Y" models, such as Y-41, Y-43, etc.

PIONEER

(See RADOLEK)

PLAZA MUSIC

Model	kc
5-Tube Super	456
6-Tube Long Wave	175
7-Tube Super	175
711 Super	175

PONTIAC MOTOR CO.

Model	kc
Air Chief 544268 (above No. 1,791,090)	262
Air Chief 544290-91 (above No. 300,000)	172
Air Chief 544290-91 (above No. 500,000)	262
Air Mate 544267 (above No. 1,791,090)	262
Air Mate 544289 (above No. 300,000)	172
Air Mate 544289 (above 1,791,090)	262
De Luxe 983506	262
Master 983507	262

PORT-O-MATIC

(See Lehman Radio Salon)

POSTAL

Model	kc
T	175

PREMIER

Model	kc
Auto Pal	175

RADIOBAR CO. OF AMERICA

Model	kc
105	465
106	262.5
107 (Philco 37-84)	470
210	262
210-B, 210-C	262
504 (Philco 37-610)	470
505	465
506	262.5
507 (Philco 37-610)	470
508, No. 1	262
508, No. 3	262.5

RADIOBAR (Cont'd)

Model	kc
510, No. 4	262
510, No. 5	262
510 (Philco 37-650)	470
515 (Philco 37-650)	470
526	262.5
528, No. 1	262
528, No. 3	262.5
528 (Philco 37-620)	470
536 (Philco 37-640)	470
550 (Philco 37-670)	470

RADIO CHASSIS INC.

Model	kc
2, 5	175
V-6	175
AL-33	456
AC-36	175
LSA-36, QAC-36	175
LSA-37	175
SB-37	456
SL-853	456

RADIO MFG. ENGINEERS

Model	kc
RME-69	465

RADIOTROPE

Model	kc
70-R	262
71-R, 72-R, 73-R	262

RCA MFG. CO (RCA-VICTOR)

Model	kc
ACR-136	460
ACR-175	460
AVR-1	445
BC6-4, BC6-6	460
BC7-9	460
BT6-3, BT6-5	460
BT6-10, BT7-8	460
C6-2, C6-8	460
C6-12, C7-6	460
C7-14, C8-15	460
C8-17, C8-19	460
C8-20	460
C9-4, C9-6	460
C11-1, C11-3	460
C13-2, C13-3	460
C15-3, C15-4	460
D7-7, D8-28	460
D9-19	460
D11-2, D22-1	460
M--30, M-31, M-32	175
M-101	175
M-104, M-105	175
M-107, M-108	175
M-109	175
M-116	175
M-119	460
M-123	475
P-31	175
R-3B. R-3C	175
R-7, R-7A	175
R-7-LW	110
R-8, R-9	175
R-10	175
R-11, R-12	175
R-21	175
R-22	175
R-25	175
R-28	175
R-28 BW, R-28-BWC, R-28-P	175
R-37, R-37-P	175
R-38, R-38-P	175
R-40-P	175
R-43	175
R-50	175
R-51-B, R-53-B	175
R-55	175
R-70, R-71	175
R-71-B	175
R-72, R-73-A	175
R-74, R-75, R-75-A	175
R-76	175

RCA MFG. CO. (Cont'd)

R-77, R-78	175
R-90	175
R-90-P	175
RAD60, RAD62, RAD64	180
RAD66, RAD 67	175
RAD80, 82, 86	175
RAE-26	175
RAE-59	175
RAE-79	175
RAE-84	175
RE-16, RE-16A	175
RE-18, RE-19, RE-20	175
RE-40	175
RE-80, RE-81	175
RO-23 (Broadcast i-f)	175
RO-23 (SW i-f)	1,075
SW Adapter	1,000
SWA-2	1,075
T4-8, T4-8A	460
T4-9, T4-9A	460
T5-2	460
T6-1	460
T6-7, T6-9	460
T6-11	460
T7-5, T7-12	460
T8-14	460
T8-16, T8-18	460
T9-7, T9-8	460
T9-9, T9-10	460
T10-1. T10-3	460
T11-8	460
4T, 4X	460
4X3, 4X4	460
5M	260
5T, 5X	460
5X3, 5X4	460
6K, 6K2	460
6M, 6M2	260
6T, 6T2	460
7K, 7T	460
7U, 7X	460
8K, 8T, 8U	460
9K, 9K2	460
9T	460
9-tube General Purpose	445
9U, 9U2	460
10K, 10T	460
13K	460
15K	460
100, 101, 103	460
110, 111, 112, 112-A	175
114, 115	175
117	460
118	460

RCA MFG. CO. (Cont'd)

120	175
121, 122	370
124	175
125, 126-B	460
127	370
128, 128-E	460
135-B	460
140, 141	445
141-B, 142-B	175
141-E	445
143	460
211	460
214	460
220	175
221	370
222, 223	175
224, 224-E	460
225, 226	460
235-B, 236-B	460
240	445
241-B	175
242, 243	460
260, 261	175
262, 263	460
280	175
281	460
301	460
310	175
320 "Duo"	370
321 "Duo"	370
322 "Duo", 322-E "Duo"	460
327	370
330, 331	175
340, 340-E, "Duo" 340	445
341 "Duo", 342	460
380 "Duo"	175
380-HR "Duo"	175
381 "Duo"	460

RCA-VICTOR (CANADIAN)

Model	kc
M-34	175
M-116	175
M-123	175
R-6, R-7	175
R-7-A, R-8-A, R-9-A	175
R-8, R-10, R-12	175
R-15	175
R-20, R-20R	175
R-21, R-22	175
R-29, R-30, R-31	175
R-35	175
R-37	175

RCA-VICTOR (CAN.) (Cont'd)

R-39	175
R-48, R-49	175
R-50, R-52	175
R-53, R-54	175
R-56	175
R-68, R-78	175
R-87, R-88	175
R-104, R-105	175
R-107, R-109	175
R-128	175
RAD. 80, RAD. 82	175
RAD. 86	175
RAD. 90	175
RAD. 101	460
RAE-59	175
RAE-84	175
RE-33, RE-37	175
RE-41, RE-57	175
RO-112	175
118	460
122	370
126-B	175 or 460
128	460
135-B	460
140	445
143	460
211	460
221	370
222	175
223-B	175 or 460
224	460
235-B	460
242, 262	460
280	175
281	460
321	370
331	175
340	445
381	460

REMLER

Model	kc
4	250
10	180
10-3	250
10-4	450
15	180
15-3	180
17, 19	180
21	180
21-3	250
21-4	450
26	450
28	450
30	450
35	450
36, 37	250
40, 41	450
42	450
43, 44, 45	450
53, 53C	450
60, 62	450
63, 64	450
71	450
88, 89	450
91	450
Best "115-KC"	115

REPUBLIC INDUSTRIES

Model	kc
Sky Hawk Patrician	175
Sky Hawk RC-5, RC-6	175
SL-5-D	175
SL-6	115
SL-6-D	175
42	175
50-L	115
50-S	175
51	175
55, 56	456
311, 316	456

R. K. RADIO LABS.

(See ARKAY)

RADOLEK (PIONEER)

Custom Craft	175
Octomatic	175
5 Tube Duola	465
6 Tube Auto Set	175
6 Tube Duola	465
8 Tube 2 Volt Battery	175
10 Tube Magic Messenger	175
951	265

RADOLEK (Cont'd)

956, 958	465
10150	175
10151	456
10963	456
10967	456
10968	456
10969	175
10970	456
10980, 10981	465

SCOTT LABS.

Model	kc
All-Wave Super	470

SEARS ROEBUCK (Silvertone)

Model	kc
603	460
604	445
1320, 1322, 1324	175
1390, 1400, 1402, 1404, 1406	175
1430	175
1462	175
1480, 1482, 1484	175
1570, 1572, 1574	175
1580, 1582, 1584	175
1590, 1592	175
1600	1,000
1630	175
1640	175
1700	175
1704	480
1705	175
1706, 1707	480
1708	175
1709	175
1710	175
1711	175
1711-A	480
1712, 1713	175
1714	175
1715	175
1720	175
1721	175
1722, 1722X	175
1725	175
1726-X	175
1729	175
1730	175
1732, 1732X	175
1750	175
1760	480
1904, 1904A	175
1906	175

SEARS ROEBUCK (Cont'd)

1914	175
1920	480
1922A	175
1923	175
1925	450
1926	480
1932A	175
1933	175
1935	450
1936	175
1954	175
1964, 1964A	175
1980	480
1982A	175
1983	175
1985	450
1992A	175
1993	175
1995	450
1996	175
7065	175
7070, 7071, 7072, 7073, 7074	480
7075, 7076, 7077, 7078	480
7090	175
7090-A	480
7091, 7092, 7093, 7094	480

SENTINEL

(See Electrical Research Labs.)

SETCHELL CARLSON

Model	kc
32, 33	456
40, 41	456
44	465
45	456
50, 51, 52	456
60, 60-S	456
61, 62	465
66, 68, 68-S	465
70, 71	456
80	456
210	456
211, 212	465
230	465
330	456
410, 510	456
630, 930	465

SHELLEY RADIO CO.

Model	kc
5, 6	460

SHELLEY (Cont'd)

34, 48	460
65, 67	460

SILVER-MARSHALL

Model	kc
All World de Luxe—(Table) Kc tuning range (540-25,000)	465
All World de Luxe—(Console) Kc tuning range, (540-25,000)	465
All World 5	465
Bearcat Midget	175
Round World 35	465
Super Air Flight	465
A, B, C, D, E	175
F, G, J,	175
Q, QD	465
R, R-T, V	465
X, Y	465
Z-DeLuxe	472.5
Z-10	465
Z-13	472.5
36-A	175
41	175
683	175
714, 716	175
724, 724B	175
726, 726SW	175
727	465
728	175
729 SW	465
738	1,000
739	650
773	175
782	175
1040	175
4801, 4802	175

SILVERTONE

(See Sears Roebuck)

SIMPLEX

Model	kc
B	175
CA, D	456
DB	456
J	175
JA	456
K, L	175
N	175
NT, NTH	456
P-Bat.	175
P-DC	175
P (prior to No. 330001)	175
P-AC, P	456
PJ 32-V, P-6V	456
Q	175
T	175
TA	456
U	456
UEX	456
W (Table or Console)	456
Z, ZS	456

SONORA

Model	kc
70, 71, 72	262
73, 84, 85	262
86, 87	262

SPARKS-WITHINGTON (SPARTON)

Model	kc
9-X	172.5
10, 12, 13	172.5
14, 14-A	172.5
15, 15-X	172.5
16, 16-AW*	172.5
17, 18	172.5
25, 25-X	172.5
26-AW*, 26	172.5
27, 27-A, 27-X	172.5
28, 28-X	172.5
30	172.5
30-A, 30-B, 30-C	172.5
33, 33-A, 33-B	172.5
34, 35, 36	172.5
40	172.5
44-P, 45, 46-P	172.5
53	456
54	172.5
56	172.5
57, 58	456
60	900
61, 62, 63, 63-AX	456
65, 65-T	456

SPARTON (Cont'd)

66, 66-T	456
67, 68	345
70	345
71, 71-B	456
72, 72-PQ	172.5
73, 73-AX, 73-BX	456
74	172.5
75, 75-A, 75-B, 75-AX	456
76	456
77	345
78	172.5
80, 81, 81-A	456
82, 83, 84	456
84, 85-X	456
86-X	456
104	456
111-X	172.5
134	456
333	456
475-A, 475-AX	456
478	172.5
506	456
517	456
536	345
537	456
556, 557	456
566, 567	456
577	456
594	456
616, 616M, 616X	345
617	456
620-X	172.5
655	456
666, 666M, 666X	345
667	456
676	172.5
685	345
686	172.5
691	345
716X	456
750-A, 750-X	172.5
766, 766M, 766X	456
766XP	456
766XS	456
775	345
776	456
827-X	456
867	456
870-A, 870-X	172.5
966	456
977, 987	456
1066, 1166	456
1167	456
1176, 1186	456

SPARTON (Cont'd)

1196	456
1466, 1476	456
1567, 1867	456

*The short-wave superheterodyne converter in these models operates on an intermediate frequency of 900 k.c.

STEINITE

Model	kc
203, 600, 605, 630, 635, (all) 642, 642B-, 643	175
700, 705, 706, 725	175

STEWART RADIO CORP.

Model	kc
60	262

STEWART-WARNER CORP.

Model	kc
SW	1,525
R-102 A, B & E, R-102	177.5
R-104 A, B & E	177.5
R-105 (SW IF)	1,525
(Broadcast IF)	177.5
R-105A, B&E	177.5
R-106, R-107	177.5
R-109	177.5
R-110	177.5
R-111, R-112	456
R-115, R-116	456
R-117, R-118	177.5
R-119, R-120	177.5
R-120A, R-120EF	177.5
R-123	456
R-125, R-126	456
R-127, R-128D	456
R-130	456
R-131, R-132	177.5
R-133, R-134	456
R-135, R-136	456
R-137	456
R-138	456
R-139-D, R-140	456
R-141	456
R-142A, R-142AS	456
R-143	177.5
R-144AS, R-145	456
R-146, R-147	456
R-148, R-149	456

STEWART-WARNER (Cont'd)

R-160	177.5
R-161-D, R-162-D	456
R-163-D, R-164-D	456
R-167, R-168	456
R-169	262
R-170, R-171	456
R-172	262
R-173	456
R-1322	177.5
R-1332	456
51-59	177.5
1090-1099	177.5
1121	456
1171, 1172	177.5
1181, 1182, 1183	177.5
1191, 1192	177.5
1201 to 1209	177.5
1231 to 1239	456
1251 to 1259	456
1261 to 1269	456
1271 to 1279	456
1281-D to 1289-D	456
1301 to 1309	456
1311 to 1319	177.5
1322	177.5
1332	456
1341 to 1349	456
1351 to 1359	456
1361 to 1369	456
1371 to 1379	456
1381 to 1389	456
1391-D to 1399-D	456
1401 to 1409	456
1411 to 1419	456
1421 to 1429	456
1431	177.5
1441 to 1449	456
1451 to 1459	456
1461 to 1469	456
1471 to 1479	456
1481 to 1489	456
1491 to 1499	456
1601 to 1609	177.5
1611-D to 1619-D	456
1621-D to 1629-D	456
1631-D to 1639-D	456
1641-D to 1649-D	456
1671 to 1679	456
1681 to 1689	456
1691 to 1699	262
1701 to 1709	456
1711 to 1719	456
1721 to 1729	262
1731 to 1739	456

STROMBERG-CARLSON

Model	kc
Compact Police	175
10	465
19, 20	175
22, 22-A	175
24, 25, 26, 27	175
29	175
33, 33-A	260
37, 38, 39, 40, 41	175
48, 49, 50, 51, 52	175
54, 55, 56, 56-R	175
58	465
60-L, 60-T	370
61, 61-H	465
62, 63	465
64	260
65, 66, 67	175
68	370
69	545
70, 72, 74	260 or 370*
82, 83, 84	465
115, 125	465
130	465
140, 145	465
150, 160	465

* Proper i-f value stamped on chassis.

STUDEBAKER

Model	kc
AC-206	260

SUPERTONE PRODUCTS

Model	kc
Superba	465

TIFFANY TONE

(See H. H. Horn)

TRANSFORMER CORP. OF AMERICA (CLARION)

Model	kc
AC-80, AC-81	175
AC-84, AC-85	175
AC-90, AC-90A, AC-91	175
AC-94	175
AC-160	175
AR-100	465
TC-1, TC-2	262
TC-20, TC-31	456

TRANSF. CORP. (Cont'd)

TC-50, TC-52	175
TC-60	456
*80, *81	175
83	175
*84, *85	175
*90, *90-A, *91	175
*94	175
95, 96	175
*100	175
†100	465
101	175
110, 111	175
120-139	175
121	175
130, 131	175
139, 140	175
150	175
*160	175
200	1000
220, 230	175
240	490
260, 270	175
280, 290	175
300, 320, 340	175
420	175
422, 423, 425, 440	465
470, 471, 472	465
480	175

See also the corresponding listings under
* letter "AC" models, such as AC-80, AC-81, etc.
† letter "AR" models, such as AR-100.

TRAV-LER

Model	kc
S-8, S-9	175
54A	456
135M, 149M	456
173	456
512	456
522, 525	456
542, 549	456
550	456
635, 635M	456
636, 636M	456
642	456
733	456

TROY RADIO MFG.

Model	kc
15	465
42, 46	465

TROY (Cont'd)

52	465
54, 55	465
56	175
65	465
74, 74B	465
75, 75B, 75C, 75CH	465
77	465
84, 84-C	465
86, 95	465
153, 175	465

ULTRAMAR MFG. CO.

Model	kc
43, 44	456
51, 52	480
54, 55	480
61, 62	480
65-A, 66-A	480
71, 72	480
75, 76	480
96, 101	480
510, 520	465
525, 526	456
601, 602, 612	456
701, 702	465
711, 712	465
801, 802	465
1004, 1005	480
1005-A, 1006	480
1006-A, 1007	480
1008, 1009	480
1010, 1011	480
1014, 1017	480
1018, 1019	480
1025, 1026	480
1028, 1029	480
1035, 1036	480
1039, 1046	480
1056, 1066	480

UNITED AMERICAN BOSCH CORP.

Model	kc
05	465
10	175
20, 20-J, 20-K, 20-L	175
31	175
36, 37	175
40, 41, 43, 45-A	175
79-C	175
91, 92	175
100, 100 Auto	175
108, 108 (Police)	175

UNITED AM. BOSCH (Cont'd)

117, 127	456
140, 140-A	175
150, 150 (Ed 1 & 2), 160	175
226, 236, 237	175
242, 243	175
250, 251	175
260, 261	517.5
305, 305-A	456
307	456
310, 312, 313	175
350, 352	175
355, 357	175
360	456
370	265
376-BT, 376-S	456
385, 386	463
402, 405	456
420	456
430, 430-T	450
440-C, 440-T	456
450	450
460-A, 460-B, 460-R	456
462-A, 462-B, 462-V	456
470	456
480-D	456
500, 501, 502	456
505	465
510, 510E	465
515	465
524, 524A	456
536	456
565	465
575, 575F, 575Q	465
585, 585Y, 585Z	465
595, 595M, 595P	465
604, 605, 605C	465
610, 620, 625	465
634, 634A	175
636, 637	175
640, 650	465
660C, 660T	465
670C, 670S	465
680	465
736, 737, 738	175
805	456

UNITED MOTORS SERVICE (DELCO)

Model	kc
R-1115	465
R-1116, R-1117	456
R-1118, R-1119	456
R-2050	465
R-3208, R-3209	450
RB-1, RC-1	175
626, 627, 628, 629	262
630, 631, 631A	262
632, 633	262
634, 635	262
1101	181.5
1102, 1103	456
1104	456
1105	450
1106	465
1107	450
1108	465 or 490
1109, 1110	455
*1115	465
*1116, *1117	456
*1118, *1119	456
2035	262
*2050	465
3026	175
3201, 3202 (below serial No. 800)	262.5
3201, 3202 (above serial No. 800)	456
3203, 3204	456
3205, 3206	450
3207	450
*3208, *3209	450
4036, 4037	262
4048	455
4049, 4050	181.5
4051	181.5
4052	456
4053	181.5
4054	262

* See also the corresponding listings under letter "R" models, such as R-1115, R-1116, etc.

U. S. RADIO & TELEVISION (APEX)

Model	kc
5-A	455
7, 7-A	262
7-D, 8	455
9	262
10, 10-C, 12, 19	262

U. S. RADIO & TEL. CO. (Cont'd)

Model	kc
24, 25	455
69	262
99	262
112-A	1,000
120	262
1006, 1007	262
3040, 3056	455
3070	262
3084, 3086	455
3084, 3086 (Serial No. 1344156 to 1344652)	427
3084, 3086 (Serial No. 1345799 to 1395800)	427

UNIVERSAL BATTERY CO.

Model	kc
802, 803	175
5010, 6110	465
6310	465
8210, 8410	465

WARE

Model	kc
S-1	175
SB1	175
SBA, SBB	175
SBF	175
SB-45	175

WARWICK MFG. CO.

Model	kc
550, 560	456
660	262.5
665	175
686	262.5

WELLS-GARDNER & CO.

Model	kc
OC	456
ODM	456
OEL	456
OF	456
OGL	456
OOA, OOB	456
02A, 02AA	175
05A	262
05AA, 05B, 05BA	262
06A	175
06W, 06X	262
07A, 07B	175
022	175

WELLS-GARDNER (Cont'd)

052, 062	262
073	175
092	175
2B, 2CM, 2DL	456
3A	456
4C	456
5-B	262
5C	262
5D	456
5E	175
5G	175
5H, 5K	456
5U	175
6B	175
6C	456
6D	175
6EL, 6F	456
6G	456
6K, 6L, 6N	175
6Q, 6R, 6S	175
6T	262.5
6S	175
6-U, 6-V, 6-Z-1	262
7C	175
7-D, 7-E	456
7FL	456
7GM	456
7H, 7J. 7K	456
7L, 7LL	456
7P, 7Q	456
7R, 7RL	456
9B, 9C	456
10, 13	175
17X	125
20	175
40, 40-A	175
50	175
92, 93	175
502	175
572	175
Z6Z1	262.5
V6Z2	262.5

WESTINGHOUSE ELECTRIC SUPPLY CO.

Model	kc
WR-5	175
WR-6, WR-6-R	175
WR-7, WR-7-R	175
WR-10, WR-12	175
WR-13, WR-13A	175
WR-15, WR-15A	175
WR-16, WR-17	175

WESTINGHOUSE (Cont'd)

WR-18, WR-19	175
WR-20, WR-21	456
WR-22, WR-23	456
WR-24	456
WR-25	172.5
WR-26, WR-26M	175
WR-27, WR-28	175
WR-29	175
WR-30, WR-31	445
WR-32, WR-33	460
WR-34, WR-35	175
WR-36	175
WR-37	370
WR-38, WR-39	445
WR-41, WR-42	175
WR-45, WR-45A	460
WR-46, WR-46A	460
WR-47	460
WR-48, WR-48A	460
WR-49, WR-50	460
WR-100, WR-101	456
WR-102, WR-103	465
WR-116	465
WR-201, WR-203	456
WR-204, WR-205	465
WR-207, WR-208	456
WR-209, WR-210	465
WR-211, WR-212	465
WR-214	465
WR-303	456
WR-304, WR-305	465
WR-306	465
WR-310, WR-311	465
WR-312, WR-314	465
WR-315	465 and 98
WR-502, WR-503	175
WR-601, WR-602	456
WR-603, WR-604	465
WR-605, WR-606	465
WR-607, WR-608	465

WESTINGHOUSE (CANADIAN)

Model	kc
Columnaire	178
A-43	175
A-44, W-44	175
A-53, W-53	175
B-6-34	175
B-64, B-74	460
B-83	175
B-103, W-103	175
W-64	370
W-73	175
W-82	175
W-83AW	445
W-84	460
W-89	175
W-90	171
W-99, W-99A, W-101	175
W-104	175
W-110	171
W-112	175
W-120	171
W-122	175
W-124	460
W-155	460
W-165A, W-165X	460
W-175	460
W-185X	460
W-254	460
W-634	370
W-801	175
W-802	178

WHOLESALE RADIO SERVICE CO. INC.

(LAFAYETTE)

Model	kc
Auto Radio	262
6 Tube Super	262
A-15	175
A-18	456
A-24, A-25	456 or 465*
A-31	456
A-33, A-34	456
A-38, A-39	456
A-54	456 or 465*
A-60	175
A-77L, A-81L	465 or 115*
AM-20, AM-26	175
B-12	456
B-21, B-22, B-23	456
B-28, B-29	456
B-30, B-32	456

WHOLESALE RADIO (Cont'd)

Model	kc
B-35, B-36, B-37	456
B-41, B-42	456
B-68, B-69	456
B-75, B-76- B-77	456
B-90	175
C-13, C-15, C-17	456 or 465*
C-25, C-26	456 or 465*
C-79, C-80	456
C-83, C-84	456
C-95	456 or 465*
F-36	115
F-44	115
F-49, F-50	456 or 465*
F-59, F-60	456 or 465*
J-3, J-4	456
J-16, J-20	456 or 465
J-37, J-50	465
L-1	175
L-20	175
10, 20, AM-20	175
80-M, 80-MA	175

* All of these receivers which were manufactured prior to October 1935 use 456 Kc. for the i-f.

WILCOX-GAY

Model	kc
A-1, A-2	175
A-3, A-4	456
A-5, A-6	456
A-7, A-8	456
A-9, A-10	456
A-11	175
A-12, A-13	456
A-15, A-16, A-17	175
A-18, A-19	175
A-21	456
A-22, A-23	175
A-24, A-25	175
A-26	456
2-S-5, 2-T-5, 2-VA-7	175
3-D-5	175
3-J-5, 3-K-5	175
3-KE5-26	175
3-PA-6-66	115
3-R-6	175
3-S-5-66	175
3-SB5-66	176
3-T-6-66	175
3-VB6-73	175
3-VB6-710	175
4B6	175
4CD5-29	175

WURLITZER (Lyric)

Model	kc
A-60	485
B-6, B-80	175
C-4	456
DC-65	175
LU-5	456
M-4	456
P-5	456
S-7, S-8	175
S-10	175
S-40	485
S-50, S-63	175
SA-5, SA-6	175
SA-90, SA-91	175
SA-91-A	175
SA 110, SA-120	175
SA-130, SA-133	175
SU-5	456
SW-8, SW-80	485
SW-88	485
U-50	456
U-50 (early), U-55	485
U-500	456
450, 451, 452	456
454	370
460	175
470, 470-A	370
471, 480	370

ZENITH RADIO CORP.

Model	kc
De Luxe	485
AH, BH, CH, LH	175
MH, NH, RH, WH	175
4-B-106	456
4-B-131, 4-B-132	456
4-P-26, 4-P-51	456
4-T-26, 4-T-51	456
4-V-31, 4-V-59	456
5-M-90	485
5-S-29	252.5
5-S-29A	262.5
5-S-56	252.5
5-S-56A	262.5
5-S-119	456
5-S-126, 5-S-127	456
5-S-150, 5-S-151	456
5-S-161	456
6-B-107	456
6-B-129	456
6-B-164	456
6-D-116, 6-D-117	456
6-D-118	456

ZENITH (Cont'd)

Model	kc
6-M-90, 6-M-91	252.5
6-M-92	252.5
6-S-27, 6-S-27A	252.5
6-S-52, 6-S-52A	252.5
6-S-128	456
6-S-137, 6-S-147	456
6-S-152, 6-S-157	456
6-V-27, 6-V-62	456
7	175
7-D-119	456
7-D-126, 7-D-127	456
7-D-138, 7-D-148	456
7-D-151	456
7-D-162, 7-D-168	456
7-M-91S & D	252.5
7-S-28, 7-S-30, 7-S-53	456
8-S-129	456
8-S-154	456
9-S-30, 9-S-54, 9-S-55	456
10-S-130	456
10-S-147	456
10-S-153, 10-S-155	456
10-S-156. 10-S-157	456
10-S-160	456
12-L-57, 12-L-58	456
12-U-158, 12-U-159	456
090, 90	175
91, 92, 103	175
210	175
210-5, 211-5, 220	175
215, 216, 217, 221, 225	175
230, 240, 241, 244, 245	175
250, 260, (SW-IF)	1000
Broadcast IF	175
263	175
270-5	125
271	175
272 (SW-IF)	1000
Broadcast IF	175
410, 411, 412, 414, 420	175
430, 440, 441, 442, 443	175
460, 461	485
462	252.5
470, 472, 473	175
474, 476, 476-A	175
475	175
500, 501, 502, 503, 514, 515, 516	175
517, 518	485
520, 521, 530, 531, 532	175
550	485
600, 602, 603, 604, 605. 606, 607, 608, 610, 611, 616, 617	175

ZENITH (Cont'd)

618, 619, 620, 621, 622, 623	175
650-HD, 651-HE	252.5
654	456
660-TD, 661-TE	252.5
663, 664	456
666, 668	252.5
680	252.5
701	456
705, 706, 707	485
711, 712	485
715	175
730, 735	175
740	175
750	485
755, 756	175
760, 765, 767	175
770-B, 775, 775-B, 780	175
801	456
805, 806	252.5
807, 808	252.5
809, 811	252.5
812	125
825, 827	485
829, S829	485
834, 835	485
845	252.5
847	252.5
850, 860, 861	252.5
862, 865, 866	252.5
870, 871	485
880, 881	485
908, 909	252.5
945, 950	252.5
960, 961, S961	252.5
970, 975	175
980, 985	485
990	485
1001, 1001A	485
1004	456

ZENITH (Cont'd)

1101, 1102	485
1162, 1170, S1170	252.5
1203	456
2032	175
2047	485
2052, 2053, 2054	175
2056	485
2059	175
5401	456
5405, 5406	456
5502, 5504	252.5
5505, 5509	252.5
5510	456
5513, 5513A	252.5
5516	456
5605, 5607	252.5
5608	125
5609	252.5
5616, 5617, 5618	252.5
5619	252.5
5621	456
5633, 5634	456
5701, 5702, 5703	485
5701-R, 5702-R, 5703-R	252.5
5704	456
5707	456
5801	456
5902	175
5908	252.5

ZEPHYR RADIO CO.

Model	kc
A5	456
B102	456
D, GR	456
J-80, NT, TA	456
61X6	456
63X8	456

Use this Space for Recording the I-F's of New Models

Model	Manufacturer	kc

Model	Manufacturer	kc

Use this Space for Recording the I-F's of New Models

Model	Manufacturer	kc	Model	Manufacturer	kc

CROSS-INDEX

OF MODEL NUMBERS OF AMERICAN RCA-VICTOR WITH THOSE OF CORRESPONDING AMERICAN GENERAL ELECTRIC, WESTINGHOUSE AND GRAYBAR RECEIVERS

RCA-Victor (American)	General Electric (American)	Westinghouse (American)	Graybar (American)
SW-2	JZ-30	....	....
R-4	J-70	WR-17	GT-7
R-5	T-12	WR-14	GB-4
R-5-DC	T-12-D	....	....
R-5-X	T-12-E	WR-14-CR	....
T-5	E-52	WR-9	....
R-6	J-75	....	GC-13
R-7	S-22 and S-22-X	WR-10	GB-8
R-7A	S-22 (2)	WR-10-A	GB-8-A
R-8	J-80	WR-18	GT-8
R-9	S-42	WR-12	....
R-10	S-132	WR-15-A	GB-989
R-11	K-62	WR-15	GB-9
R-12	J-85	....	GC-14
Rad. 16	....	....	GB-300
RE-16	SZ-42-P	WR-13	....
RE-16-A	....	WR-13-A	....
R-17-M	BX or K-41	WR-26-M	....
RE-18 and RE-18A	KZ-62-P	....	....
R-18-W	K-40-A	....	....
Rad. 18	....	....	GB-310
Rad. 21	B-1	....	....
Rad. 22	B-2	....	....
R-22-S	L-50	....	....
R-22-W	L-51	....	....
RO-23	JZ-835	WR-16	....
R-24	JZ-822	....	....
R-24-A (47)	JZ-822-A	WR-24	....
R-24-A (2A5)	....	WR-24	....
R-27	K-40	WR-26	....
R-28	K-50	....	....
R-28-P	K-50-P	....	....
R-28-P (A to G)	K-51-P	WR-27	....
M-30	A-90	....	....

(Cont'd over)

RECEIVER CROSS-INDEX—Continued

RCA-Victor (American)	General Electric (American)	Westinghouse (American)	Graybar (American)
P-31	A-81	....	....
M-32	A-60	....	....
Rad. 33	....	....	GB-311
M-34	B-40	WR-33	....
R-37	K-60	....	....
R-37-P	K-60-P	WR-28	....
R-38	K-65	....	....
R-38-P	K-65-P	....	....
RE-40	K-54	....	....
RE-40-P	K-54-P	WR-29	....
R-43	S-42-B	....	....
Rad. 44	....	....	GB-500
Rad. 46	....	....	GB-550
Rad. 48	T-41	WR-4	GB-678
R-50	H-32	....	....
Rad. 51	....	....	GB-320
R-55	....	....	GB-100
RAE-59	H-72	....	....
Rad. 60	....	....	GB-330
Rad. 62	....	....	GB-340
Rad. 66	....	....	GB-600
R-70 and R-70-N	J-72	WR-21	....
R-71	J-82	WR-19	....
R-72	J-86	....	....
R-73 (47)	J-83	WR-22	....
R-73 (2A5)	J-83-A	....	....
R-74	J-100	WR20	....
R-75 (47)	J-87	....	....
R-75 (2A5)	J-87-A	....	....
R-76	J-105	....	....
R-77	J-107	....	....
R-78	J-125	....	....
R-78 (2)	J-125-A	....	....
RE-80	....	WR-23	....
Rad. 80	H-31	WR-5	GB-700
RE-80-SW	....	WR-25	....
Rad. 82 and 82-R	H-51 and 51-R	WR-6 and 6-R	GB-770
Rad. 86 and 86-R	H-71 and 71-R	WR-7 and 7-R	GB-900
R-90	K-106	....	....
R-90P	K-106-P	....	....
91-B	C-30	....	....
100	K-43	WR-32	....
101	M-41	....	....
102	M-40	....	....
M-105	C-41	WR-41	....
M-107	C-60	....	....
110	K-52	....	....
111	K-53	WR-35	....
112	L-52	WR-34	....
114	L-53	....	....
115	K-53-M	....	....
M-116	B-52	WR-42	....

RECEIVER CROSS-INDEX—Continued

RCA-Victor (American)	General Electric (American)	Westinghouse (American)	Graybar (American)
118	M-51	WR-48	....
120	K-63	WR-36	....
121	K-64	WR-37	....
M-123	C-61	....	....
124	M-63	....	....
126-B	C-62	....	....
127	K-64-D	....	....
128	M-61	WR-46	....
128-E	....	WR-50	....
135-B	C-70	WR-47	....
140 and 140-E	K-80	WR-30	....
141 and 141-E	K-80-X	WR-31	....
142-B	B-81	....	....
143	M-81	WR-45	....
210	K-55	....	....
211	M-56	....	....
220	K-66	....	....
221	M-65	....	....
222	K-66-M	....	....
223	C-67	....	....
224	M-67	....	....
235-B	C-75	....	....
240	K-85	....	....
241-B	B-86	....	....
242	M-86	....	....
260	K-107	....	....
261	K-105	....	....
262	M-106	....	....
280	K-126	....	....
281	M-125	....	....
300	K-48	....	....
301	M-49	....	....
310	K-58	....	....
321	M-68	....	....
322	M-69	WR-49	....
330	K-78	....	....
331	K-79	....	....
340	K-88	WR-38	....
340-E	K-88-X	WR-39	....
341	M-89	....	....
380	M-128	....	....
380-H.R.	M-128-R	....	....
381	M-129	....	....

MODELS WITHOUT RCA-VICTOR EQUIVALENTS

Westinghouse:

WR-8 Westinghouse WR-6 Chassis with Clock in Columnaire Cabinet.

WR-8-R Westinghouse WR-6-R Chassis modified for vertical Operation in Columnaire Cabinet.

(Cont'd on following page)

MODELS WITHOUT RCA-VICTOR EQUIVALENTS—(Cont'd)

General Electric:

K-82	G.E. K-62 in Clock Cabinet.
J-88	G.E. J-82 with Manual Motor Board.
H-91	G.E. H-51 (modified) in Clock Cabinet.
H-91-R	G.E. H-51-R (modified) in Clock Cabinet.
J-109	G.E. J-100 Chassis and Automatic Motor Board.
JZ-826	G.E. JZ-822 in Console Cabinet.
JZ-828	G.E. J-88 with Short-Wave Adapter.

—Courtesy "Service" Magazine

CROSS-INDEX

OF MODEL NUMBERS OF AMERICAN RCA-VICTOR WITH THOSE OF CORRESPONDING CANADIAN RCA, GENERAL ELECTRIC AND WESTINGHOUSE RECEIVERS

RCA-Victor (U.S.A.)	RCA-Victor (Canada)	General Elect. (Canadian)	Westinghouse (Canadian)
SW2	SWA 102	JZ30	
R-7	R-7, R-78	S22, S22X	W-801
R-7A	R7A, R8A, R9A, R104, R105	H77, S42A	W-801
R-8	R-8	S42	....
R-9	....	....	W-801
R10	R8. R10, R12, R107	J-85	....
R11	R15	K62	....
R12	R12, R10	J85	....
RAD. 16	....	....	W16
RE16	RE37	H77	....
RAD. 17	....	....	6AC-27/28
RE18, RE18A	RE41	....	....
RAD. 18	....	....	6AC-28/29
RAD. 20	....	....	W55
R21, R22	R20R. R20, R109	....	....
RO-23	RO112	....	W112
R-28	R28	K50	W53
R-28-P	R29. R31	K52, K53	W53
R-28-P (A to G)	....	....	W53
RAD. 33	....	....	6AC-28/29
M34	M-34	B40	A-43
R37	R37	K60	....
RE 40-P	RE33	....	....
RAD. 42	....	....	W61, W81, W71
R-43	R30	S42-B	....
RAD. 48	R15, RAD. 48	T41	W71, W81, W61
R50, R-55	R20, R21	H32	....
R51-B, R53B	....	....	B103
RAE 59	RAE-59	H-72	....
RAD. 66	....	....	W89
R70, R70N	R48	J72, J76	....
R71,	R50	J82	W82
R71B	R6. R-67, R68	JB83, JB-87	B83
R72,	R52	J86	W82
R73 (47)	R53	....	....
R74, R-76, R-77	R-54, R56	J105, J107	....

(Cont'd over)

CANADIAN RECEIVER CROSS-INDEX—Continued

RCA-Victor (U.S.A.)	RCA-Victor (Canada)	General Elect. (Canadian)	Westinghouse (Canadian)
R78	R22	J125	W122
RE80	RE80	....	....
RAD. 80	R35, Rad. 80	H31	W101
Rad. 82, 82R	R39, Rad. 82	H51	....
Rad. 86, 86R	RE57, Rad. 86	H71	....
RAE-84	RAE84	....	....
RE-81	RE81	....	....
R-90	90	K106	W-103
R-90-P	....	....	W-104
100, 101	101	M41, M42	W44
M-105	M-105	C41	A-44
110, 111, 115	R-31	K59, K52, K53	A53, W53
M-116	M116	B-52	....
118	118	M51, M52	W254, W155
120	....	K-57	W53
121, 122	....	M69, K64, M62	W64, W634
M123	M123	C61	....
126-B	126-B, 223-B	L6B, L6CB	B64
128	128	M61	W165A
135B	135-B	M7B	....
140, 140E, 141	140	K80, K85	W83AW
141E, 141	....	....	W83AW
142B, 241B	R87	K8B	....
143	143	M81	W84, W185X
211	211	M56	W254, W155
220	222	....	....
221	221, 122	....	....
222	222	....	....
223	223-B, 126B	L6CB	B634
224	224	M-67	W165X
235B	235B	M7CB	B74, W185X
241B, 142-B	R88	K8CB	....
242	242	M86	W84
262	262	M106, M107	....
280	280	K126	....
281	281	M125	W124
321	321	....	....
330	R49	....	W73
331	331	K79	....
340	340	....	....
381	381	....	....
788(2)	R22A	J125A	W122A

COMPILATIONS OF "CASE HISTORIES" (ACTUAL SYMPTOMS AND REMEDIES) FOR COMMON TROUBLES IN VARIOUS MAKES AND MODELS OF RADIO RECEIVERS

Value of Trouble "Symptoms" in Locating Troubles: In many lines of service work, an experienced technician can quickly tell a great deal about the location and nature of commonly-occurring troubles by simply listening carefully to the operation of the device being serviced. For instance, an automobile service man listening intently to an automobile engine in operation knows instantly from his experience that a certain regular "metallic" clicking noise usually means that one or more valve tappets require adjustment; another peculiar characteristic "rattling" noise means that the fan belt is frayed or too loose and is striking something; a third low-pitched reverberating sound indicates that there is a leak somewhere in the muffler or exhaust manifold, etc. Knowing these "symptoms", he is able to get at the source of trouble immediately, and remedy it without making elaborate, time-consuming tests.

So, too, every wide-awake radio service man who has had some experience in servicing radio receivers, soon realizes that particular models of almost all makes of receivers develop certain definite troubles after being in use for some time, that is, almost the same troubles are usually found in the same model of receiver. These troubles are invariably accompanied by definite recognizable "symptoms" in the operation of the receiver—symptoms which can easily be recognized by simply attempting to operate it. Experienced service men soon find themselves taking advantage of this fact almost unconsciously, for when called upon to service a familiar model and make of receiver with a trouble symptom which they have run across before in a similar receiver, they immediately proceed directly to test the particular part which caused the trouble in their last experience—without taking the time required to analyze or test the various circuits of the entire receiver.

Value of a "Case History" Compilation:—If a service man remembers, or has access to the "Case Histories" for most of the popular models of the various makes of receivers, he can often make more rapid diagnoses and repairs on numerous receivers which he is called upon to service, and can speed up his work considerably. A compilation of this kind, for over 1500 popular receivers has been made by the author from the actual service records of several large service organizations with which he is associated. It is authentic in every detail, and is presented with the hope that it will be a time-saver to practical radio service men in their daily work. In some instances, the troubles arising can be disclosed quickly by one of the regular test procedures which are described in *Modern Radio Servicing*, but very often they are of a nature which makes them particularly elusive and difficult to locate by ordinary test methods. It is for cases of this kind that the following "Case History" compilation is of particular value.

Common Sense in Using "Case History" Compilations: Before presenting the compilation of "Case Histories" the author wishes to discuss several points in connection with its use, that should always be kept in mind.

(1) When using a compilation of radio receiver "Case Histories", remember that the troubles listed are by no means the *only* ones which can occur in the respective sets. They are the ones which have been found to occur most frequently, and are those which a service man should suspect and test for first.

(2) No service man, or student of radio servicing, should entertain the idea that all he needs to do in order to become a successful service man is to "arm" himself with a voluminous list of receiver "Case Histories", throw all the rest of his analyzing and testing equipment and knowledge out of the window, and proceed to conduct his service work with little effort "by chart". Nothing could be further from the truth! As every experienced radio service man knows, hundreds of cases of every-

day troubles in radio receivers are *not* the "conventional" ones, and they are often located only by the most persistent and careful testing and sometimes only by the merest chance or "luck".

(3) The list presented herewith will be useful as an *accessory* to the "conventional" routines of servicing and should be consulted as a "first try". If the correct "trouble symptom" and "remedy" are found with it, so much the better. The repair can then be made quickly without need for time-consuming analysis. If the "Case Histories" listed do not cover the particular case in hand, the service man should proceed immediately in accordance with the modern technique of analysis and testing explained in detail in the book *Modern Radio Servicing* by Ghirardi. In other words the list should be regarded as a *possible* time-saving accessory only—not as a new kind of service man's "brain".

The Compilation of "Case Histories" for Receivers:—It will be noticed that the receivers are listed alphabetically by manufacturers' names. The various models of each manufacturer follow each other in progressive alphabetical and/or numerical order. The various trouble "symptoms" which may be noticed when the receiver is turned on with the volume control set for "loud" operation are listed at the left, and the corresponding "causes" or "remedies" for each trouble are listed at the right. If the trouble occurs at a different setting of the volume control, this fact is stated. It is assumed that the service man has sufficient radio knowledge to enable him to proceed directly to remedy the trouble where only the "cause" is listed. (For a general "Trouble-shooting Chart" applicable to all general "types" of receivers see Section 6 of this book.)

Finally, the fact that a large number of "Case Histories" are presented here for many certain makes of receivers is not to be taken as an indication that these particular receivers (or the receivers of any manufacturer for that matter) are particularly subject to trouble, or that any reflection on the quality of the receivers of those particular manufacturers is intended. Such is not the case! No receiver is perfect! All receivers are subject to troubles eventually. It is natural that a larger number of those receivers which have proved to be most popular, and have therefore had the widest sale, should be in use. Consequently, it will be found that a large proportion of the service calls are for receivers of these types, mainly because of this preponderance of the number of them in use. It is on these receivers, therefore, that the largest amount of trouble information due to actual trouble-shooting experience has been obtained and recorded here.

(See following page)

ACTUAL "CASE HISTORIES" (SYMPTOMS AND REMEDIES) FOR COMMON TROUBLES IN VARIOUS MAKES AND MODELS OF HOME AND AUTO RADIO RECEIVERS

ACE A.C.-D.C. MIDGET

Trouble Symptom	Cause or Remedy
Crackling, "Sputtering" noises	1) a-c line wires from the rear of the chassis touching under the choke. Loosen the choke and run these wires around it instead of underneath it

AIR CASTLE

Trouble Symptom	Cause or Remedy
Inoperative over part of dial	1) failure of 6D8G tube to oscillate. Try substituting a 6A8 (or 6A8G) for it

AIR-KING 52

Trouble Symptom	Cause or Remedy
Inoperative, Intermittent reception	1) primary windings of oscillator coil and last i-f transformer "open". Replace coils and re-neutralize receiver

AIRLINE (old models using '26 tubes)

Trouble Symptom	Cause or Remedy
Inoperative, (r-f tubes do not light up) Fluctuating filament voltages	1) riveted junction between binding posts and power transformer lead soldering lugs loosened due to shrinkage of mounting strip. Remove the transformer, and either squeeze down the riveted joints, or flood them with solder
Intermittent reception	1) clean hardened flux or grease from contacts of local-distance switch—even if it tests O.K. on 110 volts

AIRLINE Alexander

Trouble Symptom	Cause or Remedy
Oscillation, Receiver cannot be properly aligned	1) check the value of the center-tap resistor of 2½-volt winding. It should be 150 ohms. Replace if necessary

AIRLINE AE-11

Trouble Symptom	Cause or Remedy
Low volume, Broad tuning	1) section of variable condenser out of alignment. Adjust plates until spacing appears uniform, then realign
Oscillation at 1500 kc	1) re-neutralize the receiver circuits 2) interaction between the bus-bar grid leads. Bend them close to chassis to reduce interaction effects 3) loose coil shields. Tighten them so that they make good contact

(Cont'd over)

AIRLINE AE-11 (Cont'd)

Slipping dial drive ... 1) loosen the set-screw holding the tuning drum after wedging the friction drive open. Turn the drum a half turn and tighten the set screw, making sure that the drum engages properly with the friction drive

AIRLINE BATTERY 5

Insensitive, Poor tone .... 1) replace the type '34 detector tube (unshielded '34 tube at rear of chassis) with a '32 tube, and make the following circuit change: connect the grid return directly to C —9volts (brown lead), eliminating the 1-megohm resistor from the circuit entirely

AIRLINE TRF Receivers

Poor tone .... 1) connect a 10,000-ohm resistor across the primary of the push-pull input transformer. Connect a 0.02 mfd. condenser from the plate terminal of the primary to one side of the secondary

AIRLINE 05 BA

Oscillation .... 1) replace the 0.002-mfd. detector plate condenser with one of 0.01mfd. If oscillation still persists, connect another 0.01-mfd. condenser from the choke coil to the chassis

AIRLINE 07B (32-volt Farm Receiver)

Noisy, (scratching noise) .... 1) faulty push-pull input transformer primary winding. Replace transformer

AIRLINE 9

Oscillation .... 1) remove the shaft of the gang condenser. Clean it where it contacts the frame, cleaning the spring contacts and adjusting the screw

AIRLINE 40, 40A

Whistling, especially around 800 kc .... 1) replace the oscillator grid leak with one of 40,000 ohms

AIRLINE 62 SERIES

Inoperative when new or in use only a short time	1) defective two-section armored wire-wound resistor. Replace with 25,000-ohm, 1-watt and 1500-ohm, 2-watt units respectively
Intermittent reception	1) intermittently open-circuiting 3,200-ohm "Candohm" resistor furnishing cathode and suppressor grid bias to the type '57 first detector-oscillator tube. Replace with 1-watt unit

AIRLINE 62-14

Reception only at high-frequency end of dial	1) check tuning condenser plates for "shorts" at the "in" and "near-in" positions 2) check the value of the 40,000-ohm resistor between the control-grid of the '27 oscillator tube and ground. This often changes, necessitating a replacement

AIRLINE 62-22

Intermittent reception, Fading	1) "open" cathode by-pass condenser i-f stage
Distortion, Overloading on local stations	1) if AVC plate voltage is somewhat high when receiver is first turned on, look for an open-circuited resistor between the oscillator and r-f screens to plate of AVC tube. Also check for an "open" in the "localizer"—especially at the "cathode" side of the control. The divider resistance should be 4,300 ohms total, tapped at the 1,100-ohm point. Make tests from suspected point to cathode instead of to ground 2) check for "open" by-pass condenser in i-f stage

AIRLINE 62-68

Intermittent reception	1) 3,200-ohm "Candohm" resistor (furnishing cathode and suppressor grid bias to the '57 first detector-oscillator) "opens" periodically. Replace with 1-watt unit

AIRLINE 62-70, 62-72

Intermittent fading	1) "open" or "leaky' 0.04 mfd. audio-coupling condenser between '56 second detector and grid of '47 output tube. This condenser is located below the '47 tube (under the chassis)

AIRLINE 62-76

Improving bass response. Avoid overloading of 47's	1) change plate resistor in '57 first a-f stage from 50,000 to 25,000 ohms. Shunt a 0.006 mfd. condenser from the variable arm of the manual tone control to the high-potential end of this same potentiometer

AIRLINE 62-97

"Shorted" 0.1 mfd. cond. in plate circuit of 58's	1) replace with 400-volt type condensers

AIRLINE 62-99

See also Case History listed for Airline 62-97

Inoperative	1) faulty '32 oscillator tube. Try several tubes. Readjust plate and screen voltages slightly if necessary

AIRLINE 62-120, 62-122, 62-126, 62-128

Inoperative, Intermittent reception	1) if '34 second detector tube burns out or is found to be faulty, before replacing it with a new tube test the (50-mmfd.) coupling condenser between this tube and the preceding one. It is made of braid tubing pulled over a piece of silk-covered wire, and usually becomes corroded inside and "shorts". Since the 70-mmfd. condenser across the primary of the first i-f transformer, the 45-mmfd. condenser across the secondary of the first i-f transformer, the 200 mmfd. condenser in the antenna circuit, and the 35-mmfd. grid condenser of the first detector-oscillator tube are also of this type, they should also be checked. All can be replaced with mica-dielectric molded condensers of these same capacities

AIRLINE 62-134

High-pitch whistle intermittently	1) check the 100,000-ohm grid-leak resistor, and replace if found faulty

AIRLINE 64

Weak signals, Tuning meter inoperative	1) if volume increases when finger is placed on control-grid cap of first r-f '58 tube the meter is burned out. If operation is desired until the meter can conveniently be replaced, merely "short" it out of the circuit

AIRLINE 77, 95

Poor tone after replacing defective '19 tube	1) decrease grid bias from 6- or 4½-volts by shifting the grid bias connection from the 6-volt pin to the 4½-volt pin
Static-like noise	1) faulty primary winding of push-pull input transformer. Replace transformer

AIRLINE 123, 131, 133, 142, 144

Same Case Histories as those listed under Airline 62 Series

AIRLINE 182

Power transformer overheats	1) the filament leads to the various tubes, which are twisted together and bunched close to the chassis, "short" to it. Test for this condition by unsoldering the centertap of the filament winding from "ground," and check the continuity. Any reading indicates a "short" between the filament leads and chassis

AIRLINE 326-W

Inoperative	1) short-circuit between the two wires running from the high-voltage secondary of the power transformer to the plates of the type '80 rectifier tube due to poor insulation. Replace wires
Weak reception, Noise, Power transf. "smoking"	1) 2,460-ohm section of speaker field coil "open". Replace the field coil

AIRLINE 1955

Noisy reception, No control of volume on strong stations	1) defective 8-mfd., 275-volt detector plate return filter condenser. Replace with new unit
Intermittent reception, (tubes and voltages test O.K.)	1) open-circuiting 0.01-mfd. coupling condenser connected between the plate of the oscillator tube and a lug on the oscillator coil. This condition can be checked by testing for oscillator signal. Replace with a new unit if necessary

AIR MASTER AC-DC

Distortion, Blasting, Poor tone at high volume levels	1) decrease in capacity of one or both 8-mfd. filter condensers. The trouble usually occurs when their total capacity drops to less than 12-mfd.
Distortion on low volume (after set heats up) "Mushy" tone	1) check '43 tube by replacing it with another (even though it tests O.K.) 2) check 0.01-mfd. condenser from screen of 6C6 tube, replacing it if necessary

ALL-AMERICAN MOHAWK (LYRIC)

Oscillation	1) leaky dual by-pass condenser 2) open-circuiting connections at one of the by-pass condensers

ALL-AMERICAN MOHAWK 70, 73, 75

Hum	1) change location of grid leak, isolating it from the a-c filament leads so it will not pick up hum from them

AMRAD 81

Fading about 3 or 4 hours after being switched on, (no plate voltage on the detector tube when the above condition appears)	1) defective 0.5-mfd. audio coupling condenser (has two yellow leads coming from by-pass condenser block). Replace with a new externally connected coupling condenser 1) poorly soldered connection at the r-f coils. Test by tapping the coils slightly
Hum, (hum balancers adjusted) ("Mershon" condenser tests O.K.)	1) connect a 1-mfd. condenser from the cathode of the first a-f tube to ground, using leads as short as possible
Hum (develops after about 30 minutes of operation)	1) check the 4-anode 52-mfd. Mershon electrolytic condenser. Disconnect each wire separately from each anode of the Mershon, inserting a 0 to 10 milliammetr in series with it to measure the leakage current. If the leakage indicated is over 4 mils for any 8-mfd. anode, replace with a 400-volt condenser. If it is over 10 mils for any 18-mfd. anode, replace with a 4 mfd. 400-volt condenser. The 8-mfd. anodes are the two that are nearest the copper container

AMRAD 7100

Intermittent reception	1) leads shorting in cabled wiring 2) a-f transformer leads shorting to chassis or shield
Fading	1) corroded or loose fuse-block contacts 2) a-f transformer leads shorting to chassis 3) a-f transformer leads shorting to shield
Hum	1) open-circuited center-tapped filament resistor across the type '27 tube 2) faulty electrolytic condensers
Hum at resonance	1) out of neutralization

APEX 7

Inoperative (test reveals *negative* screen-grid voltage)	1) 0.1 mfd. condenser in screen-grid circuit "leaky"
Intermittent reception	1) intermittent "open" in 3,200-ohm cathode resistor for the '24 oscillator tube Replace this resistor
Intermittent reception (on low-frequency end of dial only, perfect reception otherwise)	1) filter condensers check O.K. on leakage test, but capacity is low. Measure the capacity, or, if a capacity meter is not available, try adding another condenser in parallel

APEX 7A

Unsatisfactory performance (all voltages normal, tubes test O.K.)	1) replace the first detector-oscillator tube with a '24A, trying several tubes until a satisfying one is found

APEX 7D (Chassis 700)

Fading or Low volume	1) voice-coil wires "shorting" together at the start of the coil due to vibration of the cone. Clean the coil and paint it with a quick-drying insulating lacquer. Keep wires apart as much as possible

APEX 8A

Distortion (after receiver has played for about 30 minutes, grid of '47 tube gets red hot)	1) filament center-tap for '47 tube "open"
Distortion, Low volume, Motorboating with volume control at maximum setting	1) faulty type '27 second detector tube 2) decrease in capacity of the 8-mfd. condenser across the output of the filter unit. Replace with new unit
Sudden increase (or decrease) in volume when a nearby light is turned on)	1) 0.5 mfd. condenser connected between the r-f cathode and the grid return of the r-f and i-f coils "open". Replace with 400-volt unit
Loud hum immediately after switch is snapped on	1) open-circuited 8-mfd. cardboard electrolytic filter condensers. Replace with new units
Fading	1) faulty 0.04-mfd. coupling condenser between the plate of the type '27 second detector tube and the type '47 output tube. Replace with new unit

APEX 9A

Oscillation, Motorboating (voltages abnormally high)	1) open-circuited 7,100-ohm voltage-divider section. Replace with new unit
	2) faulty condenser across the filter output. Replace with new unit
	3) connect a 0.5-mfd., 600-volt condenser between the i-f screen or cathode circuits and ground
	4) loss of capacity in filter condensers. Replace with new units

APEX 10 SERIES

See also Case Histories listed for Apex 8A and Airline 1955 receivers

Inoperative (but operates O.K. if AVC tube is removed from socket)	1) check 1,800-ohm section of "Candohm" resistor at rear of chassis
Hum, Volume control will not reduce hum to zero	1) replace the 8-mfd. condenser under the resistance strip in the center of the chassis
Hum	1) 25-000-ohm second detector plate filter resistor "shorted"
	2) short- or open-circuited 0.06-mfd. condenser connected across the filter choke
	3) electrostatic shield in power transformer not grounded, or ground is "open"

APEX 12

R-f and i-f circuits dead, Audio circuit operative (plate-to-cathode voltages on r-f and i-f tubes about 10-volts; chassis-to-cathode voltages about 250-volts)	1) short-circuited turns on 4,600-ohm section of field coil of speaker *No. 2*. Rewind, or replace with new coil

APEX 20

Weak reception (all voltages normal)	1) "open" 0.05-mfd. blocking condenser in the input circuit of the '24 detector stage. Replace

APEX 26

Inoperative (faint signals from local stations only)	1) short-circuited 0.4-mfd. screen-grid by-pass condenser. Replace with a 0.5-mfd. tubular unit
Weak reception, Poor selectivity	2) check grid wires for "chafed" insulation where they run through holes in chassis
Poor control of volume, Intermittent volume	1) faulty volume control. Replace with a new 8,000-ohm unit
Oscillation, (extremely high screen voltages)	1) open-circuited 2,560-ohm resistor. Replace with 2,500-ohm, 20-watt unit
Oscillation (detector screen voltage high)	1) replace 2640-ohm section of metal-clad resistor with a 2,500-ohm 10-watt wire-wound resistor

APEX 27

Intermittent oscillation	1) increase the r-f by-pass condenser capacity from 0.5 to 1.0 mfd.

APEX 32

Fading, Intermittent howling	1) poor "grounding" of flat by-pass condenser can containing 6 condensers. Solder the can to the tube shields

APEX 36

Fades with a "plop" after 30 or 40 minutes of normal operation, (tubes and voltages check O.K. when operation is normal) (no plate voltage when fading occurs)	1) double filter choke (which is sealed with the power transformer in a common pitch-filled can) slips down when the pitch is heated after set is in operation and touches the high-voltage terminal on power transformer. When the set cools, the contraction of the mass causes the contact to open. Heating, however, causes the same condition to repeat itself. Melt out the pitch from the can and insulate the choke and transformer from the sides of the can and from the high-voltage terminals. Reseal the unit
Weak reception at low-frequency end of dial. Normal, or excessive volume at high-frequency end	1) check the antenna choke for an "open". Replace it if necessary, and realign the receiver

APEX 41, 42

See also Case Histories listed for Airline AE-11 receiver

Oscillation over entire dial	1) try connecting a 3000-ohm resistor into the second r-f grid lead

APEX 43, 44

Same Case Histories as those listed for Airline AE-11 receiver

APEX 46

See also the Case Histories listed for Apex 48

Distortion on low-volume setting (after tubes have been replaced) .... 1) trouble of this kind can be overcome by replacing the old volume control with another unit connected in a slightly different way. The old one is simply a resistor in the cathode circuits of the 24's. For proper replacement install a 10,000-ohm tapered unit connected with one end to the antenna lead, the other end to the cathodes of the 24's through a 250 ohm resistor, and the slider to "ground" or chassis. The break in the wire-wound resistor where the old control was connected should be closed electrically with a jumper

APEX 47

See also the Case Histories listed for Apex 48

Inoperative (strong blue glow in '80 rectifier tube) .... 1) cut out and tape the white lead coming out of the filter condenser block. Removal of this section of the condenser will not materially affect the operation of the receiver. However if it is desired, another condenser can be connected externally to replace the one cut out

APEX 48

Inoperative (smoke issuing from power transformer) .... 1) unsolder the rectifier leads and prevent future "shorts" by running them through "spaghetti" tubing insulation. Resolder them in place

No plate voltage on one of the '45 tubes .... 1) audio choke "open". It may be "shorted" out of the circuit without material change in receiver performance

APEX 60, 60A

Same Case Histories as those listed for Airline AE-11 receiver

APEX 80

Weak reception (jarring the receiver brings it back to normal)	1) faulty a-c receptacle of dynamic speaker, resulting in a loose connection and no field excitation current. Replace receptacle
Weak reception on one end of dial	1) stator plates of tuning condenser have shifted out of alignment. Plates must mesh with similar spacing at top and bottom of plates
Oscillation at certain dial settings	1) connect a 50-ohm non-inductive resistor directly into the grid lead of the second r-f tube. Also connect a 250-ohm resistor at grid end of the third r-f tube

APEX 99

Weak reception	1) 4- and 8-mfd. filter condensers "open", or lowered in capacity

APEX 99A

Intermittent reception (receiver operates only when the "on-off" switch is snapped, or when one of the house lights is turned on)	1) faulty detector tube by-pass condenser. Replace it

APEX 120

Same Case Histories as those listed for Apex 12 receiver

APEX Chassis 700

See Case Histories listed for Apex 7D

ARBORPHONE 45

Fading Insufficient selectivity	1) clean and solder the rivets that are used on the "balancing panel" located under the chassis. Rebalance the receiver, using a meter for best results
Inoperative Intermittent reception	1) fraying and breakage of leads to tickler coil in '27 detector plate circuit. Replace with high-grade flexible wire, bending coil as close to r-f coil as possible without causing oscillation 2) "opens" in grid resistances, or "corrosion" at terminals. Replace with 600-ohm flexible pigtail type resistor, or with 400 to 500-ohm units for greater sensitivity

(Cont'd over)

ARBORPHONE 45 (Cont'd)

	3) r-f coil grid-return wires to chassis loosen frequently. Connect a common ground to each coil, and connect to ground post
	4) bias condenser at right of '80 tube socket loosens where bolted in place
Hum ....1)	interaction between '80 rectifier and '27 detector tubes. Place a piece of sheet copper or aluminum about 3 inches square behind the license notice plate in front of the rectifier
Increasing sensitivity ....1) and improving general operation	replace the '27 tube with a '56 type tube

ARVIN 1934 Auto Radio Sets

Excessive hum ......1)	pickup of vibrator interference by second i-f coil, as a result of the yellow wire from the volume control to power supply unit running near it. Move it away as far from i-f transformer as possible

ARVIN 1935 Auto Radio Sets

Poor quality, Low volume ....1)	loose plug where the local-distance change is made. Repair plug, or replace with new unit
Excessive vibrator hum ....1)	move the large yellow "A" lead running from the volume-control switch to the power supply compartment as far as possible from the second i-f coil. Shielding this wire also helps a great deal

ARVIN 1936 Auto Radio Sets

Vibrator hash ....1) make sure that chassis is well grounded to firewall of car, using shakeproof washer on bolt

2) make sure to secure good grounding for the transmission line box. Ground it to the frame of the car if an under-car antenna is used, or, if a "top" type antenna is used, ground the box to some metal part known to be at the same r-f potential as the firewall. Make sure that the transmission line shielding is making firm contact with the plugs at both ends

3) remove front cover of receiver, and tighten the four screws holding the power transformer in place. Wiggle the vibrator in the socket, and make certain that each "grounding" tooth makes good contact with the sides of the vibrator case

4) in addition to regular A-line condensers, try connecting a 1-mfd. condenser across the car's A-circuit by connecting it from "ground" directly to either terminal of the ammeter or fuse block

5) solder a 1½-inch piece of shielding or flexible wire from the 6A7 grid cap tube shield to the frame of the variable condenser

6) vibrator "hash", which may occasionally increase to an undesirable level after a period of operation, may often be corrected by tightening the four screws that hold the power transformer to the chassis after the receiver has been allowed to warm up for a period of about a half hour

Mechanical hum in vibrator ....1) In some of the first few 1936 receivers delivered, a mechanical noise develops due to chattering of the vibrator against the chassis. Remove the vibrator from the set and increase the tension of the vibrator-grounding spring cup which is riveted in the radio chassis over the vibrator socket

Switch remains in "on" position ... ...1) remove the small stop pin located just above the volume control on the rear of the remote-control head. This pin may be extracted by prying it up with a screwdriver and removing it with a pair of pliers

ARVIN A2 Antenna

Proper method of installation for motor noise elimination .. .1)	the Arvin Type A 2 antenna should always be installed on the front door hinge on the same side of the car on which the radio chassis is installed
	Drill a 7/32-in. hole to accommodate the lead-in wire. The hole should be drilled in the door sill close to the door hinge in such a manner that when the door is closed the hole through which the lead-in passes is covered by the front edge of the door
	The "Phantom Filter" box should be *securely grounded* to the instrument panel or the metal part of the dash *close to* the point of entry of the antenna leading into the car
	Shield the antenna lead wire from the "Phantom Filter" to the point where the lead passes out of the car. Ground one end of the shield to the "Phantom Filter." Ground the other end to the automobile chassis or body
	If motor noise is present after the antenna is installed in this way, it is generally caused by the car hood being ungrounded and may be remedied by placin a 6-in. length (or longer if necessary) of braided shielding over the fabric strip attached to the cowl on which the rear edge of the hood rests. Solder both ends of the braid to the cowl and if the fabric hood strip is fastened in place by metal screws, remove these and drive them through the shielding to hold it in a permanent position. Clean the paint off the hood at the spot where it rests on this braided shielding so that it will be securely grounded
	Usually no suppressors—not even distributor type—are needed if the foregoing instructions are followed

ARVIN P28 to P45 Auto-Radio Remote Controls

Backlash	1) misalignment between dial mechanism and dial drive member. The small flexible shaft linking the two assemblies must not make two bends. Thin washers are used to line up these members into which the shaft is inserted
	2) Play in worm-gear drive mechanism. This may be removed by tightening the small hex adjusting nut to the point where no backlash is perceptible
	3) Kink in small dial drive flexible shaft. This small shaft must be straight and free from kinks. Otherwise backlash will be noticed on one end of the dial and not on the other
	4) excessive or insufficient amount of shafting connecting dial to tuning member. When the small link flexible shaft is either too short or too long, the curve it assumes is beyond its elastic limit and the detrimental effect is similar to that caused by a kinked shaft graphite grease should be used on the worm-drive gears and light motor oil for all other bearings in the control mechanism

ARVIN 7 Auto Radio

Intermittent reception, Oscillation Motorboating	1) replace twin AVC condenser between the 6F7 tube socket and antenna coil in the Arvin 17, 27 and 37 receivers (this is between the '78 tube socket and the antenna coil)
Oscillating while tuning	1) condensers *No. 17-4731* and *No. 17-4712* making poor ground contact through metal collar to chassis. Replace with new types, *No. 17-14020* and *No. 17-14007*, which have separate ground leads
Ignition noise	1) ungrounded cables. Ground all cables

ARVIN 10A

Hum (after replacing '84 tube)	1) install a metal shield over the tube and ground
Howl (when set is cold)	1) reverse the primary leads to the reflexed audio transformer
Howl	1) check the 12-mfd. 25-volt electrolytic condenser. Replace if faulty

ARVIN 16

Poor sensitivity	1) remove inter-channel noise suppression feature by connecting a resistor from the low end of the secondary of the detector i-f transformer, i.e., from the ground directly to the cathode of the detector tube

ARVIN 17 Auto-Radio

See also Case Histories listed for Arvin 7

Oscillation (while tuning)	1) poor "ground" contact through metal collar to chassis on condensers *No. 17-4731* and *No. 17-4712*. Replace with new type *No. 17-14020* and *No. 17-14007* condensers equipped with separate ground leads
Ignition noise	1) check to see that all cables are properly "grounded"

ARVIN 18 Auto Radio

Distorted, mushy tone, Weak reception when jarred	1) faulty 0.05-mfd. 160-volt condenser (mounted through chassis near the power pack) connected from the volume control to the resistor on the end of the second i-f transformer

ARVIN 19 Auto Radio

Motor interference which persists even if antenna is disconnected from receiver.	1) this interference is caused by chassis pickup. Remove the radio chassis front cover and sandpaper the rim of the cover to remove all grease and paint 2) ground the shield of the '78 or 6A7G tube, and ground the shielding partitions in the tuning condenser. Use narrow copper braiding to ground these to the chassis

ARVIN 20A Auto Radio

Inoperative	1) inspect r-f chassis unit and if the tube heaters are not lit, repair the broken "A" choke in the audio unit 2) if the tubes in the r-f chassis light up but the vibrator is not heard, check this same choke for a break at the opposite end
Receiver overloads on powerful local signals	1) replace the '75 tube with an '85 tube. This will reduce the sensitivity somewhat, but will improve the tone

ARVIN 25 Auto Radio

Inoperative .... 1)	short-circuited tone control (*Note*: this is a tapped condenser-type unit)
Intermittent reception ..... 1)	replace dual 0.015-mfd. antenna coupling condenser
No reception, Vibrator sounds weak .... 1)	"shorted" dual 0.02 mfd. condenser used as a buffer across power transf. sec.

ARVIN 27 Auto Radio

See also Case Histories listed for Arvin 7 and 17 receivers

Low volume, (with a type '6B7 second detector and amplifier tube) .... 1)	change the value of the 200,000-ohm type '6B7 tube plate resistor to 300,000-ohms
Intermittent reception Intermittent oscillation .. 1)	intermittent or high-resistance connection between the bodies of the metal-can condensers and their mounting flanges. Bond the condenser bodies to their flanges with solder

ARVIN 29 Auto Radio

Same Case Histories as those listed for Arvin 19 Auto Radio

ARVIN 30A Auto Radio

Same Case Histories as those listed for Arvin 20A Auto Radio

ARVIN 35 Auto Radio

Poor tone .... 1)	replace both 0.01-mfd. audio-coupling condensers with mica-moulded condensers of the same value

ARVIN 37 Auto Radio

Same Case Histories as those listed for Arvin 7 Auto Radio

ARVIN 39 Auto Radio

Same Case Histories as those listed for Arvin 19 Auto Radio

ARVIN 41, 51 Auto Radios

Distortion at low volume-control settings, and on strong signals 1)	overbias on type '6F7 tube gride. Remove the 100-ohm resistor from the cathode circuit of this tube, and connect the cathode to ground through an 800-ohm resistor. The volume control will then affect the bias on the 6A7 tube only, rather than on both this tube and the 6F7. Fix-bias the latter independently

ARVIN 62 Auto Radio

Noisy, (when tuning dial is rotated) .... 1) solder the bottom arm on the planetary drive system to the bracket at the bottom front end of the condenser gang

ARVIN 65 Auto Radio

Ignition interference .... 1) clean surface joints on front cover of receiver to remove all paint and grease
2) check the "acoustinator" plug to see that good grounding contact is obtained
3) check the right-hand breather screen for ground. "Spot" it with solder

ARVIN 617 Auto Radio

Crackling, Flickering pilot lights .... 1) dial frame is not properly grounded to receiver chassis Run a short, flexible lead between the two, and solder it securely in place

ATWATER KENT ALL-WAVE BATTERY RECEIVERS

Poor quality, High battery drain, Oscillation .... 1) leaky 8-mfd. 200-volt electrolytic condenser connected to B-plus. Replace with new unit of higher voltage rating

ATWATER KENT H-1, H-2

Inoperative .... 1) open-circuited antenna choke
2) short-circuited i-f trimmer condensers. Replace mica dielectrics and re-align the i-f amplifier

ATWATER KENT "L" CHASSIS

Oscillation, Set "dead" .... 1) dirty or corroded connections at rotor spring contacts on the condenser gang. Clean and increase tension of springs or solder flexible pigtails between the rotor and the condenser frame

Oscillation (sensitivity switch in "local" position) .... 1) coupling between wire leading to switch and r-f choke. Bend this wire away from the coil opening

Lack of voltage on the detector or first audio tube .... 1) burnt-out filter resistors
2) short-circuited condensers
3) burnt-out plate circuit resistors
4) burnt-out input transformer

ATWATER KENT L1

Distortion, Hum .... 1) bias resistor for the '45 output tubes "open"

ATWATER KENT "L" CHASSIS

Oscillation, Set dead	1) dirty or corroded connections at rotor spring contacts on the condenser gang. Clean and increase tension of springs or solder flexible pigtails between the rotor and the condenser frame
Lack of voltage on the detector or first audio tube	1) burnt-out filter resistors 2) short-circuited condensers 3) burnt-out plate circuit resistors 4) burnt-out input transformer

ATWATER KENT 7-D

Squeals at low volume	1) leaky condenser *C18*. Replace with an 8-mfd., 400-volt unit 2) open-circuited section in i-f transformer *T5*. Replace with new unit

ATWATER KENT 30 SERIES

Poor sensitivity, Poor selectivity	1) replace antenna coil with a compensator coil; i.e., a center-tapped coil, connecting one end to grid, the other to ground and the tap to the antenna terminal

ATWATER KENT 37, 38

Inoperative	1) short-circuited filter condenser 2) short-circuited speaker output condenser 3) short-circuited r-f by-pass condenser (for Model 37 only)
Weak reception	1) open-circuited first a-f plate resistor 2) open-circuited detector plate resistor 3) tuning belts loose 4) tuning condensers not synchronized
Intermittent reception	1) loose nuts on power pack terminal strip 2) antenna lead short-circuiting to shielding braid
Noisy reception	1) defective volume control resistance strip 2) loose nuts on power pack terminal strip 3) dirty volume control resistance strip and contacts (for Model 37 only)

ATWATER KENT 40

Weak reception	1) open-circuited detector plate resistor 2) open-circuited first a-f resistor 3) tuning belts loose 4) tuning condensers not synchronized 5) defective glass tube grid leak resistor. Replace it with a carbon pigtail type resistor unit

(Cont'd)

ATWATER KENT 40 (cont'd)

Inoperative	1) shorted r-f by-pass condenser
Choked reception, Distorted and weak	1) short-circuited or leaky speaker output condenser 2) open-circuited detector plate resistor
Intermittent reception	1) loose nuts on power pack terminal strip 2) poor contact of volume control slider arm 3) antenna lead short-circuiting to shielding braid
Oscillation, (during warming-up period)	1) shunt a 250,000-ohm resistor across the secondary of the first a-f transformer
Insensitive, (only powerful local stations are heard) (tubes and voltages test O.K.), Hum	1) poor connection between flat-type antenna coil and its lug. Resolder connection 2) detector grid condenser short-circuiting to tuning condenser frame. Mount the condenser rigidly or wind tape around its free end 3) receiver circuits out of alignment. Realign circuits
Set dead	1) open-circuited 625-ohm r-f and a-f bias resistance section and 2,200-ohm type '71A bias resistance section. Replace with new resistance units
Noisy reception	1) dirty volume control. Clean resistance strip or replace unit 2) intermittently open-circuiting 6,500-ohm detector plate resistor. Replace with new unit
Noisy reception, Crackling	1) loose connection in r-f plate circuit between bias resistor and ground 2) defective "flat" type wire-wound cathode. Replace tube
Noisy reception while tuning	1) remove complete condenser gang assembly from chassis and wash in gasoline, cleaning all contact points
Low volume, Fading	1) type '26 tubes are old. Connect additional filament leads from power pack to first r-f socket filament lugs, so as to lower the voltage drop in these leads, thereby raising the filament voltage

ATWATER KENT 41

Inoperative	1) burnt-out tube 2) open-circuited r-f line choke
Weak reception	1) tuning belts loose 2) tuning condensers not synchronized 3) remove 1st r-f plate resistor from circuit
Hum at resonance	1) open-circuited r-f filament by-pass condenser

ATWATER KENT 42

Same case histories as those listed for Atwater Kent 37, 38 and 40

ATWATER KENT 43

See also case histories listed for Atwater Kent 40

Inoperative, Weak reception	1) open-circuited detector or first-audio resistor
Intermittent reception	1) broken voice-coil lead at soldered joint 2) loose nuts on power pack terminal strip 3) antenna lead shorting to shielding braid
Weak reception	1) tuning belts loose 2) tuning condensers not synchronized

ATWATER KENT 44, 45

Same case histories as those listed for Atwater Kent 40

ATWATER KENT 46, 47

Same case histories as those listed for Atwater Kent 40, 43

ATWATER KENT 51 D.C.

Same case histories as those listed for Atwater Kent 41

ATWATER KENT 52

Same case histories as those listed for Atwater Kent 40

ATWATER KENT 53

Same case histories as those listed for Atwater Kent 43

ATWATER KENT 55, 55-C

See also case histories listed for Atwater Kent 67

Choked reception, Distorted and weak	1) open-circuited detector cathode bias resistor 2) open-circuited screen by-pass condenser
Oscillation	1) open-circuited screen by-pass condenser 2) tuning condensers not synchronized
No signals (no screen voltage)	1) shorted screen-grid by-pass condenser

(Cont'd)

ATWATER KENT 55, 55C (cont'd)

Distorted (high output grid bias)	1) open-circuited bias resistor across speaker field
Distorted (no output grid bias)	1) short-circuited bias resistor across speaker field
Weak or no signals	1) open first or second a-f bias resistor
Low volume	1) open-circuited first r-f transformer primary 2) receiver circuits out of alignment
Poor high-frequency response	1) remove the "quality" condenser connected across the plates of the type '45 tubes, located in the audio transformer assembly. The condenser is located at the at the top of the can, which must be heated in order to remove it)
Intermittent reception, Fading a few minutes after being switched on, resulting in a buzzing sound	1) open-circuited secondary in second r-f transformer. Test for an intermittently open-circuiting coil with a 60-watt bulb near it to heat it
Audio "howl"	1) open-circuited 4-mfd. plate filter condenser in the a-f circuit (*C14*). Replace with a new unit

ATWATER KENT 55-F, 55-FC

See also case histories listed for Atwater Kent 67

Choked reception, Distortion	1) open detector cathode bias resistor 2) open-circuited screen by-pass condenser
Oscillation	1) open-circuited screen by-pass condenser 2) tuning condensers not synchronized
Weak or no signals	1) open-circuited detector coupling resistor

ATWATER KENT 60, 60-C

See also case histories listed for Atwater Kent 67

Noisy reception, Low volume	1) drop in value of 40,000-ohm and 65,000-ohm a-f grid resistors. Replace with new units
Intermittent reception, (snapping the power switch off and on brings set back to normal)	1) open-circuited speaker voice coil. Repair or resolder the open circuit
Weak or no signals	1) open-circuited first or second a-f tube bias resistors

ATWATER KENT 61-D.C.

See also case histories listed for Atwater Kent 67

Noisy reception ....1)	loosening of the winding on the filament resistor. Replace with a tighter wound resistor

ATWATER KENT 67

Fading, Intermittent reception ....1)	poorly soldered connections at leads of tubular condensers. Resolder all connections
2)	poor contact between lugs and resistance wire in wire-wound resistors
3)	poorly soldered connections to metallized resistors having solder ends. In all of the above cases test the connections with an ohmmeter, moving them mechanically during the test, and keeping the test prods on the *terminals* and *not* on the resistance element.

ATWATER KENT 70, 72, 74, 75, 76

Dial readings off calibration 1)	three control-grid leads in incorrect positions. Rearrange them to run parallel

ATWATER KENT 80, 82

Weak and distorted, Inoperative ....1)	open-circuited output tube grid choke
No control of volume ....1)	high-resistance connection between oscillator tube cathode prong and socket. Clean and tighten the socket prongs
2)	"gassy" or high emission AVC tube (applies to models 85, 86 only)
Poor sensitivity ....1)	defective type '24 AVC tube. Test by removing tube from socket and noting difference in volume. If the volume increases the tube is defective and requires replacement
Hum, Distortion (not due to condensers or resistors) ....1)	replace grid resistor in type '47 tube input circuit
2)	replace the detector plate coupling condenser
Intermittent reception ....1)	high-resistance short-circuits between socket holes. Rub pencil eraser on top of tube sockets to remove shorts

ATWATER KENT 84 D.C.

Low volume, (voltages test O.K.) ....1)	open-circuited connection at lug of choke connected between the i-f blocking condenser and the volume control

ATWATER KENT 84 (EARLY MODEL)

Set dead	1) open-circuited type '24A first detector plate choke due to corrosion at the terminals. Resolder leads at terminals 2) internally open-circuited plate coupling and i-f selecting choke in the grid lead of the type '24A i-f tube (value 66-ohms). Replace with a new unit 3) increase in value of 40,000-ohm bias resistor in the oscillator circuit. Replace with new unit
Noisy reception	1) corroded tuning condenser contacts
Noisy reception, Intermittent reception, Fading	1) intermittently open-circuiting primary winding in one of the i-f transformers. Replace with new unit and realign the receiver circuits

ATWATER KENT 84

Weak reception on strong local stations, (voltages and currents test O.K.)	1) excess wax from field coil working into armature, freezing driving unit or voice coil of speaker
Poor volume, Intermittent volume	1) open-circuit in i-f stopping choke, due to broken leads at lugs under the protective wax
Inoperative	1) defective oscillator coil. Replace with new oscillator coil, realigning oscillator at 1500 kc, by means of the trimmer on top of the oscillator tuning condenser. Then adjust the oscillator for 800-kc by means of disc at bottom of coil

ATWATER KENT 85

See also case histories listed for Atwater Kent 80

Poor control of volume	1) defective type '24 AVC tube (even though it may test O.K.) Replace by substitution with new tube
Intermittent reception, Noisy reception	1) poorly soldered connections. Check by wiggling every connection and connecting terminal, as well as wires through shields, etc. with the set in operation 2) peeling condenser plates, causing intermittent short-circuits between plates. Burn with high voltage—all terminals disconnected

ATWATER KENT 86

See first case history listed for Atwater Kent 80

ATWATER KENT 89

See also case history listed for Atwater Kent 80

Oscillation ....1)	change in value of 425-ohm bleeder resistor. Replace with 1-watt unit
Noisy reception ....1)	noisy type '35 variable-mu tube (even though it may test O.K.) Replace with new tube

ATWATER KENT 92, 94

See also case history listed for Atwater Kent 80

Set dead, but becomes operative after a few minutes, building up to normal reception in about half an hour .....1)	short-circuiting trimmer condensers. Clean the trimmers with alcohol and replace the mica strips inside them

ATWATER KENT 96

Intermittent reception .....1)	heater current through the type '35 i-f tubes and type '24 AVC tube too high, causing the AVC tube to draw grid current when heating and resulting in an erratic action of the AVC resistor network. Insert a heavy wire-wound resistor in the heater circuit in order to cut down the heater voltage slightly. This will prevent grid current from flowing in the AVC tube grid circuit
Inoperative, (high positive grid voltage on r-f, first detector and i-f tubes), Falling of neon glow ....1)	grid resistor in i-f circuit short-circuiting to plate winding of input i-f transformer, causing plate voltage to be supplied to grid of i-f tube. Isolate and insulate resistor from plate winding

ATWATER KENT 99

Set dead, (made crackling noise before it had ceased operating) (about 400 volts present between chassis and type '35 first detector tube control grid) Erratic operation of neon glow tube ....1)	carbon resistor shunted across the secondary winding of the first i-f transformer short-circuiting to primary winding. Wind tape around resistor and move it away from possible contact with the primary winding
Inoperative, (high positive grid voltage on r-f, first detector and i-f tubes), Falling of neon glow ....1)	grid resistor in i-f circuit short-circuiting to plate winding of input i-f transformer, causing plate voltage to be applied to grid of i-f tube. Isolate and insulate grid resistor from plate winding

(Cont'd)

ATWATER KENT 99 (cont'd)

Inoperative (Cont'd) ...... 2) resistor in i-f transformer short-circuiting to side of can. Move it away from can and insulate it

ATWATER KENT 145

Audio squeal, (condition is aggravated by touching the grid cap of the type '2A6 tube) ....1) remove and discard the metal clamp around the type '2A6 tube grid lead at the point where it is grounded. Solder the wire twisted around the grid lead to point where clamp was grounded

ATWATER KENT 155

Hum, Distortion ....1) leaky dual and triple filter condensers. Replace with 8-mfd. sections

2) change in value of volume control from normal value of ½-megohm. Replace with new unit

3) adjust trimmer between tuning condensers and speaker at the top front of chassis to loudest point

Low volume, Receiver gets out of alignment, Screen-grid resistor changes in value ....1) replace the type '85 tube with a type '75 tube, making the following changes in the circuit: connect a 0.25-megohm resistor in series with the 0.1-megohm resistor and B-plus. By-pass this resistor to ground with a 0.1-mfd., 200-volt condenser. Also connect a 4-mfd., 30-volt condenser across the 300-ohm resistor connected between the chassis and the a-c—d-c switch

ATWATER KENT 165

Oscillation, Hum, Distortion ....1) decrease in capacity of second filter condenser

Oscillation, Weak reception, Cross-talk ....1) open-circuited first detector-oscillator bias resistor

Slipping tuning drive .....1) install new bearing race

Vibrating noise at loud volume ..1) end play in variable tuning condensers

ATWATER KENT 188

"Rattling" at the least vibration, Noisy reception ..1) substitute other wires for the control-grid wires to the r-f tubes. The mineral content sometimes present in the rubber insulation may make it conductive, causing interaction. This defect does not usually show up under ordinary tests

ATWATER KENT 206

Low-frequency dial calibration incorrect	1) adjust oscillator padding condenser. This is the screw at rear of chassis
Noisy reception, No short-wave reception	1) increase tension of wave-band switch contacts 2) clean switch contacts with Carbona

ATWATER KENT 217-D

Same case histories as those listed for Atwater Kent 7-D

ATWATER KENT 246

Audio howl as volume control is advanced with tone control in "low" position	1) defective volume control. Replace with new unit
Intermittent reception	1) poor connection at filter choke from plate of type '58 first detector tube, caused by loosening and corrosion of connecting brads

ATWATER KENT 260

Set requires about 2 or 3 hours after the switch is turned on, before it begins to operate. This is only the case in cold weather when the set has not been used for some time	1) it is necessary to cool the chassis (possibly by placing it in a refrigerator), then test the individual components when cold. Since the a-f transformer is sealed in a can with pitch, the pitch will contract when cooled, pressing against the windings and causing a possible short-circuit between two poorly insulated points. When the pitch is heated, it will expand, releasing the pressure and the short-circuit will no longer appear. This condition can happen with any impregnated unit

ATWATER KENT 277

Weak reception, Distortion, Oscillation	1) open-circuited first detector cathode bias resistor 2) leaky by-pass condenser
Cross talk	1) use red antenna lead and ground bias antenna lead

ATWATER KENT 310

See also case history listed for Atwater Kent 510

Inoperative, (no r-f or i-f plate voltage) (low output plate voltages)	1) small AVC and second-detector coupling condensers shorting to primary of second i-f transformer

(Cont'd)

ATWATER KENT 310 (cont'd)

Inoperative, (all voltages test O.K.) Shadowgraph operates	1) open-circuited r-f choke in diode circuit
Inoperative, (no plate voltages) Thin line on shadowgraph	1) filter choke shorting to core or shield 2) insulate choke from chassis and mark "hot"
Hum at resonance	1) oscillator tube cath.-htr. short-circuit
Distortion, Screen element of type '2A5 tube red hot	1) open-circuited section in output transformer primary
"Sizzling" when receiver is switched on	1) temporary breakdown of electrolytic condensers 2) change type '80 rectifier to direct-heater type tube
Intermittent reception	1) splashed particles of solder on contacts
Intermittent reception, Inoperative	1) open-circuiting oscillator series condenser

ATWATER KENT 318

Intermittent reception of low-frequency broadcast stations	1) poorly soldered connections to top of oscillator coil lug 2) open-circuiting oscillator coil section
Weak reception, Distortion, Shadowgraph indication narrows	1) cathode prong of type '55 tube socket grounding to chassis screw
First and third short-wave bands inoperative	1) first detector grid coil open-circuited
Second short-wave band inoperative, "Hiss" at low-frequency end of second short-wave band	1) first detector grid coil open-circuited
Fading, Volume increases abruptly	1) replace volume control. Push or pull upon shaft to ascertain condition

ATWATER KENT 345

Intermittent reception, Cuts off completely	1) defective type '2A7 detector-oscillator tube. Replace with new tube

ATWATER KENT 376

Same case histories as those listed for Atwater Kent 206

ATWATER KENT 425

Same case histories as those listed for Atwater Kent 165

ATWATER KENT 427-D

Same case histories as those listed for Atwater Kent 7-D

ATWATER KENT 447

Same case histories as those listed for Atwater Kent 318

ATWATER KENT 465Q

See also case histories listed for Atwater Kent 665Q

Distortion, (sounds like defective speaker), "Howling"	1) open-circuited 8-mfd. condenser connected between B-plus at speaker cord and ground. Replace with new unit

ATWATER KENT 510

Audio oscillation	1) mismatched type '2A5 tubes in the push-pull audio stage. Replace with matched tubes

ATWATER KENT 557

Same case histories as those listed for Atwater Kent 318

ATWATER KENT 612

Line fuses "blow"	1) short-circuited buffer condensers
	2) inoperative type '83 rectifier tube (not burnt-out)
Noisy, intermittent reception	1) loose connection to oscillator series condenser
	2) loose element in type '57 tube
Noisy reception	1) open-circuited or leaky buffer condensers

ATWATER KENT 627

Oscillation, Unstable	1) open-circuited first detector cathode by-pass condenser
	2) add r-f choke in r-f cathode circuit
No signals on low-frequency part of dial Oscillation	1) loose rivets on 0.1450-mfd. condenser located in oscillator can

ATWATER KENT 665Q

Fading about 15 minutes after set is switched on	1) disconnect the red positive wire from the air-cell battery and short-circuit the resistor, making it possible to use the cell for several weeks more
Poor tone	1) open-circuited connection on speaker coil. The coil is replacable on early models, but on later models, the entire unit requires replacement *(Cont'd)*

ATWATER KENT 465 (cont'd)

Noisy reception at low volume, (noise somewhat like a fog horn)	1) defective black electrolytic condenser. Replace with new unit

ATWATER KENT 667

Same case histories as those listed for Atwater Kent 227

ATWATER KENT 667-D

Same case histories as those listed for Atwater Kent 7-D

ATWATER KENT 708, 711

Inoperative, Noisy reception on short-wave band	1) defective tubes 2) defective silencing adjustment resistor 3) defective wave-change switch. Resolder all connections at this switch and re-align the receiver circuits

ATWATER KENT 812

See also case histories listed for Atwater Kent 612

Poor tone, Blocks at maximum volume setting	1) change value of ½-megohm potentiometer connected to diode plate *2* of the second detector to about 1-megohm. Shunt with fixed 1-megohm resistor to restore potentiometer value to normal
Noisy reception, Intermittent reception	1) loose connection inside the sleeving of the wires connecting one end of 1,450-mmfd. condenser inside oscillator coil shield
Erratic operation of silent tuning control	1) loose element in one of the type '57 tubes in the silent tuning control stage. Replace with new tube
Erratic "tone-beam" operation	1) intermittent shorting of 46,000- and 40,000-ohm carbon resistors in this circuit. Insulate from each other
No "tone-beam" action	1) open-circuited 40,000-ohm tone beam bleeder resistor

AUDIOLA JR. (WESTMINSTER)

No plate voltage	1) short-circuiting of 0.01-mfd. condenser connected between the type '45 tube plate and ground
Oscillation	1) high-resistance ground connection due to a loose rivet between the dual 0.1-mfd. metal case condenser and the chassis. (This rivet also holds one side of the second r-f tube socket.) Solder a pigtail jumper from the condenser can to chassis
Fading (reception restored to normal when the chassis is tapped)	1) poorly soldered connections at all three grid cap clips. Resolder these connections

AUDIOLA 30-B

No control of volume on powerful local stations	1) adapt the receiver for use with type '35 tubes. Substitute a 10,000-ohm potentiometer for the old volume control, connecting one end of it to the antenna and the other end to a 25,000-ohm bleeder resistor for the screen voltages; connect also at this latter terminal the original r-f bias resistor. The movable arm of the potentiometer is grounded to the chassis. Replace the tubes with type '35s

BALKEIT A3, A5, A7

Noisy reception	1) inoperative audio transformer 2) inoperative phono-pickup jack 3) inoperative electrolytic condenser
Fading	1) worn carbon strip in volume control

BALKEIT 41A

Oscillation	1) high-resistance or open-circuiting contacts of loose or improperly fitting tube shields. Solder flexible pigtails between all tube shields and the chassis 2) interaction between the wires from the the diode plates and control grid of the type '75 tube. Separate the leads as far apart as possible

BELMONT 41, 42A

Inoperative	1) short-circuited primary winding in the output transformer. Replace with a new unit

BELMONT 51-C

Set dead, (no plate voltage on the type '57 detector tube)	1) defective 250,000-ohm plate supply resistor. Replace with new unit
Noise at high volume, (banging the set will bring this noise out at any level)	1) broken type '80 tube plate lead terminal between the wafers of the tube socket, resulting in intermittent contact. Replace the socket

BELMONT 420

Whistle, Oscillation	1) oscillation in type '38 power pentode amplifier tube, due to change in value of control-grid and cathode-grid resistors. Replace with new resistors if values are changed
	2) change in value of type '76 r-f amplifier tube plate resistor. Replace with new unit

BELMONT-GAMBLE 777 Series B-C, 778 Series A

Intermittent hum, (disappears when line switch is snapped off and on)	1) intermittent open-circuiting of the common lead of the dual condenser unit 0.1—0.25-mfd., 220-volt) comprising the bias voltage hum filter and screen bypass condensers. Replace the entire unit with two separate units of same capacity and voltage

BEST 4 TUBE MIDGET

Inoperative, (only voltage present across speaker field)	1) defective type '25Z5 tube, caused by an open-circuit inside one of the cathode leads. Replace with new tube
Difficulty in tuning, Set drifts off freqeuncy setting	1) loose tension of the springs on the tuning condenser rotors. Solder pigtails across rotors and springs

B.O.P. "AIR MATE"

Distortion, Poor tone at high volume	1) decrease of value of condensers in electrolytic condenser block. Replace the complete section if any unit is defective (never replace single units)

B.O.P. CHEVROLET

Pronounced vibrator buzz	1) open-circuited filter output condenser. Connect a 4-mfd. condenser from the B-plus terminal of the type '75 tube to ground

BOSCH JR.

Same case histories as those listed for Bosch 16, 17, 18

BOSCH CB 49

Same case histories as those listed for Bosch 16, 17, 18

BOSCH R6, R7

Poor selectivity .... 1) receiver circuits out of alignment

BOSCH 5-C

Inoperative .... 1) open-circuited field coil

BOSCH 16, 17, 18

Oscillation, Noisy tuning .... 1) high-resistance variometer wiping contact. Remove the inner shaft of the variometer and carefully clean the wiper blade and brass contact surface. In assembling the unit, bend the blade so that it will make better contact
2) broken pigtail at condenser next to the variometer. Solder a new one about 1½-inches longer
3) poor tension of contact springs or rotor of tuning condenser gang. Clean contacts and provide better tension or solder pigtails between the rotor and condenser frame

Weak reception at high or low frequencies, Oscillation .... 1) variometer rotor not working together with condenser gang. When the tuning condenser is at zero setting, the variometer rotor should be at right angles to the stator

Hum .... 1) defective tubes
2) open-circuited section in center-tapped resistor
3) unmatched audio transformer secondary windings
4) connect a 2-mfd. filter condenser from one side of the speaker field terminals to chassis, determining exactly which is the best side by trial connections
5) short-circuited choke tuning condenser

Weak reception, Poor sensitivity (high plate current in 2nd or 3rd r-f tube) .... 1) open-circuited 500-ohm carbon resistor in the control-grid circuit of the second or third r-f stage
2) volume control shaft short-circuiting to metal panel

Noisy reception .... 1) leaky 0.001-mfd. detector plate by-pass condenser

BOSCH 20

Inoperative	1) short-circuited 40,000-ohm, 1-watt oscillator plate dropping resistor. Replace with a 3- or 5-watt unit
Poor control of volume	1) remove the antenna lead from the volume control and use the control only on the cathode of the i-f tube. Add a 1,000-ohm minimum bias resistor to the 200-ohm volume control unit in the set at present

BOSCH 28, 29

Intermittent reception, Fading	1) intermittent short-circuiting to chassis of black lead from the variometer stator. The sharp-edged hole through which the lead passes cuts through its insulation and the vibration causes it to touch the chassis intermittently. Replace with a heavier insulated lead, providing also adequate insulation at the hole
	2) loose lug on front of first condenser stator section
Weak reception, Distorted reception	1) open-circuited 50,000-ohm detector plate supply resistor
Noisy reception	1) noisy 50,000-ohm detector plate supply resistor
	2) noisy primary windings of a-f transformers
	3) noisy volume control. Replace with new unit
Motor-boating, Oscillation	1) connect additional 1-mfd. by-pass condensers from either side of detector plate supply resistor to chassis
Hum at resonance	1) open-circuited supply line by-pass condenser. Out of neutralization

BOSCH 31, 32

Fading, Intermittent reception	1) intermittently open-circuiting screen voltage-divider resistor 2) intermittently open-circuiting second detector screen resistor
Hum	1) open-circuited filter condenser 2) short-circuited field coil "by-pass" or "tuning" condenser
Weak reception, Hum	1) short-circuited field coil tuning condenser
Muffled tone Distorted reproduction	1) open-circuited second detector screen resistor
Inoperative, (no plate voltages)	1) primary winding of 2nd i-f transformer shorting to secondary winding
Poor tone at low volume	1) intermittently open-circuiting 2-megohm screen-grid resistor. Replace with new unit

BOSCH 38

Same case histories as those listed for Bosch 28, 29

BOSCH 46

Oscillation, Weak reception	1) open-circuited type '226 tube bias-resistor condenser
Inoperative, Intermittent reception	1) short-circuited or intermittently short-circuiting compensating condenser

BOSCH 48, 49

Same case histories as those listed for Bosch 16, 17, 18

BOSCH 54 D.C.

Noisy tuning, Oscillation	1) see first case history listed for Bosch 16, 17, 18
Weak reception, Oscillation	1) see second case history listed for Bosch 16, 17, 18
Distorted reproduction, Low or no output grid bias	1) weak or exhausted "C" battery
Weak reception, High plate current on 2nd or 3rd r-f tube	1) open-circuited grid suppressor resistor
Weak reception, Distorted, Hum at resonance	1) open-circuited detector cathode by-pass condenser

BOSCH 58

Lack of sensitivity	1) adjust antenna aligning condenser, located above antenna and ground posts, at 1,000-kc for maximum volume
Set dead, (no grid bias on the first a-f tube)	1) defective 2-megohm coupling resistor in the grid circuit of the first a-f tube. Replace with a new unit
Inoperative, (set operates when control-grid lead of first r-f tube is touched)	1) test variable condenser across antenna coupling stage for short-circuited plates. The cap screws holding the rotor plates usually work off center and touch stator plates
Distortion, Weak reception, Station "hiss"	1) open-circuited detector screen resistor 2) open-circuited de-coupling resistor
Weak in "local" position, Station "hiss"	1) open-circuited 500-ohm resistor in local-distance switch circuit

BOSCH 60

See also case histories listed for Bosch 61

Lack of sensitivity	1) adjust antenna aligning condenser (located above antenna and ground posts) at 1,000-kc for maximum volume
Hum	1) open-circuited 1-mfd. condensers connected between each side of the line and chassis
"Local" position of local-distance switch inoperative	1) open-circuited carbon resistor between antenna tuning condenser and ground
Inoperative	1) short-circuited 0.25-mfd. r-f plate by-pass condenser located under the tube sockets behind the r-f tuning unit. Replace

BOSCH 60, 61

Two-spot tuning, Weak reception, Distorted and choked reception, Poor sensitivity, Erratic tuning meter operation	1) open-circuited 1-megohm detector screen resistor. Replace with a 1- or 2-megohm unit
Station "hiss," Weak reception	1) open-circuited r-f de-coupling resistor 2) open-circuited r-f secondary return by-pass condenser 3) broken lead to 500-ohm resistor in local-distance switch circuit 4) open-circuited 500-ohm resistor in local distance switch circuit

BOSCH 62 (1933)

Weak reception	1) leaky or partially short-circuited AVC plate by-pass condenser
Inoperative	1) inoperative AVC tube

BOSCH 73

Low volume when set is switched on—reception becoming normal about 15 minutes after set is in operation	1) open-circuited third r-f screen-grid resistor. This is a 750-ohm, 1-watt wire-wound unit. Replace with a carbon unit

BOSCH 96A

Low volume, Distortion	1) loose driving rod on the magnetic speaker cone. Solder the rod to the cone

BOSCH 126, 146

Same case histories as those listed for Bosch 46

BOSCH 150

Short-wave reception at center of dial setting	1) i-f amplifier out of alignment 2) oscillator not tracking properly. Check tracking condenser 3) loose coil and tube shields

BOSCH 166, 167

Same case histories as those listed for Bosch 46

BOSCH 200, 201

Low volume, Noisy reception	1) leaky dual 4—8-mfd. electrolytic filter condenser in power pack. Replace with new unit 2) defective 0.01-mfd. line buffer condenser. Replace with new unit

BOSCH 242, 243

Low volume, Poor tone	1) remove 0.05-mfd. audio coupling condenser between detector and first audio tubes 2) remove the 1-megohm resistor in the plate circuit of the type '56 detector tube 3) connect together the two open leads which are left as a result of the above

BOSCH 350

Intermittent reception, Hum (dial-light bulb flickers) (heater voltages low) ..1)	loose rivets holding soldering lugs of grounded sides of filaments at tube sockets. Make sure all these rivets are tight and are making good contact with the chassis, or solder heavy wires from the ground lugs to chassis

BOSCH 360

Intermittent oscillation ..1)	corroded joints between tube shields and shield bases. Drill a hole between shield and base and put a "Parker-Talon" screw through it
Steady or intermittent oscillation on weak stations ..1)	poorly grounded tube shields, or corroded contacts between the shields and chassis. Bond shields to chassis with separate pigtails or aluminum solder
Dead ....1)	condensers *C-39* and *C-40* short-circuiting or a section of resistor *R-3* open-circuiting

BOSCH 402

"Howls" (only when set heats up) Inoperative ....1)	defective type '6F7 tube (even though it may test O.K.). Replace with new tube

BRUNSWICK PANATROPES

Low volume when playing phonograph records, (chassis O.K.) ..1)	replace damping rubbers on pick-up head with new "live" rubbers

BRUNSWICK PR-17-8

Hum, Weak reception, No bias on first r-f tube ....1)	volume control arm not making contact
Oscillation ....1)	open-circuited type '26 filament by-pass condenser

BRUNSWICK S-14, S-21, S-31, S-81, S-82

Noisy reception	1) poor contacts on "local-distance" switch
No control of volume	1) volume control shaft short-circuited to chassis
Slipping tuning dial drive	1) increase tension of cable drive spring by moving screw to which spring is attached forward in slotted hole 2) apply drop of oil to tuning gang shaft bearing and pulleys
Hum, Oscillation	1) open-circuited section of filter condenser block
Distortion, Inoperative	1) leads from audio transformer short-circuited to ground
No reception, low plate voltages	1) short-circuited plate by-pass condenser
Insufficient sensitivity	1) wind a 3 to 5 turn coil at grid end of each r-f secondary coil. Connect one end to plate of preceding tube
Intermittent phono operation	1) loose terminal of tubular condenser connected to terminal of transfer switch (for Brunswick S-31 only)
Intermittent reception, Fading	1) high-resistance connection to control grid of second r-f tube

BRUNSWICK 3-NC-8

Distortion, Weak reception	1) open-circuited a-f transformer primary
Distortion at low volume	1) broken spider on speaker cone
Weak reception	1) carbonized 20,000-ohm carbon bleeder resistor—change to wire-wound unit
Insufficient sensitivity	1) shunt 40-ohm section of flat wire-wound voltage divider near volume control with a 500-ohm unit
Insensitive at high or low frequencies	1) oscillator trimmers out of adjustment 2) r-f compensator condenser out of adjustment
Inoperative above 600 kc, Dial settings incorrect	1) snapped tabs on oscillator series condenser
Unstable operation, Oscillation, "Birdies"	1) open-circuited oscillator grid leak
Hum	1) partially short-circuited speaker rectifier stacks

(Cont'd)

BRUNSWICK 3-NC-8 (cont'd)

	2) remove speaker frame ground connection
House fuse blows	1) short-circuited sections of speaker stacks

BRUNSWICK 3-NW-8

Tuning meter fluctuates	1) shunt a 0.0001-mfd. condenser across meter
Distortion, Weak reception	1) open-circuited a-f transformer primary
Weak reception, Inoperative	1) open-circuited 1-megohm AVC grid resistor
Intermittent reception	1) snapped tabs on oscillator series condenser
Inoperative below 600 kc, Dial settings incorrect	1) snapped tabs on oscillator series condenser
Insensitive at either high or low frequencies	1) oscillator trimmers out of adjustment 2) r-f compensator condenser out of adjustment

BRUNSWICK 5-KR, 5-KRO, 5-KR-6

Weak reception, No bias on first r-f tube	1) volume control arm not making contact
Oscillation	1) open-circuited type '26 tube filament by-pass condenser
Oscillation over entire dial	1) open-circuited by-pass condenser across split primary winding of second and third r-f stages
Distortion, (high detector plate voltage)	1) open-circuited detector-plate limiting resistor
Oscillation on high frequencies	1) adjust r-f compensating condenser
Poor selectivity, Low sensitivity	1) adjust r-f compensating condenser

BRUNSWICK 5-NC-8

Same case histories as those listed for Brunswick 3-NC-8

BRUNSWICK 5-NO

Distortion, Weak reception	1) open-circuited a-f transformer primary
Distortion at low volume	1) broken spider on speaker cone
Weak reception	1) carbonized 20,000-ohm carbon bleeder resistor—change to wire-wound unit
Insufficient sensitivity	1) shunt 400-ohm section of flat wire-wound voltage divider near volume control with a 500-ohm unit
Insensitive at high or low frequencies	1) oscillator trimmers out of adjustment 2) r-f compensator condenser out of adjustment
Inoperative above 600 kc, Dial settings incorrect	1) snapped tabs on oscillator series condenser
Unstable operation,	1) open-circuited oscillator grid leak
Oscillation, "Birdies"	1) open-circuited oscillator grid leak

BRUNSWICK 10

See also case histories listed for TCA Chassis

Weak reception, Oscillation	1) screen drop resistor carbonized (4,100 ohms) 2) det. plate resistor (0.5 meg) carbonized 3) open-circuited speaker voice coil

BRUNSWICK 11, 12

Intermittent reception	1) loose internal connection of oscillator plate by-pass condenser 2) broken porcelain turret condenser brackets 3) short-circuiting first detector coupling condenser (fastened to stator of first detector tuning condenser) 4) lugs on r-f coil forms shorting to chassis within shields 5) coil leads snapped at lugs—making contact intermittently
Inoperative, (positive control-grid bias on 1st detector tube)	1) short-circuited coupling condenser
Distortion, Hum, Oscillation	1) capacity of 6-mfd. electrolytic filter condenser below normal 2) carbonized 5,000-ohm resistors in voltage-divider circuit 3) screen voltage drop resistor carbonized

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BRUNSWICK 11, 12 (cont'd)

Inoperative over part of tuning range ...1)	broken porcelain turret condenser brackets
Slipping condenser drive ...1)	raise volume-tone control assembly by insertion of small washers
Low volume, Inoperative ...1)	charring and change in value of the 14,000-ohm, 2-watt resistor connected in series with a ⅛-watt, 5,000-ohm resistor (in the case of the type '24 oscillator) and another ⅛-watt, 5,000-ohm resistor as a bleeder to ground. Very often these resistors burn out entirely. Replace with 2-watt, ½-watt and 1-watt units respectively
No control of volume ...1)	grid returns in r-f, mixer, and i-f stages short-circuiting to ground
Poor high-frequency response ...1)	remove the small 0.001-mfd. condenser connected to the second detector plate. Replace with a 0.00025-mfd. unit

BRUNSWICK 14

No control of volume........1) leakage between first electrolytic filter condenser insulation and chassis
2) leaky 0.02-mfd. r-f or first detector tube secondary return by-pass condenser
3) leaky 0.1-mfd. i-f secondary return by-pass condenser
4) speaker leads shorting to frame of speaker or terminal cover
5) carbonized screen voltage dropping resistor
6) replace AVC tube

Intermittent reception, Fading ...1) loose internal connection to 0.5-mfd. oscillator plate by-pass condenser
2) lugs of coil forms shorting to chassis
3) broken turret condenser porcelain brackets
4) snapped coil windings at lugs of coils
5) short-circuiting first detector coupling condenser
6) defective or loosely connected 0.1-mfd. screen grid by-pass condenser in the detector circuit. Check its condition, replacing if defective and solder its riveted connections
7) intermittently open-circuiting 0.001-mfd. condenser connected between the grid and plate of the type '24A detector tube. Replace with new unit

Fading, Intermittent reception, (insertion of analyzer plug in socket or pulling out type '45 push-pull tubes, restores set to normal operation) (tubes and voltages check O.K.) ....1) intermittently open-circuiting a-f transformer secondary. Replace with new transformer

Noisy tuning........1) burrs on plates of tuning condensers (burn off with high voltage—all leads disconnected)

Inoperative, (high positive control-grid bias voltage on first detector tube) ....1) short-circuited first detector coupling condenser mounted upon stator of first detector tuning condenser

Inoperative ....1) lugs on coil form shorting to chassis or shield
2) broken turret condenser porcelain brackets

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BRUNSWICK 14 (cont'd)

Distortion at any volume level	1) screen drop resistor carbonized to lower value
Speaker field overheats	2) two 5,000-ohm carbon resistors in plate voltage divider circuit carbonized to lower value
	3) third electrolytic condenser below normal capacity
Full volume for minute or so after receiver is switched on	1) replace AVC tube with "quick-heater" type tube
	2) leaky insulation between first electrolytic condenser and chassis
Slipping tuning dial drive	1) raise volume-tone control assembly by inserting small washers
	2) increase tension of cable drive spring by moving screw, to which spring is attached, forward in slotted hole
	3) apply drop of oil to tuning gang shaft bearing and pulleys
Insensitive on high frequencies, Inoperative below 650 kc	1) change oscillator tube
Weak reception (voltages and resistances check O.K.)	1) leaky condensers across the two grid terminals of the type '45 power tubes (this does not show up in a point-to-point test). Replace with new 0.00025-mfd. units
Noisy reception	1) poor contacts on "local-distance" switch
Hum at resonance, Oscillation	1) r-f amplifier out of neutralization
Inoperative-distorted reception	1) leads from audio transformer shorted to chassis
No signals, (low plate voltages)	1) short-circuited 1-mfd. condenser across the output of the filter circuit. Replace with new unit
Hum	1) defective filter-condensers. Test by bridging each unit with a 1- or 2-mfd. condenser, replacing all defective units
Fading, Rapid changes in volume under vibration	1) short-circuiting of small black by-pass condensers located next to each 5-prong socket. Test each by substituting with a 0.25-mfd. condenser

BRUNSWICK 15

Distortion	1) short-circuited detector screen by-pass condenser. Check it with a neon lamp or condenser tester
Rushing noise (like escaping steam). Strongest at lower end of dial	1) remove condenser across local-distance switch. No replacement is necessary
Noisy reception, Intermittent reception	1) defective 0.02-mfd. coupling condenser in a-f circuit. Replace with new unit 2) inspect set thoroughly mechanically
Weak reception, Choked and distorted	1) short-circuited speaker output condenser
Station "hiss" (switch in "local" position)	1) remove 0.0002-mfd. condenser connected from one side of the "local-distance" switch to chassis
Intermittent reception	1) poorly-riveted contacts on audio coupling condenser 2) open-circuiting screen or cathode by-pass condensers in r-f stages
Noisy volume control, Intermittent reception	1) poor or corroded connection of copper strip to plunger of volume control
Weak reception	1) poor connection to 4-megohm resistor in detector secondary return circuit
Noisy tuning	1) corroded condenser gang rotor contacts
Inoperative receiver, (high positive control-grid voltages on r-f tubes)	1) corroded condenser gang rotor contacts. Bond rotors to chassis with flexible wire pigtails
No reception, Weak reception on lower end of dial	1) shorted screen-grid by-pass condensers 2) readjust trimmers on tuning condenser

BRUNSWICK 16

See also case histories listed for Brunswick 11, 12

Noisy volume control	1) dirty contacts inside of volume control. Take apart and clean
Weak reception	1) detector plate resistor carbonized

BRUNSWICK 17 SERIES

See also case histories listed for Brunswick 11, 12

Inoperative, (tubes light up)	1) high-voltage short circuit to speaker frame

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BRUNSWICK 17 SERIES (cont'd)

Inoperative (Cont'd)	2)	grounding of 14,000-ohm screen-grid resistor located in the right half of the chassis between the two coil shields
	3)	change in value of the two 5,000-ohm resistors in the oscillator stage. Replace with new units
	4)	short-circuited 0.5-mfd. condenser in the plate circuit of the oscillator stage
Intermittent reception, (set becomes operative when someone walks across the floor)	1)	peeling of tuning condenser plates, causing intermittent short-circuits between them. Burn with high voltage—all terminals disconnected
Weak reception	1)	open-circuited r-f and i-f control-grid return circuits
	2)	open-circuited by-pass condensers
Distortion, Weak reception	1)	intermittent cathode-to-heater short-circuit in the type '51 second detector tube. Replace with new tube
Fading, (several seconds after intensity of signal builds up to high level; resuming normal operation after a few seconds)	1)	slow-heating tube in the AVC stage, while the rest of the tubes are "quick heaters." Replace with quick heating tube
No control of volume, Distortion	1)	leakage between the can of the first electrolytic condenser and the chassis due to the poor fish-paper insulation
	2)	decrease in value of the screen-grid voltage dropping resistor, located between the two i-f transformers. This results in a consequent decrease in value of the two 5,000-ohm, 0.5-watt resistors which are used to obtain the oscillator plate voltage. Replace the former resistor with a 15,000-ohm wire-wound unit and the smaller one also with the same type unit
	3)	cathode-heater leakage in the r-f and i-f tubes. Replace with new tubes
	4)	speaker terminal shield short-circuiting to one or more terminals

BRUNSWICK 18

Same case histories as those listed for Brunswick 11, 12 and 16

BRUNSWICK 22

See also case histories listed for Brunswick 15

Fading ....1) connecting lug of input winding on one of the r-f coils short-circuiting to shield can intermittently. Insulate the lugs with tape to eliminate recurrence of this trouble
2) corroded joints at the local-distance switch. Replace with new unit
3) defective "Bradley" unit tone control. Replace with a new unit

BRUNSWICK 21

Same case histories as those listed for Brunswick 14

BRUNSWICK 24

Same case histories as those listed for Brunswick 17

BRUNSWICK 31

Same case histories as those listed for Brunswick 14

BRUNSWICK 32

Same case histories as those listed for Brunswick 15

BRUNSWICK 33

See also case histories listed for Brunswick 11, 12

Radio reception interference during playing of records ......1) lead to "change-over switch" snapped

BRUNSWICK 42

See also case histories listed for Brunswick 15

Mechanism stops after few revolutions ......1) adjust cycle switch

Mechanism slows down or stops during operation cycle ......1) clean motor brushes and commutator

Records reject continuously ......1) jammed solenoid plunger
2) insufficient tension of stop lever spring

Strong vibration, Mechanical hum ......1) solenoid improperly centered
2) hardening of rubber damper in solenoid

Record rejecting mechanism inoperative (motor operates) ......1) burnt-out or open-circuited solenoid
2) too much tension on stop lever spring

Records are not rejected....1) contacts on tone-arm switch fail to open,

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BRUNSWICK 42 (cont'd)

Records not rejected (Cont'd)	usually because they are set too close together. Adjust the contacts so that they open when the end of the record is reached
Record-rejecting mechanism resumes another rejecting cycle immediately after completing one and before record is played	1) defective contact blades on the cycle switch, which fail to open when the cycle is ended. Adjust the switch so that the contacts will open when the cycle is ended
Pick-up lowers off record	1) cabinet not level
Pick-up lowers past first record groove	1) cabinet not level 2) tension of suspension arm spring too great
Needle does not slip into first record groove	1) insufficient tension of suspension arm spring
Mechanism jams, Records jam, Records split	1) record gate incorrectly adjusted 2) records warped

BRUNSWICK 81, 82

Same case histories as those listed for Brunswick 14

BULOVA M501

Same case histories as those listed for TCA Chassis

BREMMER TULLY 82

Low volume	1) open-circuit in one of the wires to the ballast tube 2) short-circuited r-f cathode by-pass condenser. Replace with a 0.5-mfd. unit

CADILLAC MASTER 1935

Large 2,000-ohm resistor burns out	1) secondary of last i-f coil short-circuiting to primary. Replace with new i-f transformer

CAMDEN 1480, 2480

Same case histories as those listed for Clarion 480

CAPEHART 400 SERIES

(Automatic phonograph record changer section of receiver)

Records keep rejecting......1)	automatic-stop trip lever needs oiling
2)	hair-spring on clutch-throwout lever broken
3)	clutch gears set too close
Records do not hit spindle..1) correctly	adjust record tray
2)	adjust magazine
Pick-up arm does not set....1) on records correctly	Adjust pickup arm lever hook
"On-Off" and phono- .....1) graph switch defective	fibre insulation worn. Take apart and back it up with metal; be sure it does not ground to shaft

CHAMPIONETTE 5 TUBE MIDGET

Inoperative a few min- ..1) utes after being placed in operation, Fading	decrease in value of 25,000-ohm resistor connected between the plate and screen grid of the detector tube. Replace with new unit

CLARION A.C.-D.C. 5 TUBE RECEIVER

Low volume ....1)	defective detector-plate load resistor. Replace with a new unit

CLARION 40

See also histories listed for TCA Chassis

"Popping" noise while .....1) set is warming up	replace the 1-megohm grid resistor with a ½-megohm unit
Uneven control of .... 1) volume	defective volume control potentiometer. Replace with a new 5,000-ohm unit
2)	connect a 100- or 200-ohm resistor in series with the volume control and chassis, so as to prevent the possible reduction of grid-bias to zero
Poor selectivity ....1)	short-circuited volume control
2)	burnt-out antenna coil. Rewind with silk-covered wire
Oscillation ....1)	connect a 0.002-mfd. condenser from one side of power line to chassis
Excessive hum ....1)	loose laminations in the filter choke

CLARION 51, 52, 55

Oscillation, ...1) Intermittent reception, Noisy reception	open-circuited or leaky r-f cathode by-pass condenser

CLARION 90, 94, 95

Weak reception, (tubes and voltages check O.K.) ....1)	replace the 0.05-mfd. (0.02-mfd. in models 94, 95, 160) condensers connected in the r-f and first detector tube grid-return circuits. These constitute part of the antenna and first detector coil assemblies. Remove the cans and replace
Inoperative ....1)	defective 500,000-ohm resistor connected between the plate of the AVC tube and the r-f filament circuits. Replace with a unit of higher wattage rating

CLARION 100

Oscillator inoperative ....1)	defective type '24 detector-oscillator tube (even though it checks O.K.). Replace with a new tube by substitution. Re-align the receiver circuits

CLARION 160

Same case histories as those listed for Clarion 90, 94, 95

CLARION 220

Receiver dead, Inoperative ....1)	change in value of 4,000-ohm resistor between oscillator coil and cathode of the detector-oscillator tube. Replace with a new 1-watt unit
2)	change in value of 4,000-ohm bias resistor of type '24 autodyne tube, preventing it from oscillating. Replace with ½-watt carbon unit, soldering it to one end of chassis and by-passing it with a 0.001-mfd. condenser
3)	open-circuited or loose control-grid wire to the type '24A detector-oscillator tube. This is a short piece of 1,000-ohm wire inside a sheath, making it difficult to detect an open circuit. Connect a new lead with a 1,000-ohm, ½-watt carbon or metallized resistor in series

CLARION 280

Poor tone ....1)	incorrect connection at voice-coil or speaker field. Reverse connections at either point and note the effect

CLARION 300

Hum .... 1) loose laminations in filter choke
2) short-circuited, or partially short-circuited filter choke winding
3) air gap disturbed (strike core with hammer)

Oscillation, Motorboating .... 1) open-circuited 0.01-mfd. condensers by-passing first detector, first and second i-f secondary return-leads to ground

Intermittent oscillation, Intermittent motorboating, Weak reception .... 1) open-circuiting 0.01-mfd. r-f, first detector, first i-f and second i-f secondary return by-pass condensers

CLARION 480

Hum .... 1) loose laminations in filter choke
2) short-circuited, or partially short-circuited filter choke winding

Inoperative on short waves .... 1) "flat" oscillator tube. Replace with new tube

Distortion, Low signal strength, Poor neon tube action .... 1) replace "tun-a-lite" bulb

Fading, Intermittent reception, Intermittent distortion .... 1) poor contacts on "tun-a-lite" socket Replace socket.
2) defective grid filter condensers in r-f, i-f and first detector circuits
3) open-circuiting audio coupling condenser

Fuses blow, Type '5Z3 rectifier tube burns out .... 1) first section of dual filter condenser block leaky

CLARION 320

Fading, Set goes dead .... 1) tube shields touching the control-grid caps of the i-f or r-f tubes. Wrap pieces of fish paper around control-grid caps

CLARION 470

Intermittent reception, Distortion, Poor sensitivity .... 1) replace the present 10,000-ohm type '2A6 tube bias resistor with a 5,000-ohm unit

CLIMAX 4-Tube A.C.-D.C.

Low volume, Weak reception .... 1) open-circuit in the detector load resistor. Replace with a good 0.5-megohm, 1-watt unit. The detector plate voltage should be about 150-volts when the resistor has been replaced

COLONIAL 1933 MODELS

Microphonics	1) loosen nuts on the rubber-cushioned condenser mounting studs

COLONIAL 31

Set dead, No r-f bias voltage (even though r-f bias resistor tests O.K.)	1) open-circuited center-tapped r-f filament resistor, which is sealed in the power transformer case. Replace by mounting a 10- or 20-ohm center-tapped unit on the transformer terminals
Weak reception, Broad tuning	1) tuning condensers not synchronized
Hum at resonance, Oscillation	1) open-circuited 0.5-mfd. type '26 tube filament by-pass condensers
Fuses blow	1) short-circuited 1-mfd. line buffer condensers

COLONIAL 31 D.C.

Receiver cannot be switched off unless ground wire is disconnected	1) short-circuited 0.5-mfd. condenser in ground circuit

COLONIAL 32

Fading, Intermittent reception	1) open-circuiting 0.1-mfd. audio coupling condenser
	2) open-circuiting 0.1-mfd. detector secondary return by-pass condenser
	3) open-circuiting sections of *4407-P* by-pass block in audio circuit
	4) broken porcelain tuning-condenser mounting brackets
	5) loose or broken volume control resistance elements
	6) poor or unsoldered connections to the carbon resistor pig-tails
	7) open-circuited or leaky sections of first, second, third r-f and detector by-pass condenser blocks
	8) open-circuiting 750,000-ohm red carbon resistor in first r-f secondary return circuit
	9) defective type '26 tubes (even though they test O.K.). Replace with new tubes by substitution *Note*: fading in this receiver as a result of defective tubes is often due to the double tube shields which provide poor ventilation. It may be well to drill large holes in the shield to provide better dissipation of the heat. In any event, adequate ventilation should be provided for the tubes
Noisy reception	1) corroded or loose fuse-block clips
	2) volume control carbon resistor elements caked or cracked
	3) noisy 65,000-ohm carbon resistor in first audio plate circuit
Weak reception, Distortion	1) open-circuited detector cathode bias resistor
	2) open-circuited first audio cathode bias resistor
Poor tone, Weak reception	1) open-circuited or burnt-out field coil
Choked reception, Distortion (no output tube bias voltage)	1) open-circuited 100,000-ohm resistor in secondary return of push-pull input transformer
Weak reception at higher frequencies	1) tuning condensers not synchronized
Microphonic at resonance..	1) insert small felt washers between stator plates of tuning condensers
Oscillation, General instability	1) open-circuited 35,000-ohm resistor connecting from first r-f screen to chassis

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COLONIAL 32 (cont'd)

Reception of one or two stations over entire dial	1) tuning condenser shaft loose from pulley 2) broken tuning condenser drive
Inoperative	1) broken tuning condenser mounting brackets 2) antenna lead shorting to metal braid

COLONIAL 32 D.C.

Fading, Intermittent reception	1) open-circuiting 0.1-mfd. audio coupling condenser 2) open-circuiting 0.1-mfd. detector secondary-return by-pass condenser 3) open-circuiting sections of by-pass block in audio circuit 4) broken porcelain tuning condenser mounting brackets 5) loose or broken volume control resistance elements 6) poor or unsoldered connections to the carbon resistor pigtails 7) open-circuited or leaky sections of first, second, third r-f and detector by-pass condenser blocks 8) open-circuiting 750,000-ohm red carbon resistor in first r-f secondary return circuit
Poor selectivity	1) remove 750,000-ohm resistor from third r-f secondary return circuit

COLONIAL 33

See also case histories listed for Colonial 34

Low volume	1) receiver circuits out of alignment 2) open-circuited aerial connection 3) open-circuited 60,000-ohm screen-grid resistor section of the three-section voltage divider located near the two r-f screen-grid tube sockets. Replace with a 25,000-ohm unit in order to obtain an increase in volume
Low volume, Distortion, (low plate or screen-grid voltage; high grid-bias voltage)	1) change in value of "lavite" or graphite voltage-divider resistors or high-resistance contacts at their terminals. Check the resistance values and go over the connections with a soldering iron
Fading	1) loose elements in type '24 tubes. Replace by substituting new tubes 2) intermittently open-circuiting primary in the first audio transformer. Replace with new transformer
Inoperative, (no r-f plate or screen voltages)	1) open-circuited 15,000-ohm section of voltage divider
Inoperative, (no screen voltage)	1) open-circuited 60,000-ohm section of voltage divider
Inoperative, (no first-audio plate voltage)	1) open-circuited 50,000-ohm resistor in audio plate circuit
Inoperative, (no d-c voltages on any tubes)	1) open-circuited 210-ohm section of center-tapped resistor in high-voltage secondary return circuit
Inoperative, (no output tube plate voltage)	1) open-circuited 800-ohm bias resistor
Oscillation	1) open-circuited 50,000-ohm section of voltage divider 2) open-circuited 0.5-mfd. screen by-pass condenser 3) open-circuited 0.2-mfd. plate circuit by-pass condenser 4) open-circuited 0.2-mfd. first r-f, second r-f, or detector secondary-return by-pass condensers
No control of volume	1) cable of volume control shaft off pulley 2) volume control shaft pulley loose
Weak reception, Distortion	1) open-circuited 100,000-ohm resistor in secondary return circuits of first or second r-f transformers 2) open-circuited or burnt-out speaker field

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COLONIAL 33 (cont'd)

Weak over entire dial	1) open-circuited band selector coupling coil
Distortion, No output tube grid bias	1) open-circuited 100,000-ohm resistor in push-pull input transformer secondary return circuit
Intermittent reception, Fading	1) open-circuiting or leaky 0.2-mfd. r-f secondary return by-pass condensers 2) open-circuiting screen by-pass condenser 3) leaky r-f plate circuit by-pass condenser

COLONIAL 34

Oscillation, (r-f screen and plate voltages high)	1) open-circuited 50,000-ohm center section of voltage divider
Inoperative	1) open-circuit in one of the sections of the 121,000-ohm voltage divider resistor. Check each section carefully, replacing if defective 2) open-circuited 420-ohm center-tapped resistor (usually at the negative end) connected in the negative leg of the power supply, located between the two type '45 sockets. This may be short-circuited temporarily, but a replacement is advisable
Slight oscillation, (poor reception on the lower frequencies)	1) open-circuit in one of the 0.2-mfd. condensers located under the condenser gang shield and used as secondary return by-pass units. One terminal is soldered to each coil. Replace with new units if found defective
Distortion, Lack of grid-bias on the type '45 amplifier tubes	1) open-circuited grid-bias resistor — a 10,000-ohm carbon unit connected from the secondary center-tap of the input push-pull transformer to chassis. Replace with new unit
Low volume at high frequencies (tubes and voltages test O.K.)	1) open-circuit in one of the small bobbin coils used to couple the tuning unit more effectively. These are located in the antenna and first r-f units of the band-pass filter. Defect is usually at the lug
Oscillation	1) short-circuited section of voltage-divider resistor. Replace with new unit

COLONIAL 36 A.C.

Intermittent reception	1) leaky 0.25-mfd. by-pass condensers. Replace if defective 2) defective 0.5-mfd. condenser between the first audio transformer and cathode. Replace with a new unit 3) defective tube sockets, resulting in poor contact at tube base prongs. Clean and bend contacts or replace with new sockets 4) defective 0.1-mfd. coupling condenser. Replace with new unit 5) defective phonograph switch. Replace with a new switch 6) high-resistance grounds at r-f shields. Bond together all the grounding lugs with a piece of bus-bar and solder the latter in turn, securely to the chassis
Insensitive	1) open-circuited antenna winding in the first r-f coil 2) loose connection at the antenna-end terminal of the first r-f coil
Excessive hum	1) open-circuit or increase in value in the 400,000-ohm resistors connected between the grids of the type '45 push-pull tubes and the hum-balancing potentiometer. Replace the dual unit with single ½-watt resistor
Low volume, Distortion, Inoperative	1) replace the 350-ohm bias resistor connected between the chassis and first and second r-f tube cathodes, with a 1-watt carbon unit 2) replace the two 400,000-ohm grid leaks in the output tube grid circuits 3) replace the 60,000- and 100,000-ohm voltage-divider resistors.

COLONIAL 136

Type '25Z5 tube flashes	1) defective electrolytic condenser in power supply unit. Replace with a 225- or 250-volt unit 2) replace the 0.02-mfd. condenser across the plates of the type '25Z5 tube with a 400-volt unit 3) check the antenna series condenser. Connect a 0.001-mfd. unit in the circuit if one is not there

COLONIAL 250

Inoperative	1) defective heater cord 2) defective type '25Z5 tube
Hum	1) adjust speaker and grid leads (*Cont'd*)

COLONIAL 250 (cont'd)

No AVC action	1) open-circuit or change in value of AVC resistor connected in the circuit of the type '6B7 AVC tube. Replace with new unit

COLONIAL 300

Poor tone	1) defective condenser bank. Replace
Inoperative	1) replace dual 4-mfd. filter condenser

COLONIAL 601

Type '83 rectifier tube flashes	1) short-circuited electrolytic filter condenser. Replace with new unit 2) overloading of rectifier tube
Distortion	1) defective type '37 tube (even though it may test O.K.). Replace with new tube 2) defective type '37 tube resistor. Check all resistors in this circuit for changes in value

COLONIAL 654

No control of volume on local stations	1) connect a lead from the unused lug of the volume control to the point where the 0.001-mfd. condenser is connected to the antenna coil primary

COLUMBIA C-100A

Cuts off during the passage of strong signals Intermittent reception (voltage drops across the power supply and at plate of the power pentode tube)	1) defective type '47 tube (even though it may test O.K.). The insulation in this tube breaks down on strong signals, causing the cut-off. Replace with new tube

COLUMBIA SCREEN-GRID 8

Inoperative	1) open-circuited detector choke 2) short-circuited condenser in detector choke and condenser assembly 3) open plate choke in one of r-f circuits 4) short-circuited r-f coupling condenser
Oscillation	1) open screen-grid by-pass condenser 2) readjust compensating condensers
Loss of volume over a period of time	1) loose rotor section on the condenser gang. Drill and tap the condenser gang hub for a setscrew, in order to hold the rotor section in place

COLUMBIA SCREEN-GRID 9

Weak reception, "Frying" noise ....1) open-circuiting detector plate choke. Replace with new unit

COLUMBIA SCREEN-GRID 31

Same case histories as those listed for TCA Chassis

COLUMBIA 205, 310

Same case histories as those listed for Kolster K-20

CORONADO 7700

Distortion ....1) defective speaker
2) defective input transformer. Replace with new unit

COURIER 65

Oscillation ....1) connect a 0.1-mfd. condenser from the ungrounded contact of volume control to ground on chassis

1933 CROSLEY RECEIVERS

Inoperative after about ½ hour of operation, (tubes and voltages check O.K.) ..1) defective i-f transformer, damaged because of its close proximity to the tubes in the receiver. Replace with new unit

CROSLEY "BUDDY", "CHUM"

Inoperative ....1) open-circuited 10,000-ohm screen-grid circuit voltage-dropping resistor (wire-wound). Replace with a carbon unit even though the above resistor may test O.K.

CROSLEY "WASHINGTON"

Inoperative, No voltage on r-f tubes ....1) burnt-out volume control replace with new unit
2) burnt-out r-f voltage resistor

CROSLEY 5

Volume control inoperative ....1) replace defective 5,000-ohm volume control resistor

CROSLEY D-5

Noisy reception ....1) defective type '42 tube

Inoperative ....1) defective electrolytic filter condenser in power pack

(Cont'd)

CROSLEY 8H1

Excessive "hiss" between stations	1) replace 500-ohm type '6F7 tube cathode resistor with a 250-ohm unit 2) shunt a 2,000-ohm resistor across the cathode bias resistor of the type '6D6 tube nearest the power transformer

CROSLEY 30-S, 31-S, 33-S, 34-S

Inoperative	1) terminals of tube sockets short-circuiting to chassis, as holes admitting them are too small for safety. Enlarge the holes
Hum	1) leaky electrolytic condensers. Replace with new units
Low volume, Lack of sensitivity	1) decrease in value of 11,000-ohm resistors connected in parallel in the bleeder circuit. Replace with 5-watt units
Low volume, Poor tone	1) connect a 15,000-ohm resistor between the positive side of the detector plate resistor and ground

CROSLEY 40 A.C -D.C.

Excessive hum, (hum disappears when set is removed from cabinet)	1) condenser block punched by one of the screws which hold the chassis to the cabinet, thereby short-circuiting the condenser. When screw is removed, the hum ceases, since the condenser is no longer short-circuited

CROSLEY 40

Distortion after a few minutes of operation	1) defective 750-ohm resistor on the resistor strip causing improper bias on the type '45 tubes. The defect is apparent only when the receiver heats up

CROSLEY 40-S, 41-S

Low volume, Noisy reception	1) high-resistance connection between the tuning condenser rotor and the frame Solder flexible pigtails from the rotor shaft to the frame
Intermittent reception,	1) defective 0.5-mfd. r-f cathode by-pass condenser. Replace with new unit 2) defective coupling condenser between the plate of type '27 detector tube and the control-grid of the first a-f tube. Replace with new unit 3) broken solid-wire leads running from the voice coil to the connecting lugs. Replace with flexible leads

CROSLEY 42, 42A

No reception, (no r-f plate voltage)	1) short-circuited r-f by-pass condenser 2) open-circuited 1,400-ohm r-f resistor
Hum	1) defective Mershon condenser
Oscillation	1) readjust balancing condensers
Irregular noises when tuning	1) clean variable condenser plates and solder a pig-tail lead from rotor to chassis
Fading	1) clean volume control contacts and strip

CROSLEY 42 (Using 45-mil. "Dynacoil" Speaker)

Low volume, Poor sensitivity	1) change in value of 6,000-ohm carbon resistors. Replace with 10-watt wire-wound units

CROSLEY 42-S

See also case histories listed for Crosley 40-S

Distortion Poor tone	1) low detector tube grid-bias voltage due to leakage between sections of the dual 0.5-mfd. by-pass condenser across the detector and first a-f bias resistors

CROSLEY 53

Inoperative (type '45 tube grid-bias resistor smoking)	1) defective 0.5-mfd. condenser connected between the speaker voice coil and the type '45 tube grid-bias resistor terminal. Replace with new unit

CROSLEY 54

See also case histories listed for Crosley 53

Audio "howl" (normal operation restored when the analyzer cable is plugged into the circuit)	1) change in value of the 150000-ohm coupling resistor connected between the detector plate choke and the audio coupling condenser, and one side of the a-f choke. Replace with new unit
Intermittent oscillation when analyzer is plugged into power tube socket (plate voltage decreases and grid-bias increases when this condition occurs)	2) change in value of the 1-megohm type '45 tube grid resistor. Replace with new unit
Low volume	1) leaky 0.1-mfd. condenser between the plate of the detector tube and grid of the audio tube. Replace with a new unit if the leakage resistance is more than 50- or 75-megohms *(Cont'd)*

CROSLEY 54 (cont'd)

Poor sensitivity .... 1)	replace the 150,000-ohm detector plate resistor with a 300,000- or 400,000-ohm unit

CROSLEY 58

Fading .... 1)	rewire the filament circuits with direct connections instead of leaving one side grounded
Distortion .... 1)	disconnect the detector screen-grid from the r-f screen grids, connecting it to the detector plate in series with a 250,000-ohm resistor and by-passing it to ground with a 0.25-mfd. condenser
Inoperative, ... 1) (switch has to be put off and on a number of times before receiver starts), (tubes and voltages test O.K.) Insertion of the analyzer cable or test prods starts the receiver operating	defective detector grid-bias resistor by-pass condenser. It is usually short-circuited, but is cleared up by the least change of voltage. Replace with new unit

CROSLEY 82-S

Same case histories as those listed for Crosley 40-S

CROSLEY 102 AUTO RADIO

Oscillation .... 1)	defective type '6B7 second detector tube, having low emission. Replace with new tube
Inoperative .. .. 1)	short-circuited 0.1-mfd. condenser across power transformer secondary

CROSLEY 122

Type '24 oscillator tube 1) fails to oscillate at low frequency end of dial	shunt a 1-watt, 750-ohm resistor across 650-ohm volume control and replace with type '24A tube

CROSLEY 124

High control-grid bias on the r-f and i-f tubes ....1) change in value of grid-bias resistors. Connect a 400- to 750-ohm resistor between the volume control and ground, which will keep the bias under control

Inoperative ....1) open-circuited 2,000-ohm flexible resistor between the cathode of the oscillator tube and ground. Replace with new unit

Intermittent reception, (set resumes normal operation after being inoperative for several hours) ....1) defective "bathtub-type" can type condenser unit located underneath several other units. Replace with new unit

Noisy reception, Intermittent reception ....1) defective volume control. Install a new 5,000-ohm unit

Low volume ....1) defective 15,000-ohm r-f and i-f tube screen-grid resistors. Replace with new unit

Fading ....1) defective 4-section 0.1-mfd. condenser block. Usually requires complete replacement

"Rasping" tone, Low frequency howl ....1) distorted voice coil, rubbing against pole pieces. Replace with new coil

Oscillation when light is snapped on or off anywhere in house ....1) move position of type '47 tube grid wires from between socket terminals of the type '27 detector tube and type '51 tube screen terminal to a position near the detector choke

CROSLEY 124J

Impossible to align at 175-kc ....1) grounded or short-circuited winding on first i-f transformer. Replace with new unit
2) defective type '27 oscillator tube. Replace with new tube
3) check phasing of twin speakers

CROSLEY 124-1

Fading, Intermittent reception ....1) high leakage in one of four 0.1-mfd. condensers located in condenser block *No. W22412*
2) defective two 0.25-mfd. units and 0.5-mfd. unit in block *No. W23736*.

CROSLEY 126-1

Distortion ....1) defective audio coupling condenser
2) speaker out of adjustment

CROSLEY 129

Oscillation at high frequencies (tubes and voltages test O.K.)	1) change in value of critical 200-ohm fixed portion of volume control. Replace with new volume control unit

CROSLEY 130

Reception drifts off frequency setting of tuning dial	1) leaky or open-circuited 8-mfd. 300-volt filter condenser. Replace with new unit of higher voltage rating
	2) leaky or open-circuited 4-mfd. 150-volt screen-grid condenser. Replace with new unit
	3) adjust the oscillator trimmer condenser

CROSLEY 132 "CHIEF"

Low volume, (tubes and voltages test O.K.)	1) short-circuited 0.0001-mfd. condenser between the cathode of the '56 tube used as a diode-detector and the 5-megohm resistor. Check the latter unit for change in value also

CROSLEY 132-1

No AVC action	1) defective 0.15-megohm resistor (*R-4*). Replace with new unit

CROSLEY 137

Insensitive, No distant reception	1) defective oscillator coil. Replace with new unit

CROSLEY 146

Insensitive, Weak reception on local stations, No distant reception, (voltages test O.K.)	1) open-circuited 12-mfd. condenser section of dual 12-6 mfd. cardboard-encased filter unit. Replace with a 400-volt unit

CROSLEY 148

Set dead ....1) charred or open-circuited 750-ohm type '42 tube bias resistor. Replace with a new unit
2) short-circuited 6-mfd., 300-volt and 8-mfd., 25-volt dual electrolytic filter condenser. Replace with new unit

Distortion, (high current flow in the plate circuit of the output tube) ....1) grounded speaker winding

Inoperative below 1200 kc, Volume control inoperative past first ½-revolution, Oscillation all over dial ....1) defective 6—8-mfd. electrolytic condenser (even though it may test O.K.). Substitute a unit of higher voltage rating and note result

Weak reception ....1) defective tone-control condenser

Intermittent reception ... 1) dirt in padding condenser causing a high-resistance short-circuit. Clean unit with Carbon Tetrachloride

CROSLEY 159

Set dead ... . 1) burnt-out resistor in the cathode circuit of the type '43 output tube. Replace with a new unit

CROSLEY 163

Low volume (plate voltage of type '77 second detector tube drops to about 5-volts) ....1) open-circuited 3-megohm and 300,000-ohm plate load resistors in the type '77 tube circuit. Replace with new units

CROSLEY 167

Distortion, Low volume ....1) leakage between filter condensers and the type '2A5 tube cathode bypass condenser section. Both of these units are contained in a common can

Chassis smokes, Inoperative ....1) short-circuit between the positive terminals of the 6-mfd. condenser connected between the output transformer primary and ground and the 8-mfd. condenser connected between the cathode and ground. This places a heavy load on the 750-ohm flexible resistor connected between cathode and ground, causing it to burn out. Replace the resistor and the condenser units(*Cont'd*)

CROSLEY 167 (cont'd)

Inoperative	1) insulate leads to the dial-lamp socket with spaghetti. The original leads often ground to the chassis
	1) defective electrolytic filter condenser. Replace with new unit
Weak or intermittent reception on low frequencies	1) short-circuited 0.1-mfd. condenser across 3,500-ohm resistor in the cathode circuit of the type '58 first detector-oscillator tube

CROSLEY 170 DUAL TEN

See also case histories listed for Crosley 171

Oscillation, (ceases when the finger is placed on the cap of the first type '58 tube)	1) open-circuited r-f oscillator coil located behind the hand switch

CROSLEY 171

Noisy reception, Loss of volume	1) defective 0.0005-mfd. tubular condenser in series with antenna coil
Inoperative	1) defective triple 8-mfd. filter condenser unit (part *No. W-29097*). Replace with the improved part *No. W-29097-A*
	2) defective 8,500—25,000-ohm "Candohm" resistor (part *No. W-28471*). Replace with new unit
	3) defective rectifier tube as a result of the above condition. Replace with new tube
No AVC action, Poor volume	1) defective section in "Candohm" resistor. Replace with new unit (part *No. 28471*)

CROSLEY 175

Inoperative on lower frequencies	1)	replace 7,000-ohm cathode resistor in the oscillator circuit with a 5,000-ohm unit. Re-align the i-f amplifier

CROSLEY 178

Tubes burn out when the set is switched off, Inoperative	1)	short-circuited resistor between one side of the filament circuit and ground
	2)	short-circuited "safety" resistor connected between the movable arm of the volume control potentiometer and the ground The above condition causes the 22.5-volt "C" battery to be connected across the filaments when the switch is turned off

CROSLEY 305 CHASSIS

Noisy reception, Unstable operation	1)	change in value of the 11,000-ohm stabilizing resistors connected in parallel from the B-plus terminal of the audio transformer to ground. Replace with new units
Intermittent reception	1)	intermittently open-circuiting heater in the type '27 first audio tube. Replace with new tube
	2)	intermittently short-circuiting 0.5-mfd. detector cathode resistor by-pass condenser, resulting in no bias on the type '27 detector tube. Replace with a new unit
	3)	decrease in value of 55,000-ohm first detector plate supply resistor. Replace with new unit
	4)	leaky 0.001-mfd. r-f by-pass condenser connected between plate and cathode of the first detector tube. Replace with new unit
	5)	leaky a-f coupling condenser between the first detector plate choke and the control grid of the first audio tube
	6)	leaky electrolytic condensers. Replace with new units

CROSLEY 515

Weak or intermittently weak reception	1)	defective dual 0.02-mfd., 200-volt type '6D6 tube cathode by-pass condenser (even though it may test O.K.). Replace with a new unit

CROSLEY 609, 610

Oscillation	1)	readjust angles or positions of r-f coils

CROSLEY 609, 610 (cont'd)

Noisy tuning	1) corroded condenser gang rotor shaft tension spring. Connect a flexible pigtail between the condenser rotor and chassis
Distorted reproduction	1) open-circuited 10,000-ohm resistor in secondary return circuit of output tube
Lack of sensitivity or selectivity	1) readjust angles or positions of r-f coils

CROSLEY 706

Noisy tuning	1) corroded condenser gang rotor shaft tension spring. Connect a flexible pigtail between the condenser rotor and chassis
Noisy reception	1) clean volume control resistance element and contact arm
Oscillation, General instability	1) open-circuited type '226 tube filament by-pass condenser
Inoperative, High voltage output shorted	1) filter choke leads shorting to chassis 2) speaker field pin jacks shorting to chassis
Inoperative, No plate voltage on the first a-f tube	1) loose spring contact at plate prong of first a-f tube socket. Repair or replace with new socket
No reception, (no r-f plate voltage)	1) shorted r-f by-pass condenser
Hum	1) defective Mershon condenser
Weak reception and oscillation	1) readjust balancing condenser
No r-f plate voltage	1) replace 3,250-ohm, r-f resistor

CROSLEY 804 (JEWELBOX)

Distortion about 20 minutes after receiver is switched on	1) leaky 0.25-mfd., 400-volt by-pass condenser connected from the B-plus cathode of the first type '27 a-f tube. Replace with new unit

CROSLEY 814

Distortion, Low volume, Inoperative	1) open-circuited section in 10,000-ohm "Candohm" resistor section connected between the screen circuits and ground

DAYFAN 5005-A

Oscillation between 1400- and 1500-kc ....1) connect a 0.01-mfd. condenser between the screen-grid on the first r-f tube and the ground post, insulating the ground post from the chassis. Make sure that the ground wire goes directly to the condenser and not to the post

DAYTON A.C. "NAVIGATOR"

Inoperative ....1) defective a-c switch. Replace with new switch

DE CHAMPE RECEIVERS

Loss of volume .... 1) magnetic speaker armature off center. Recenter the armature

DE-FOREST CROSLEY "ARIA" 740, "TROUBADOR" 750 "MINSTREL" 810

Loud hum .... 1) defective 3-section "Mershon" filter condenser. Replace with new unit or drill a hole in the hard rubber top and fill the can till about ½-inch from the top with distilled water, sealing up the hole with sealing wax

DE-FOREST CROSLEY (CANADIAN) "ARIA", "MELODY", "TROUBADOR"

Distortion at low volume ....1) decrease in resistance of 20,000-ohm, 2-watt carbon bleeder resistor connected between the r-f plate supply and the cathode of the audio tube. This causes overbiasing of the a-f tube. Discard the bleeder resistor and self-bias the tube with a 2,000-ohm, 1-watt unit

Low volume, Poor tone ....1) defective speaker voice coil
2) open-circuited field coil in speaker

DELCO 500, 630

Insensitive, No distant reception ....1) blocking of weak signals by noise-suppression circuit. Remove the grounded wire of the volume control and re-connect it to the cathode terminal of the type '6D6 tube. If this causes resulting audible vibrator noise, connect a 100-ohm resistor in series with the 275-ohm common '6D6 and 6B7 tube bias resistor

DE WALD "BAG"

Inoperative ....1) open-circuited ballast lamp. Replace with new lamp

DE WALD "DYNETTE"

Inoperative	1) defective line resistor. Replace with new unit

DeWALD 632 D.C.

Inoperative, Tubes do not light	1) burnt-out pilot light

DE WALD 802

Hum	by-pass condensers for the '2A5 and '2A6 tubes
Distortion on short-wave band	1) defective 0.05-mfd. type '2A7 grid return circuit by-pass condenser. Replace with new unit

EARL 21, 22 D.C.

Tubes blow, (r-f secondary coil burnt out)	1) antenna variometer shaft short-circuiting to chassis
Inoperative, Reversed plate readings on r-f and first audio tubes	1) short-circuited 2-mfd. filter condenser
Oscillation, Whistle	1) defective or open-circuited detector by-pass condenser

EARL 21, 31

Noisy reception	1) loosening of two screws fastened to bakelite strip which hold the variometer assembly in place
Inoperative, (no detector tube plate voltage)	1) open-circuited detector plate supply resistor. Replace with new unit

ECHOPHONE MODEL C

Poor sensitivity, Hum	1) substitute a type '56 tube in place of the type '27 tube
Inoperative, Oscillation	1) loose or bent socket prongs, causing poor contact at tube connection terminals

ECHOPHONE S-3, S-4

Low volume, Loss of sensitivity with volume control at maximum setting	1) open-circuited 1-megohm resistor connected from B-plus to the screen-grid of the type '24 detector tube. If defective, an increase in volume will be noticed when the unit is shunted with the fingers. Replace this resistor with a new unit 2) replace the r-f coils with litz-wound coils (used on the later type models). Re-aligning is necessary if this is done 3) replace the 1-megohm control-grid bias resistor located on the resistor panel, which is fastened on the side of the chassis, with a new carbon pigtail unit
Noisy reception, Low volume	1) defective tone control condenser. Replace with new unit 2) tuning condenser plates touching at certain positions. Bend these out so that they will not touch

EDISON C-2

(Same "case histories" as listed for Edison R-1, R-2)

EDISON C-4

(Same "case histories" as listed for Edison R-4, R-5)

EDISON R-1, R-2

Weak reception, No regeneration around 550-kc with regeneration switch in "ON" position, Intermittent distortion, (tubes and voltages test O.K.)	1) poor ground connections from 1.5-mfd. plate by-pass condensers located in center part of chassis near volume control coupling shaft. Solder pigtails from their common ground to chassis 2) solder pigtail from rotor of tuning condenser gang to ground on chassis 3) tighten antenna binding post 4) tighten bolts in gang condenser, being careful not to throw it out of alignment while doing so 5) tighten the two screws in single-turn voice coil under the speaker 6) weak or defective type '26 tubes 7) antenna too short 8) readjust compensating condensers 9) open-circuited grid-suppressors
Poor sensitivity, Low volume, Hum	1) replace type '27 detector tube and type '25 first audio tube with type '56 tubes, using the original 2.5-volt detector filament winding for heating the filaments of both tubes 2) remove the grid leak and condenser in

(*Cont'd*)

EDISON R-1, R-2 (cont'd)

the detector grid circuit, and bias that circuit with a 40,000-ohm, 1-watt resistor. This should be by-passed with a 0.1-mfd. condenser
3) re-bias the first audio tube with a 2,700-ohm resistor in the cathode circuit, by-passing it with a proper sized condenser
4) adjust hum controls

Intermittent reception .... 1) open-circuit in any one of the three 600-ohm grid suppressors
2) short-circuited trimmer condenser on the condenser gang
Test for the above by tuning in a station and with volume control at maximum setting, move the trimmers slightly with an insulated tool and listen for any change in volume. Repeat the same with the suppressors

Inoperative, (all resistors and other components check O.K.) .... 1) open-circuited 3-mfd., 1,000-volt filter condenser section, connected from one side of the high-voltage secondary to center-tap of the type '81 tube filament winding
2) "open" type plate resistor in '226 tube circuit
3) "open" bias resistor in '250 tube circuit

Noisy reception .... 1) arcing between coil and core of plate transformer
2) arcing in type '226 tube plate resistor

EDISON R-4, R-5

Poor tone, Condensers blow, Plate voltages high .... 1) open-circuited 10,000-ohm "loss" resistor in power pack. This resistor should be checked frequently, as it is the cause of most trouble in these sets

Hum, Distortion .... 1) filament winding of type '45 tube short-circuiting to the filament winding of the type '27 detector tube, depriving the '45s of their biasing voltage, since the center tap of the '27 tube is normally grounded. Repair by shifting the center tap on the type '27 tube from the ground to the type '45 filament winding center tap

EDISON R-6, R-7

Weak reception, (low plate voltages on all r-f tubes)	1) short-circuiting of 0.05-mfd. condenser located in the detector filter unit, which is connected from the third r-f tube plate to ground
Inoperative, (very low or no screen voltage in r-f stages)	1) short-circuited 0.5-mfd. condenser located in r-f filter unit connected between second and third r-f tube screens to ground
Rumbling or drumming sound on low audio frequencies	1) voice coil striking field coil housing at the bottom of the voice coil passage. Insert thick cardboard washer to give voice coil more travel distance
Intermittent reception, (stations tune in faintly then burst through strong and clear), (no detector tube plate voltage)	1) intermittent grounding of r-f choke to case, causing a short-circuit to ground and the cut-off of the plate supply on the first detector tube
Intermittent reception	1) loose type '27 tube socket contacts. Tighten the contact springs, or replace socket 2) defective phono switch. Replace with new switch 3) defective power switch. Replace with new switch 4) tighten all hexagonal nuts on power pack connector panel

EDISON-BELL 35

Hum	1) replace power transformer with one having an electrostatic shield or connect two 0.25-mfd., 600-volt condensers in series across the a-c input, grounding their common connection to the chassis 2) open-circuited grounding lead to electrostatic shield

EMERSON AC-7, M-AC-7

Oscillation, Weak reception	1) drop in value of 12,500-ohm, 2-watt resistor. Replace with a 10-watt wire-wound unit 2) leaky screen-grid by-pass condenser
Hum	1) partial short-circuit on high-voltage winding of power transformer, throwing the center-tap off

EMERSON D-S5 (CHASSIS)

Intermittent reception, Noisy reception, Fading	1) volume control contacts internally loose 2) open-circuiting audio coupling condensers
Distorted reproduction, High output grid-bias voltage	1) open-circuited 250,000-ohm resistor connected across field coil in series with another resistor
Distortion, Output tube grids glow, Low grid-bias voltage on output tube	1) leaky grid filter condenser in output stage

EMERSON L-A

(Same "case histories" as listed for Emerson 415, 416)

EMERSON L-AC-5

Oscillation (tubes and voltages test O.K.)	1) replace condenser *C-7* with a 0.0005-mfd. or higher unit

EMERSON "MICKEY MOUSE"

Hum	1) connect a high-capacity condenser between one side of the line and the chassis. Change the position of the 0.0001-mfd. coupling condenser, placing it where the hum is least audible while the receiver is in operation.

EMERSON U-6D (CHASSIS)

Receiver drifts off frequency, (trouble appears only when set is in cabinet)	1) overheating of midget-type compensating condenser in series with broadcast oscillator coil. Drill ⅝" hole in cabinet near condenser to ventilate it

EMERSON V-4

Insensitive, Low volume on low frequencies (tubes and voltages test O.K.)	1) defective antenna pickup coil. Move coil either up or down over secondary of first tuned r-f stage until the most satisfactory result is obtained, then cement the coil in that position 2) antenna and interstage circuits out of alignment

EMERSON 4-TUBE A.C.-D.C.

Distortion, Low volume	1) defective condenser connected between the plate and cathode of the type '38 a-f tube. This is usually a short-circuited unit. Replace with a 0.004-mfd. condenser

EMERSON 20A, 25A

Loud crackling noise after being in operation about an hour	1) intermittent short-circuit to chassis caused by a large lump of solder on one of the filter-choke lugs. The heat developed in the set after it is in operation for some time causes the fibre terminal strip on which the lug is mounted to bend toward the chassis, causing the intermittent short-circuit 2) defective 4-mfd. filter condensers. Replace with new units

EMERSON 26

Partial or intermittent distortion, Whistling	1) defective 15,000-ohm, ¼-watt screen voltage dropping resistor of type '57 second detector tube. Replace with 1-watt unit

EMERSON 38

(Same "case histories" as those listed for Emerson U-6D chassis)

EMERSON 39

(Same "case histories" as those listed for Emerson D-S5 chassis)

EMERSON 42, 49

(Same "case histories" as those listed for Emerson U-6D chassis)

EMERSON 59

(Same "case histories" as those listed for Emerson D-S5 chassis)

EMERSON 415, 416

(Same "case histories" as those listed for Emerson V-4)

EVEREADY 1, 2, 3

Weak reception, Distortion	1) open-circuited 50,000-ohm detector plate supply resistor
Noisy reception	1) noisy 50,000-ohm detector plate supply resistor 2) noisy primary winding of a-f transformer
Motorboating, Oscillation	1) connect additional 1-mfd. by-pass condensers from either side of detector plate supply resistor to chassis
Hum at resonance	1) open-circuited supply line by-pass condenser
Intermittent reception	1) loose lug on front of first condenser stator section 2) variometer connection lead short-circuiting to chassis

EVEREADY 30, 40

Oscillation at high volume level	1)	adjust variometer on end of condenser gang shaft by loosening mounting screws and turning stator of variometer
	2)	check line voltage
Intermittent reception	1)	intermittently open-circuiting winding on speaker voice coil, opening with the vibration of the speaker. Rewind or replace the voice coil

EVEREADY 50

High-resistance section of dual volume control burns out	1)	substitute a 50,000- or 75,000-ohm, 2-watt fixed resistor for the defective section. Replacement of complete unit is unnecessary

EVEREADY 52, 53, 54

Noisy tuning, Oscillation	1)	corroded variometer rotor contact
Weak reception at high or low frequencies	1)	variometer out of adjustment
Noisy reception	1)	noisy 0.001-mfd. detector plate by-pass condenser
Hum	1)	add filter condenser from either side of speaker field to chassis
	2)	short-circuited choke "tuning" condenser
Weak reception	1)	control shafts short-circuiting to metal panel
High plate current	1)	open-circuited grid suppressors

FADA KU

Intermittent distortion	1)	intermittent high-resistance short-circuit between the primary and secondary of the input push-pull transformer. Replace with a new unit

FADA RK-101 MOTOSET

Noisy reception	1)	poor shielding of leads running from power unit to receiver. See that the metal sleeve is properly grounded to the car frame; it should be bonded at several points

FADA (CANADIAN) W-452X

Distortion at low volume	1)	overloading in the r-f section. Remedy: slightly detune the first r-f stage

FADA 10, 11

Noisy reception,	1) noisy first or second a-f transformer primary
Inoperative, Weak reception	1) shorted or grounded lugs of r-f coils 2) readjust balancing condensers
No reception, (low "B" voltage, or no r-f plate voltage)	1) short-circuited filter condenser in block 2) short-circuited r-f by-pass condenser
Poor selectivity	1) open- or short-circuited wave-trap secondary coil
Fading	1) replace volume control
Loud hum, Poor tone	1) due to electromagnetic interaction between the first a-f transformer and the power transformer or filter chokes. Substitute a type '56 tube for the type '27 detector tube and "short" the grid leak and condenser. Insert a 30,000-ohm resistor, shunted by a 1-mfd. condenser between the detector tube cathode and ground. Remove the first a-f transformer and substitute in its place resistance-capacity coupling 2) pilot-light socket short-circuiting to chassis 3) pilot-light socket lug short-circuiting to chassis
Pitch melts out from power transformer	1) caused by heat generated by type '80 tube situated close to the transformer. Place a piece of asbestos board between the tube and transformer

FADA 16, 17, 20

Inoperative, Weak reception	1) lugs of r-f coils shorted or grounded to chassis
Noisy reception	1) noisy first a-f transformer primary
Intermittent reception, Oscillation	1) open-circuiting cathode or plate by-pass condenser (block)
Fading	1) noisy volume control. Replace with new unit
Weak reception,	1) readjust balancing condensers
No reception, (no plate voltage)	1) short-circuited filter condenser in block 2) short-circuited by-pass condenser

FADA 25, 25-Z

Fading	1) noisy volume control. Replace with new unit

(Cont'd)

FADA 25, 25-Z (cont'd)

Weak reception	1) readjust balancing condensers 2) defective 0.001-mfd. by-pass condenser between the plate and cathode of the type '27 detector tube. Replace with new unit
Intermittent reception, Oscillation	1) open-circuiting r-f cathode or plate by-pass condenser block
Intermittent reception	1) defective tinsel speaker cord 2) poor connection of speaker tinsel cord to phone tips
Inoperative, Weak reception	1) r-f coil lugs short-circuiting or grounding to chassis
No reception, (no plate voltage)	1) short-circuited filter condenser in block 2) short-circuited by-pass condenser
Hum, Distortion	1) open-circuited filter condenser 2) poor grounding of condenser block 3) short-circuited filter condenser block leads 4) pilot light socket short-circuiting to chassis 5) pilot light lug short-circuiting to chassis
Noisy reception	1) noisy a-f transformer primaries
"Frying" noise	1) replace the first audio transformer 2) reverse the a-c line plug. One side causes more hum than the other
Slipping dial	1) pour some powdered rosin between the discs and the engaging drum on the driving mechanism

FADA 30, 31

Same case histories as those listed for Fada 10, 11

FADA 32

Same case histories as those listed for Fada 16, 17, 20

FADA 35, 35B

Intermittent reception	1) open-circuiting r-f cathode or plate by-pass condenser (block) 2) defective tinsel speaker cord 3) corroded contact arms of double volume control 4) poor connection of speaker tinsel cord to phone tips
Oscillation	1) open-circuiting r-f cathode or plate by-pass condenser
Hum	1) open-circuited filter condenser 2) poor grounding of condenser block 3) short-circuited filter condenser block leads—rubber insulation cracked
Inoperative, Weak reception	1) r-f coil lugs short-circuiting or grounding to chassis
Noisy reception	1) noisy a-f transformer primaries
Hum, Distortion	1) pilot-light socket short-circuiting to chassis

FADA 41

Intermittent reception, Fading	1) open-circuiting r-f secondary windings (leads snapped at lug) 2) open-circuiting 0.01-mfd. audio coupling condenser
Weak reception	1) open-circuited 50,000-ohm resistor in diode detector plate circuit
Hum	1) open-circuited 0.5-mfd. detector amplifier cathode by-pass condenser 2) poor cathode-heater insulation of type '27 tubes
Distorted, Weak reception	1) leaky 0.01-mfd. audio coupling condenser
Inoperative	1) short-circuited 0.01-mfd. audio coupling condenser

FADA 43

Same case histories as those listed for Fada 41, 761

FADA 44, 46, 47

Same case histories as those listed for Fada 41

FADA 48-KW, 49-KW

Oscillation, "Howling," Fading	1) leaky by-pass condensers. Test for and replace all defective units

(Cont'd)

FADA 48-KW, 49-KW (Cont'd)

Low volume, Audio oscillation, (set plays when test prod is placed on plate terminal of second i-f tube)	1) poor contact between resistance element and movable arm on volume control, causing an increase in the value of the AVC circuit resistance, thus making it over-effective and causing a decrease in volume. Adjust the arm so it will make good contact

FADA 50

Same case histories as those listed for Fada 70, 71, 72

FADA 66

Oscillation on one or more short-wave bands	1) connect a 300-ohm, non-inductive resistor in series with the control-grid lead of the type '24A first detector-oscillator tube

FADA 70, 71, 72

No reception	1) short-circuited by-pass condenser located under variable condenser in shield can 2) open-circuited resistors in series with the plate voltage supplied to r-f coils
Intermittent reception, No reception	1) broken leads on loop antenna 2) open resistor in power pack

FADA 761, 762, 764, 766

Fading, Intermittent reception	1) open-circuiting r-f cathode by-pass condenser 2) open-circuiting r-f plate by-pass condenser 3) open-circuiting 0.5-mfd. screen by-pass condenser
Oscillation, Distortion at any volume level	1) open-circuited screen resistor connected from detector screen to chassis 2) resistor connected from detector screen to chassis changed to higher value

FAIRBANKS MORSE 238-T32

Noisy reception	1) vibrator unit mounted too tightly to chassis. Remount it, using two screws and insert ½-inch pieces of sponge rubber between each metal washer under the screw head, and the chassis

FEDERAL RECEIVERS (using types 201-A, 222 and 226 tubes)

Type 'BA rectifier tube burnt out, or requiring replacement ...1)	replace with a type '5Z3 rectifier tube. Reconnect the high-voltage leads to the grid and plate terminals on the tube socket and provide a 5-volt filament voltage by a step-down transformer or possibly by winding an additional secondary on the power transformer core. The positive lead is taken from one of the filament terminals

FIRESTONE 1322

Speaker rattle ...1)	loose solder in speaker
Microphonics ...1)	loosen rubber washers holding condensers
2)	tighten all nuts and screws
"Metal-case buzz," Rattle ...1)	loosen "Parker-Talon" screws, take cover off, bend, and replace

FORD-MAJESTIC

Intermittent reception while riding, (performs O.K. on test bench) ...1)	intermittent short-circuiting of tube caps to shields. Insulate the tops by means of paper or cardboard discs
Heavy "A" battery drain Fuses blow ...1)	leaky or short-circuited 0.01-mfd., 1,000-volt condenser connected across power transformer secondary. Replace with 1200-volt unit or two 0.02-mfd., 600-volt units if a single unit is not on hand
2)	check contacts for burned wires
3)	defective type '6Y5 rectifier tube. Replace with type '84 tube, changing socket to five-pin type and discarding wire connected to spray shield
Excessive noise ...1)	connect a 0.25- or 0.5-mfd. low voltage paper condenser directly across the rectifier filament

FORD-PHILCO N

Inoperative, (tubes and voltages test O.K.) ...1)	padding condenser soldering lugs on tuning condenser frame puncturing through insulating paper glued to can of fixed condenser beneath, thereby grounding out the i-f. Bend the lugs up and slip a heavy piece of insulating fibre under them

FORD-PHILCO 1934

Intermittent volume ...1)	wires to terminals on inside of i-f coils touching rivets of trimmers and changing condenser capacities. Rearrange the leads

FORD 35

Intermittent reception, Low volume ...1) header speaker cone leads short-circuiting to steel spring support

FREED EISEMANN NR-60

Noisy reception ....1) corroded variometer tap switch
2) loose carbon element of volume control

FREED EISEMANN NR-65, 78, 79

Intermittent reception, Fading ...1) corroded connection beneath rubber insulation at terminal of 500-ohm, 1-watt fixed bias resistor connected in series with the volume control, causing the resistance to vary from 500- to 25,000-ohms when the chassis heats up. Replace with new unit

Hum ....1) open-circuited type '27 tube heater center-tap-to-ground lead. Resolder the connection

FREED EISEMANN NR-80

No control of volume.......... 1) volume control contact arm not engaging resistor strip

Hum, Distortion ....1) hum controls shorting to chassis

Also same case histories as listed for Freed Eisemann NR-85

FREED EISEMANN NR-85

Noisy volume control .....1) connect a 2,000- or 3,000-ohm potentiometer across the antenna choke, enclosing the leads in a grounded shield.
2) adjust the third neutralizing condenser to a point at about 150 kc, just below oscillation

FREED EISEMANN 95

Low volume ....1) defective dynamic speaker field supply filter condenser or rectifier tube. Replace with new units

FRESHMAN EQUAPHASE

Oscillation ....1) equalizing condensers incorrectly adjusted

Broad tuning ....1) equalizing condensers incorrectly adjusted

Inoperative ....1) trimmer condenser stator plate or lug shorting to chassis
2) hum control contact arm not making contact to resistance

FRESHMAN EQUAPHASE G60S POWER UNIT

No plate voltage.......... 1) open resistors in power pack

No bias on type '71A .... 1) open-circuited resistors in power pack
tube

Inoperative .... 1) open-circuited resistors in power pack
Weak reception

Noisy reception .... 1) open-circuited 300-ohm equaphase resistor

Fading .... 1) defective volume control

FRESHMAN N

Inoperative .... 1) loose terminals on power pack connection strip

Fading, ... 1) loose terminals on power pack connection strip
No control of volume 2) replace volume control

No reception, ... 1) shorted r-f by-pass condenser
(low voltage)

Weak or no reception...... 1) defective pig-tail resistors

No reception .... 1) open-circuited output transformer

FRESHMAN 2N

Fading .... 1) loose or corroded connections at connecting terminals in the power pack, making intermittent contact. Go over these terminals and tighten each with a large screwdriver
2) open-circuited filament winding in power transformer. Re-connect the leads from this winding to any of the other windings of the same voltage. If the r-f and audio tubes are heated from the same winding, replace the 1800-ohm r-f bias resistor with a 500-ohm unit, since there is now more current flowing in this circuit

FRESHMAN Q-15

See also case histories listed for Freshman Q-D-16-18

FRESHMAN Q-16

See also case histories listed for Freshman Q-D-16-18

Intermittent reception, .. 1) defective type '22 tube biasing resistor. Replace with new unit
Fading 2) go over all socket connections, contacts and soldered joints for intermittent contacts

FRESHMAN Q-D-16-8, 3-Q-15, 3-Q-16

Noisy reception, Intermittent reception	1) open-circuiting flexible pig-tail resistors
Hum at resonance	1) poor type '222 tube
Broad tuning, Oscillation	1) incorrect adjustment of regeneration control

GALVIN

See receivers listed under "Motorola"

GEM A.C.-D.C.

Inoperative	1) defective speaker coil, usually open-circuited. Since the speaker here cannot be repaired, the unit should be replaced
Loud crackling noise after being in operation about an hour	1) poor connection at the lug of the filter choke

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(GENERAL ELECTRIC (AMERICAN)* RECEIVERS)

GENERAL ELECTRIC A-53*

Distortion, "Squawking" noise	1) short-circuited condensers *C-16* or *C-26*. Replace with new units
Inoperative	1) open or high-resistance contacts on band switch
Noisy reception, Hissing noise, "Birdies"	1) defective type '6K7 r-f tube (even though it may test O.K.). Replace with new tube

GENERAL ELECTRIC A-54

Oscillation, Distortion (at low frequency end of broadcast band with tone control at high-frequency setting *only*)	1) open-circuit or high-resistance connection at condenser *C27*. Resolder connections to this condenser and note the effect

* For Canadian General Electric Receivers, see the listings in the "General Electric (Canadian)" group. This follows immediately after the G. E. (American) receivers.

GENERAL ELECTRIC A-63

High voltage between type '6A7 or '6A8 tube and ground ....1)	open-circuit between shield pin of type '6K7 tube and socket resulting in an "open" ground contact. This causes the '6K7 to oscillate and draw grid current through *R-11*, resulting in the appearance of a d-c voltage across it and from the type '6K7 or '6A7 tube to the control-grid ground.
Noisy reception at high volume causing interference in other sets ..1)	filings in air-gap of speaker
Hum ....1)	shield the control-grid wire of the type '6F5 tube
Distortion ....1)	open- or partially open-circuited 250,000-ohm type '6F5 tube plate resistor (*R8*)

GENERAL ELECTRIC A-64

Severe a-c hum ....1)	electrostatic shield of the electrolytic by-pass condenser (*C23*) touching the high a-c voltage terminal of the type '5Z4 rectifier tube and making contact with it. Move the condenser away from the terminal and wind tape or insulating paper over the shield
Intermittent reception, Inoperative ..1)	open or high-resistance contacts on band switch due to decrease in tension of springs behind contacts. Bend the springs with long-nosed pliers toward the stationary section of the switch
2)	dirty contacts on band switch. Clean contacts with abrasive paper and wipe off with a cloth. Do not use any kind of lubricant on switch. If it works stiffly, oil the *external* moving parts *only*
Better reception on local stations with the type '6H6 tube removed ......1)	open-circuited secondary in the second i-f transformer

GENERAL ELECTRIC A-65

Same "case histories" as listed for General Electric A-63

GENERAL ELECTRIC A-67

See also "case histories" listed for General Electric A-64

Noisy reception developing into distortion ....1)	defective ½-megohm type '6F6 tube grid resistor (even though it may test O.K.). Replace with new unit

GENERAL ELECTRIC A-82, A-86, A-87, A-88

Loss of volume, Poor selectivity, (abnormally high screen voltage on the type '6K7 i-f tube)	1) open-circuited 10,000-ohm resistor section (*R18*) or tapped resistor (*R11, R17, R18*)
No signals on all bands, Static	1) short-circuited 0.1-mfd. condenser in "sentry box"
Inoperative on "C" band, (operates perfectly on all other bands)	1) open-circuited 0.0013-mfd. condenser (*C21*), preventing the receiver from oscillating on that band

GENERAL ELECTRIC A-125

Inoperative, (audio amplifier alive)	1) short-circuited type '6K7 tube in AVC circuit
No DX reception	1) short-circuited "permaliner" condenser. Test each circuit in chassis separately with oscillator to trace this trouble
Poor tone on "E" band (18—40-mc),	1) no fault of receiver. Due to inadvertant frequency modulation of transmitter
Tuning dial off calibration, Tuning meter functions erratically, Low volume, Poor tone, Poor short-wave reception	1) defective type '6L7 tube. (Even though it tests O.K.). Replace with new tube

GENERAL ELECTRIC A-205, A-208

Distortion, Poor tone	1) improper phasing of dual speakers. Reverse the connections on one of the voice coils
Speaker rattle or "buzz"	1) unevenly tightened speaker mounting bolts. Speaker cone warps as a result of an excessively tightened bolt, causing the voice coil to be thrown off center

GENERAL ELECTRIC B-40

Intermittent reception Vibrator "hash"	1) defective vibrator. Replace with new unit

GENERAL ELECTRIC BX-41

Same case histories as those listed for RCA-Victor R-17-M

GENERAL ELECTRIC C-41

Regeneration in a-f circuit, (intense shrillness present when set is operated at half volume) ....1)	reverse input or output leads in interstage transformer, thereby changing the phase of the transformer and preventing coupling with some other part in the receiver

GENERAL ELECTRIC C-61

Periodic oscillation ....1)	defective type '6D6 tube
2)	defective type '41 tube

GENERAL ELECTRIC GE-118

Continual frying noise with volume control at either minimum or maximum setting, ...1)	induction from a-c transformer leads running under resistors. Using an insulated screw driver, move the leads out until the noise stops

GENERAL ELECTRIC H-31

See also case histories listed for Radiola 80 and Westinghouse WR-5

Intermittent reception ..1)	defective i-f transformer primary. Usually occurs in the second i-f transformer
Distortion on local stations at low volume settings of the volume control ....1)	drop in value of 110,000-ohm unit on resistor strip
Crackling noise ....1)	metal filings between tuning condenser plates. Clean out with a pipe cleaner

GENERAL ELECTRIC H-32

Same case histories as those listed for RCA-Victor R-50

GENERAL ELECTRIC H-51, H-71

Same case histories as those listed for General Electric H-31

GENERAL ELECTRIC H-72

See also case histories listed for Graybar GB-100

Intermittent reception, Low phono volume ......1)	corroded contact segments of radio-phono transfer switch

GENERAL ELECTRIC J-70

Same case histories as those listed for RCA-Victor R-4

GENERAL ELECTRIC J-75

Same case histories as those listed for RCA-Victor R-4

GENERAL ELECTRIC J-80

Same case histories as those listed for RCA-Victor R-8

GENERAL ELECTRIC J-83, J-83A

See also case histories listed for RCA-Victor R-73

Fading ....1)	replace 50,000-ohm resistor under the r-f coil with a 60,000-ohm unit and resolder all oscillator coil connections

GENERAL ELECTRIC J-85

Same case histories as those listed for RCA-Victor R-8, R-10

GENERAL ELECTRIC J-87, J-87A

See also case histories listed for RCA-Victor R-73

GENERAL ELECTRIC J-88

Fading, Intermittent reception ....1)	open-circuited or leaky r-f, 1st detector and i-f secondary-return by-pass condensers
Oscillation, Motorboating, Station hiss ....1)	corroded condenser-gang rotor contacts
2)	open-circuited r-f, 1st detector and i-f secondary-return by-pass condensers
Motorboating ....1)	leaky r-f, 1st detector, and i-f secondary-return by-pass condensers

GENERAL ELECTRIC J-100

See also case histories listed for RCA-Victor R-74

Hum when stations are tuned in ..1)	cathode short-circuits in the type '56 and '58 tubes, caused by high voltage surges on fluctuating line voltages. Install voltage regulator resistors to prevent wide voltage variations
Oscillation ....1)	open-circuited 10-mfd. condenser with yellow lead connecting the volume control lug. (*Note*: watch the polarity in replacing, as the ground in this receiver is positive.)

GENERAL ELECTRIC J-105

See also case histories listed for RCA-Victor R-74

Oscillation ....1)	open-circuited 10-mfd. condenser with yellow lead connecting to volume control ing. (*Note*: watch polarity in replacing as ground in this receiver is positive)

GENERAL ELECTRIC J-107

Intermittent volume, Removal of AVC tube has no effect on volume ....1)	high-resistance short-circuits between condensers *C38*, 10-mfd., 200-volts; *C21*, 0.5-mfd., 600-volts; *C19*, 0.1-mfd., 600-volts; *C36*, 10-mfd., 400-volts; *C35*, 10-mfd., 400-volts

GENERAL ELECTRIC J-125

See also "case histories" listed for RCA-Victor R-78

Hum when stations are tuned in	1)	cathode short-circuits in the types '56 and '58 tubes, caused by high voltage surges on fluctuating line voltages. Install voltage-regulator resistors to prevent wide voltage variations
Excessive hum	1)	remove dial-light wires from the vicinity of the r-f choke on top of chassis. Also twist these wires

GENERAL ELECTRIC K-40A

Weak reception, Distortion	1)	high leakage or total short-circuiting of double 4-mfd. electrolytic condensers. The most troublesome unit is in the '25Z5 circuit and the next is in the type '77 or type '78 cathode circuits
	2)	defective type '25Z5 tube, (even though it tests O.K.). Replace with new tube
Plate currents of type '38 tubes abnormally low, (all other voltages test O.K.)	1)	defective type '25Z5 rectifier tube. Replace with new tube

GENERAL ELECTRIC K-41

Same "case histories" as those listed for RCA-Victor R-17-M

GENERAL ELECTRIC K-43

60-cycle hum, (most noticeable when signal is tuned in)	1)	connect a 500-ohm resistor from the set side of the 0.01-mfd. antenna condenser to chassis

GENERAL ELECTRIC K-50

See also "case histories" listed for RCA-Victor R-28

Oscillation	1)	defective filter condenser

GENERAL ELECTRIC K-50-P

Same "case histories" as those listed for RCA-Victor 28-P

GENERAL ELECTRIC K-51

Low volume	1)	defective series padding condenser in the type '2A7 circuit. Replace with a new unit
	2)	defective type '2A7 tube (even though it may test O.K). Replace.
	3)	oscillator and i-f circuits out of alignment

GENERAL ELECTRIC K-51-P

Same "case histories" as those listed for RCA-Victor 28-P

GENERAL ELECTRIC K-52, K-53

Hum ....1) connect the receiver to a good ground connection and the hum will disappear

GENERAL ELECTRIC K-60, K-60-P

See also "case histories" listed for RCA-Victor R-28

Oscillation, Motorboating, (stops when type '2B7 tube grid cap is touched with the finger) ....1) decrease in capacity of condenser *C30*. Replace with a 4-mfd., 600-volt paper type unit

GENERAL ELECTRIC K-62, KZ-62-P

See also "case histories" listed for RCA-Victor R-11 and RCA-Victor 121

Motorboating ....1) leaky by-pass or filter condensers, contained in a common can. It is usually advisable to replace the entire can

No AVC action ....1) decrease in value of one of the AVC resistors. Replace with resistors of the proper value

Oscillation (all receiver circuits are correctly aligned) ....1) decrease in capacity of condenser connected across the rectifier output. Replace with a new unit
2) dirty or corroded condenser rotor contacts. Solder flexible pigtail leads between the rotors and the condenser frame or chassis

GENERAL ELECTRIC K-64

See also "case histories" listed for RCA-Victor 121

Intermittent reception as the tuning dial is rotated, (this is not the case when the set is removed from the cabinet) ..1) short-circuit between the bare wire connecting the stator plates of the gang condenser and the wave-band switch, and another bare wire near it connected to ground. When chassis is inserted in the cabinet, the condenser gang is pressed down on its rubber cushions, as a result of the shaft fitting into the hole, thereby forcing the two wires very closely together and causing them to short-circuit. Separate the wires about twice the distance that they were apart originally

GENERAL ELECTRIC K-65

Some case histories as those listed for RCA-Victor R-28

GENERAL ELECTRIC K-66

Same case histories as those listed for RCA-Victor 220

GENERAL ELECTRIC K-78

Same case histories as those listed for RCA-Victor 330

GENERAL ELECTRIC K-79

Same case histories as those listed for RCA-Victor 331

GENERAL ELECTRIC K-80, K-80X

See also case histories listed for RCA-Victor 140, 141

Inoperative on "C" and "D" bands	1) defective type '2A7 oscillator tube (even though it tests O.K.). Replace by substitution
Oscillation, Howls on strong signals	1) shield the grid leads of the type '2B7 second detector tube
Inoperative, (audio system O.K.) (high grid voltage and low plate and screen voltages on the type '2A7 tubes)	1) short-circuit between detector coils *L13* and *L18* (receiver wiring diagram). The defect is usually at the beginning or end of the winding and the coil can easily be repaired. The coil should be doped and the receiver circuits should be aligned after it is replaced

GENERAL ELECTRIC K-85

See also case histories listed for RCA-Victor 240

Inoperative on "C" and "D" bands	1) defective type '2A7 oscillator tube (even though it may test O.K.). Replace by substitution
Oscillation, "Howls" on strong signals	1) shield the grid leads of the type '2B7 second detector tube

GENERAL ELECTRIC K-105

Same case histories as those listed for RCA-Victor 261

GENERAL ELECTRIC K-106

Inoperative, Poor quality, Poor sensitivity, Poor AVC action	1) r-f amplifier out of alignment 2) oscillator not tracking at the proper frequency

GENERAL ELECTRIC K-107

Same case histories as those listed for RCA-Victor 260

GENERAL ELECTRIC K-126

Same case histories as those listed for RCA-Victor 280

GENERAL ELECTRIC M-49 (Phonograph Motor)

Starting difficulty	1) failure of stator to rotate on the outer bearing, due to spaghetti sleeve sticking in the slot or to the resilient bumper 2) improper lubrication on outer bearing

GENERAL ELECTRIC M-50

Same case histories as those listed for RCA-Victor 117

GENERAL ELECTRIC M-51

Same case histories as those listed for RCA-Victor 118

GENERAL ELECTRIC M-56

Same case histories as those listed for RCA-Victor 211

GENERAL ELECTRIC M-61

Same case histories as those listed for RCA-Victor 128

GENERAL ELECTRIC M-65

See also case histories listed for RCA-Victor 221

Inoperative on broadcast band (tubes and voltages test O.K.)	1) open-circuited 4-mfd. screen-grid circuit condenser located in the power pack. Replace with a 500-volt unit

GENERAL ELECTRIC M-66

Same case histories as those listeo for RCA-Victor 128

GENERAL ELECTRIC M-67

Same case histories as those listed for RCA-Victor 224

GENERAL ELECTRIC M-81

Same case histories as those listed for RCA-Victor 143

GENERAL ELECTRIC M-86

Same case histories as those listed for RCA-Victor 143

GENERAL ELECTRIC M-89

Same case histories as those listed for RCA-Victor 341

GENERAL ELECTRIC M-106

Same case histories as those listed for RCA-Victor 262

GENERAL ELECTRIC M-106

Poor sensitivity on short-waves (intermittently or steadily ....1) defective i-f or detector by-pass condensers between coil returns and ground
2) slipping dial on *fast* speed knob setting. Bend down three contact springs on tuning knob shaft

GENERAL ELECTRIC M-107

Same case histories as those listed for RCA-Victor 263

GENERAL ELECTRIC M-125

Same case histories as those listed for RCA-Victor 281

GENERAL ELECTRIC M-129

Same case histories as those listed for RCA-Victor 381

GENERAL ELECTRIC N-60

Ignition interference ....1) lengthen the distributor rotor arm by peening it. This shortens the gap between it and the stationary contacts, thereby reducing the length of the arc

GENERAL ELECTRIC S-22D

Same case histories as those listed for RCA-Victor R-7

GENERAL ELECTRIC S-42

See also case histories listed for RCA-Victor R-8

Noisy reception, (disappears when set is tapped) ....1) tighten bolt located between type '35 i-f tube and type '24 first detector tube, which holds oscillator coil in place and also provides ground for it

GENERAL ELECTRIC S-42D

Same case histories as those listed for RCA-Victor R-9D

GENERAL ELECTRIC SZ-42P

Same case histories as those listed for Radiola 86

GENERAL ELECTRIC S-132

Same case histories as those listed for General Electric K-62

GENERAL ELECTRIC T-12

Poor reception ....1) increase the length of the aerial from 50 to 100 feet

GENERAL ELECTRIC T-41

Same case histories as those listed for Radiola 48

GENERAL ELECTRIC 18

Hum ....1) defective antenna condenser

GENERAL ELECTRIC 51-R

Same case histories as those listed for Radiola 80

GENERAL ELECTRIC 80

Fading ....1)	defective AVC tube

GENERAL ELECTRIC 109

Intermittent radio or phono reception ....1)	corroded contact segments at master change-over switch
Fading, Sharp drop in volume, Weak reception, Station hiss ....1)	open-circuited 0.05-mfd. r-f, first detector and i-f secondary-return by-pass condensers
Poor control of volume, Distortion, Distortion at resonance ....1)	leaky 0.05-mfd. r-f, first detector and i-f secondary return by-pass condensers
Noisy tuning, Oscillation, Motorboating between stations ....1)	corroded condenser-gang rotor contacts. Bond rotor to chassis with flexible pigtails
Intermittent reception, Inoperative ....1)	open-circuiting or open-circuited 0.1-mfd. audio coupling condenser
Inoperative home record meter ....1)	remove meter and decrease tension upon pivot of meter needle

GENERAL ELECTRIC 125

Fading, Sharp drop in volume, Weak reception, Station hiss ....1)	open-circuited 0.1-mfd. r-f, first detector and i-f secondary-return by-pass condensers
Poor control of volume, Distortion, Distortion at resonance ....1)	leaky 0.1-mfd. r-f, first detector and i-f secondary-return by-pass condensers
Noisy tuning, Oscillation, Motorboating between stations ....1)	corroded condenser-gang rotor contacts. Bond rotor to chassis with flexible pigtails
Mechanical hum ....1)	loose laminations of filter choke—heat in oven, press together, allow to cool
Noisy reception ....1)	noisy volume control
Fading, Dial settings incorrect ....1)	snapped tabs on oscillator series condenser

GENERAL ELECTRIC 700

Same case histories as those listed for Westinghouse WR-5

GENERAL ELECTRIC (CANADIAN) RECEIVERS

GENERAL ELECTRIC (CANADIAN) ALL-WAVE RECEIVERS

Inoperative on "C" or "X" band, (set may operate if switch is snapped hard against the stop), Cleaning or tightening contacts does not improve the switch	1) warped 7 inch shaft on the wave-change switch. This prevents the rear switch arm from turning far enough, and either the wrong contact or sometimes no contact is made in this section

GENERAL ELECTRIC (CANADIAN) H-32
Same case histories as those listed for Radiola 17

GENERAL ELECTRIC (CANADIAN) H-72
Same case histories as those listed for RCA-Victor R-4

GENERAL ELECTRIC (CANADIAN) J-82
Same case histories as those listed for RCA-Victor R-71

GENERAL ELECTRIC (CANADIAN) J-86
Same case histories as those listed for RCA-Victor R-71

GENERAL ELECTRIC (CANADIAN) J-105, J-107
Same case histories as those listed for RCA-Victor R-74

GENERAL ELECTRIC (CANADIAN) K-50
Same case histories as those listed for RCA-Victor R-28

GENERAL ELECTRIC (CANADIAN) K-52, K-53
Same case histories as those listed for RCA-Victor R-28P

GENERAL ELECTRIC (CANADIAN) K-64
See also case histories listed for RCA-Victor 121

GENERAL ELECTRIC (CANADIAN) K-80, K-85
Same case histories as those listed for RCA-Victor 140

GENERAL ELECTRIC (CANADIAN) K-106
Same case histories as those listed for RCA-Victor R-90

GENERAL ELECTRIC (CANADIAN) M-62
See also case histories listed for RCA-Victor 121

GENERAL ELECTRIC (CANADIAN) M-69
See also case histories listed for RCA-Victor 121

GENERAL ELECTRIC (CANADIAN) M-86
Same case histories as those listed for RCA-Victor 143

GENERAL ELECTRIC (CANADIAN) M-86

Same case histories as those listed for RCA-Victor 143

GENERAL ELECTRIC (CANADIAN) S-22, S-22X

Same case histories as those listed for RCA-Victor R-4

GENERAL ELECTRIC (CANADIAN) S-42A

Same case histories as those listed for RCA-Victor R-4

GENERAL ELECTRIC (CANADIAN) T-41

See also case histories listed for Radiola 48

Excessive plate voltage and current in the output stage, Excessive screen-grid and plate voltages on the r-f tubes	1) one of the filter choke leads connected to the high-voltage center tap of the power transformer grounding to case. This results in the full unfiltered voltage from the rectifier tube passing through all the tube circuits. Insert a piece of insulating paper or empire cloth between the leads and the case of the choke

GENERAL MOTORS 50

Poor volume, Plate voltages low	1) leaky or short-circuited r-f plate condenser, usually the top one in the three-pile assembly

GENERAL MOTORS 120, 130, 140, 150

See also case histories listed under General Motors 160

Intermittent drop in volume, (set does not go completely dead)	1) tighten screws holding stator plates on gang condenser 2) solder wire between top and bottom stator lugs
Weak reception, Inoperative, (serial numbers below *29100A* or *1700B*) (all voltages, condensers and resistors check O.K.)	1) grid-bias on tubes too high. Connect a 200-ohm, 10-watt resistor across the 240-ohm section of the bias voltage divider in order to decrease the grid-bias on the tubes and bring up the sensitivity of the receiver

GENERAL MOTORS 160

See also case histories listed under General Motors 120

Oscillation, Noisy tuning	1)	corroded condenser-gang rotor contacts. Solder the r-f filament grid return leads directly to chassis and connect flexible pigtail resistors between the rotors and the tuning condenser frame
Fading, Intermittent reception	1)	open-circuiting 0.01-mfd. audio coupling condenser
	2)	open-circuiting screen by-pass condenser
	3)	broken antenna section of dual volume control
Poor control of volume	1)	replace type '24 tube in r-f stage with '35 tube
Dial readings incorrect	1)	re-align receiver
	2)	re-locate dial scale
Fuse blows	1)	short-circuited or leaky 0.1-mfd. line buffer condensers
Hum	1)	short-circuited 0.1-mfd. filter choke "tuning" condenser
	2)	defective type '27 tube

GENERAL MOTORS 252

See also case histories listed under General Motors 253

Intermittent buzz, (stops when aerial and ground are disconnected, but when it is not of an external nature)	1)	defective type "23 first detector tube (even though it may test O.K.). Replace by substitution tests with a new tube
Excessive hum	1)	defective power transformer input by-pass condensers, having the center tap grounded. Replace with a pair of 0.003-mfd. units

GENERAL MOTORS 253, 254, 255, 256, 257, 258

See also case histories listed under General Motors 252

Inoperative unless AVC tube is withdrawn	1)	open-circuited 2-megohm resistor in grid circuit of AVC tube
Distortion	1)	open-circuited 100,000-ohm section of voltage divider across speaker field

GLORITONE 26, 26P

Whistling, Howling Noise, Oscillation	1)	lead from antenna post to volume control shifted from original position. See that it runs from antenna terminal to one corner of the chassis, and from this point to the next corner, and then to

(Cont'd)

GLORITONE 26, 26P (Cont'd)

(Cont'd)	the volume control, sliding it under all other wires and making sure that it rests directly on the metal chassis all the way.
Intermittent reception, (2,640-ohm resistor heats up excessively when set cuts out)	1) replace the "Candohm" resistor with a carbon-type unit 2) short-circuit in speaker field which is tapped to act as a bleeder resistor for the screen-grid voltage supply, causing it to heat. This is usually caused by the wearing of the enameled wire insulation under the lead connection. Repair by placing a heavy piece of paper or empire cloth under this lead and giving the entire coil a coat of dope

GLORITONE 27

Fading, (switching a light on or off restores set to normal operation) (all parts test O.K.)	1) solder a flexible pigtail from the rotor of the tuning condenser to the ground
Low volume	1) defective speaker field; coil open-circuits under load. Test by touching metal screwdriver to core with set in operation and noting magnetism

GLORITONE 99

Distortion at high volume	1) defective 4-mfd. electrolytic condenser 2) check 400,000-ohm resistor from type '47 grid to voltage divider for change in value or open circuit, causing high pentode plate current 3) check type '47 tube. Replace if weak

GLORITONE 99-B

Loud whine developing at high volume and building up till signal is drowned out	1) vibration of oscillator and tuning condenser plates transmitted from the speaker through the chassis. Float the oscillator and tuning condensers on rubber cushion supports

GRAYBAR GB-8, GB-8A

Same case histories as those listed for RCA-Victor R-4

GRAYBAR GB-9

Fading	1) open-circuited 5-megohm resistor in AVC circuit 2) leaky 0.1-mfd. AVC grid-return by-pass condensers
Weak reception, Insensitive, Inoperative until AVC tube is withdrawn	1) leaky 0.1-mfd. AVC grid-return by-pass condensers
Distortion at any volume level	1) carbonized voltage-divider resistors. Install wire-wound unit for screen drop resistor
Stations tune with "plop"	1) Reduce AVC heater voltage
Fading, Noisy, Intermittent reception	1) corroded contact of volume control shaft 2) loose volume control resistance winding
Noisy tuning, Oscillation	1) corroded condenser-gang rotor contacts. Install flexible pigtail leads on rotor
Very weak-distorted reception	1) open-circuited coupling winding in second i-f transformer
Distortion, Weak reception, High positive bias on one output tube	1) "short" from "prim." to "sec." of push-pull input transformer
Hum, Motorboating when one type '47 tube is withdrawn	1) resistor on phono terminal strip shorting to terminal No. 4

GRAYBAR GB-100

Fading	1) leaky 0.1-mfd. AVC grid by-pass condenser (in power pack condenser block—blue lead)
Intermittent reception, Oscillation	1) open-circuited screen by-pass condenser
Weak reception, Inoperative until AVC tube is withdrawn	1) leaky 0.1-mfd. AVC grid by-pass condenser in power pack. Replace 2) open-circuited 1-megohm AVC grid resistor in power pack
Poor tone	1) operate pentode tubes as triodes 2) remove 18,000-ohm and 0.005-mfd. condenser across output plate circuit
Distortion at any volume level, Weak reception	1) carbonized voltage divider resistors. Install wire-wound unit for screen drop resistor

GRAYBAR GB-310, GB-311

Same case histories as those listed for Radiola 18

GRAYBAR GB-320

Same case histories as those listed for Radiola 18

GRAYBAR GB-330, GB-340

Same case histories as those listed for Radiola 60

GRAYBAR GB-500

See also case histories listed for Radiola 44

Poor volume, Poor selectivity ....1)	tuning condenser rotors out of line. Re-set the tuning condensers and rebalance the circuits

GRAYBAR GB-550

Same case histories as those listed for Radiola 44, 46

GRAYBAR GB-600

Same case histories as those listed for Radiola 66

GRAYBAR GB-678

Same case histories as those listed for Radiola 48

GRAYBAR GB-700, 770, 900

See case histories listed for Radiola 80

GRAYBAR GB-989

Same case histories as those listed for RCA-Victor R-10

GRAYBAR GC-13

Same case histories as those listed for RCA-Victor R-4

GRAYBAR GC-14

Same case histories as those listed for RCA-Victor R-8

GRAYBAR GC-10-69, 10-88, 10-99

Fading, Sharp drop in volume, Weak reception, Station hiss ....1)	open-circuited 0.05-mfd. r-f, first detector and i-f secondary-return by-pass condensers
Poor control of volume, Distortion, Distortion at resonance ....1)	leaky 0.05-mfd. r-f first detector and i-f secondary by-pass condensers
Noisy tuning, Oscillation, Motorboating between stations ....1)	corroded condenser gang rotor contacts. Bond rotors to chassis with flexible pig-tails
Intermittent reception, Inoperative ....1)	open-circuiting or open-circuited 0.1-mfd. audio coupling condenser

GRAYBAR GT-7

Same case histories as those listed for RCA-Victor R-4

GRAYBAR GT-8

Same case histories as those listed for RCA-Victor R-8

GRAYBAR 700, 770, 900

Same case histories as those listed for Radiola 80 and Westinghouse WR-5

GREBE HS-4

Intermittent reception, Noisy reception, Oscillation	1) replace 8,500-ohm resistors in screen-feed circuit, using wire-wound 10-watt units 2) remove entire 6-section metal-cased by-pass condenser. Replace the r-f and i-f cathode by-pass units with 0.1-mfd. condersers; the second detector tube by-pass units with 0.5-mfd. by-pass condensers; and the tone control condenser with a 0.02-mfd. unit. The capacity of the screen by-pass condensers is also 0.1-mfd.

GREBE M 3-4

Fading	1) leaky or intermittently open-circuiting condensers. Test each separately with high voltage and a neon lamp. Replace if defective

GREBE SK-4

60-cycle hum, (filter condensers check O.K.)	1) defective 0.1-mfd. condenser mounted at the detector tube. Replace with new unit

GREBE 7

Inoperative	1) short-circuited tuning condenser 2) defective push-pull input transformer

GRIMES SERENADER O

Oscillation at low frequencies (tubes and voltages test O.K.)	1) high-impedance r-f coil primary windings. Detune the plate coil in the first r-f stage by connecting a 0.00005-mfd. condenser across it

GRUNOW CHASSIS 5A

No voltage	1) flashing occurring between the hum-bucking coil and the speaker winding, destroying the field coil leads

GRUNOW CHASSIS 5B

Motorboating, Weak reception on local stations only .... 1)	open-circuited 20-mfd. filter condenser. Replace with new unit across the terminals of the old unit on condenser bank
2)	open-circuited 8-mfd. filter condenser. Repair similar to above. *Note*: it may be best to replace the entire bank, since the units on the newer types have better connecting leads
60-cycle hum .... 1)	pilot light short-circuiting on variable condenser gang. Twist insulating washer until pilot light is insulated from condenser frame, then apply some cement to hold it in place
Set draws current after being turned off, (dial-light glows dimly) ..1)	due to large capacity of condenser jammed in behind the speaker. Replace with smaller unit
Hum .... 1)	loose laminations in filter choke
2)	defective filter choke coil. Replace with new coil

GRUNOW CHASSIS 6A, 6C

Poor tone .... 1)	replace the coupling condenser between the type '75 and '42 tube with a 0.01-mfd., 600-volt unit. This unit is located on the left side of the chassis behind the short resistor strip
Excessive distortion when volume control is advanced toward maximum setting .... 1)	high-resistance leak in 0.01-mfd. coupling condenser, being of the order of 5-megohms. Replace with new unit

GRUNOW CHASSIS 6D

Set dead .... 1)	short-circuited lead in condenser block. This necessitates the replacement of the entire block, as the negative lead is tied inside it
Intermittent reception .. 1)	defective type '75 tube (even though it may test O.K.). Replace with new tube

GRUNOW CHASSIS 7A

Intermittent reception	1) too much delay in AVC circuit. Replace all the 0.1-mfd. by-pass condensers in the grid circuits of the type '78 tubes with 0.01-mfd., 600-volt units
Screen-grid resistor burns out	1) replace this 14,700-ohm section of the voltage divider with a 15,000-ohm, 10-watt wire-wound unit
Poor tone	1) leaky electrolytic filter condensers. Replace with new 8-mfd. units, leaving the shield off
Hum, Poor tone	1) defective type '6B7 tube (even though it may test O.K.). Replace with new tube
Intermittent loss of volume, Inoperative at high-frequency setting of dial, (trouble corrected by shifting band switch from broadcast to short-wave band and back again)	1) defective 0.1-mfd. condenser in block located on bank lug attached to oscillator coil in shield can farthest from the front of the chassis. Replace with new unit
Inoperative, Intermittent reception	1) defective 0.1-mfd. condenser in block behind tuning gang with green lead, which is connected together with two red leads to a common terminal at the left rear of the short-wave switch. Replace with a 600-volt unit 2) defective 1,000-ohm resistor, as a result of the above condition, located in resistor bank. Replace with new unit

GRUNOW CHASSIS 7B

Loss of volume	1) defective volume control. Replace with a new unit
Noisy reception on the "A" band, Inoperative	1) dirty or corroded grounding arms which hold the variable condensers in place. Clean them with fine sandpaper and replace
Dual-ratio drive does not stay in low-ratio position	1) loosen the two small bolts on the drive-sleeve assembly; push the drive sleeve back slightly, re-tightening the screws as tightly as possible
Microphonic noises	1) chassis bolts too tight. Loosen bolts 2) shafts on chassis touching the wood of the cabinet

GRUNOW CHASSIS 8A, 9A

See case histories listed for Grunow Chassis 7A

GRUNOW CHASSIS 11A

See also case histories listed for Grunow Chassis 7B

Oscillation	1) high-resistance connection between shield and socket of type '6C6 tube. Drill out rivet, replacing it with a 6-32 brass machine screw and nut

GRUNOW CHASSIS 12A

Low volume, Poor tone, Distortion	1) speakers out of phase—polarity on their terminals reversed. Test by shorting out voice coil in large speaker and reverse polarity on one of the small speakers. Connect leads on one of small speakers in position which gives best response. Then do the same with large speaker, connecting leads in position which gives best output

GRUNOW CHASSIS 65B, 65C

Same case histories as those listed for Grunow Chassis 5B

GRUNOW 500

Same case histories as those listed for Grunow Chassis 5A

GRUNOW 501

Same case histories as those listed for Grunow Chassis 5B

GRUNOW 650

Same case histories as those listed for Grunow Chassis 6A, 6C

GRUNOW 660, 661, 662

Same case histories as those listed for Grunow Chassis 6A, 6C

GRUNOW 670, 671

Same case histories as those listed for Grunow Chassis 6D

GRUNOW 700, 701

Same case histories as those listed for Grunow Chassis 7A, 8A, 9A

GRUNOW 750, 751

Same case histories as those listed for Grunow Chassis 7B

GRUNOW 801

Same case histories as those listed for Grunow Chassis 7A, 8A, 9A

GRUNOW 901, 902

Same case histories as those listed for Grunow Chassis 7A, 8A, 9A

GRUNOW 1101

No control of volume ....1) replace remote control cable
2) short-circuit between blue wire and metallic shield over black wire

GRUNOW 1151, 1152

Same case histories as those listed for Grunow Chassis 11A

GRUNOW 1241

Same case histories as those listed for Grunow Chassis 12A

GULBRANSEN "CHAMPION JUNIOR"

Set dead ....1) double open-circuit caused by the corrosion of the primary leads of the first audio transformer, inside the case. Remove the transformer from the case and after removing tape, etc., from the connected joints, clean off the corrosion and solder a new section of the wire to the leads. Re-tape and insulate the newly soldered joints carefully

"Sluggish," Poor tone, Lack of sensitivity ....1) voltage-dropping resistors off value. Check their resistance, replacing with new units if above or below tolerance value

GULBRANSEN 8 TUBE A-C CHASSIS

Noisy reception, Intermittent reception ....1) defective type '24 r-f tube (even though they may test O.K.). Replace with new tubes
2) intermittently short-circuiting 0.3-mfd. r-f plate supply by-pass condenser (one of 3 units in a common can). Replace with a new unit

GULBRANSEN 75

Static on all stations, (tubes and voltages check O.K.) ....1) defective plate choke coil in type '24 detector circuit

GULBRANSEN 92, 93

Tubes burn out ....1) arcs occurring between the "B" limiting resistor connected from the type '33 socket to the nearby filament wire

HALSON L-10

Hum ....1) defective volume control. Replace unit

HALSON 515SW

Same case histories as those listed for Zenith A

HAMMARLUND "PRO", "COMET"

Failure of the i-f oscillator ....1) high-resistance connection to one of the secondary lugs on the i-f oscillator coil. Resolder the connection

HOWARD 1936 A.C.-D.C. MODELS

Hum ....1) interaction of pilot light leads running from sockets to the resistor and other nearby wires. Isolate these leads from all the rest of the receiver circuits

HOWARD E-14

Hum ....1) insert a 30-henry choke between the speaker cable and the field coil terminal, adding a 16-mfd. condenser to the input of this choke. *Note*: since there is no room on the chassis for this installation, it will be necessary to install a little shelf in the cabinet above the power transformer, for mounting the units

HOWARD MODEL SG-B

Oscillation ....1) dirty or corroded contact springs on the tuning condenser rotors. Solder flexible pigtails from the rotors to the ground and also clean the contacts

HOWARD X-2, X-3, Y-3

Noise suppressor system does not function ....1) reduce length of the antenna

INTERNATIONAL (KADETTE)

(See listings under KADETTE)

JACKSON-BELL "PETER PAN"

Inoperative ....1) inspect the soldered joints on the coils under the tape. They often corrode

JACKSON-BELL 260

Set dead, (grid bias on type '45 tube approximately 75-volts) ....
1) replace the 0.02-mfd. coupling condenser (*C-12*)
2) replace the 2-megohm type '45 tube grid resistor (*R-6*)
3) leaky 0.1-mfd. r-f cathode by-pass condenser. Replace with new unit

KADETTE B & S

Intermittent reception ..1) replace type '6B7 tube

KADETTE ES-19, ES-20

Inoperative ....1) short-circuited 0.05-mfd. tone control by-pass condenser. Replace.
2) burnt-out 50,000-ohm tone control as a result of the above condition. Replace with new unit
3) short-circuited electrolytic condenser block. Replace with new unit

KADETTE 2 TUBE RECEIVER

Inoperative ....1) open-circuited 3,000-ohm resistor located under the type '12A7 tube

KADETTE "INTERNATIONAL"

Inoperative, (no plate and screen-grid voltage on all tubes) ....1) defective 75-ohm resistor in the plate lead of the type 'KR-1 rectifier tube. Replace with a 10-watt wire-wound unit
2) defective type 'KR-1 rectifier tube. Replace with a new tube

Squealing at the high-frequency end of the tuning dial ..1) short projecting wire from the control grid of the type '36 tube situated too close to the r-f coil. Remove the wire from the coil and re-align the receiver circuits

Weak reception, Low volume, Distortion ....1) defective 0.05-mfd. condenser connected between the plate of the rectifier tube and one leg of the line. Replace with a new unit
2) defective filter condensers. Replace with 4-mfd., 175-volt units
3) defective cathode by-pass condenser. Replace with a 5-mfd., 35-volt unit

KADETTE 72

Oscillation, Microphonic howl ....1) interaction between the grid leads of the type '106 and '34 tubes. Separate them
2) defective type '25S tube (even though it may test O.K.) Replace.

KARADIO

No local reception ....1) partially short-circuited 100,000-ohm a-f coupling condenser connected between the plate of the type '85 tube and the first a-f transformer. Replace with new unit
2) defective oscillator, usually a result of a defective type '36 tube. Replace tube

KENNEDY 4 A.C.-D.C.

Intermittent reception, Noisy reception	1)	check tube socket connections. Loose connection in one of the tube plate circuits

KENNEDY 26

Inoperative	1)	shorted compensating condenser on condenser gang
Noisy, Intermittent reception	1)	shorting compensating condenser on condenser gang

KENNEDY 30, 32

Fading, Intermittent reception	1)	short-circuiting or leaky detector plate by-pass condensers
	2)	open-circuiting or open-circuited 0.06-mfd. audio coupling condenser
	3)	open-circuiting voice coil of dynamic speaker

KENNEDY 60

Intermittent reception	1)	green lead to stator of first tuning condenser broken (replace with flexible wire)
Fading	1)	corroded contacts or insufficient blade tension of wave-band switch in short-wave converter.

KENNEDY 62

Distortion	1)	short-circuit between the primary and secondary windings of the push-pull input transformer. Replace with new unit
Intermittent reception Inoperative (when tuning control is reached or moved from one side of receiver to other)	1)	replace the stator connecting leads with more flexible wires. The present ones open-circuit, since they are not flexible and cannot stand being twisted, when the condenser is rocked

KENNEDY 62A

Same case histories as those listed for Kennedy 60

KENNEDY 526

Same case histories as those listed for Kennedy 26

KENNEDY 632

Same case histories as those listed for Kennedy 30, 32

KNIGHT S. G. 8

Same case histories as those listed for Columbia Screen Grid 8

KOLSTER CK-35

Poor selectivity over part of the tuning dial	1) open-circuited 2,700-ohm wire-wound grid suppressor resistor in the grid circuit of the first r-f tube. Replace with a ¼-watt, 2,200-ohm metallized unit

KOLSTER K-20

Whistle	1) speaker cord too near detector tube 2) shield power tube and ground shield
Starting howl	1) connect 100,000-ohm resistor across first audio secondary
Noisy reception	1) sparking or arcing voltage divider 2) noisy audio transformer primary windings 3) worn resistance element in volume control 4) loose nuts on terminal strip
Weak reception	1) open grid-suppressor resistors
Fading, Intermittent reception	1) open-circuiting plate by-pass condenser 2) loose nuts on terminal strip 3) short-circuiting detector tuning condenser vernier 4) open-circuiting filament by-pass condenser
Inoperative	1) short-circuited detector tuning condenser vernier
Microphonic	1) remove small condensers shunting grid suppressors 2) increase value of grid suppressors
Oscillation	1) open-circuited plate or filament by-pass condenser 2) remove one or more small condensers shunting grid suppressors 3) increase value of grid suppressors 4) leaky neutralizing condensers across the suppressor resistors in the r-f amplifier grid leads. Replace with new trimmer condensers, setting their capacity just beyond the point of regeneration

KOLSTER K-21

See also case histories listed under Kolster K-20

Loud "howl" for about ten minutes after set is turned on	1) remove extra piece of green wire connected from the control grid of the first a-f tube. This wire is laced for a way with the tuner power supply wires, but its other end is left open. Its removal will check the howl *(Cont'd)*

KOLSTER K-21 (Cont'd)

Poor sensitivity .... 1) remove the grid suppressor in the grid circuit of the third r-f tube. Removal of the others will cause oscillation at the high-frequency end of the tuning dial

Frying noise .... 1) defective hum control center tap on the type '26 tube filaments

Regeneration .... 1) hum balancers out of adjustment. Readjust them till operation becomes normal

KOLSTER K-22, K-23, K-24, K-27, K-28

See case histories listed for Kolster K-20, K-21

No reception .... 1) look for loose prongs on loudspeaker plug
2) open circuit in voice-coil leads
3) shorted filter condenser in power pack

Noisy reception .... 1) defective audio transformer in power pack

KOLSTER 42

Weak reception with volume control at maximum setting, (tubes and voltages test O.K.) ..... 1) leaky 0.0025-mfd. grid condenser in detector circuit. Replace with new unit

KOLSTER K-43

Fading Intermittent reception	1) leaky or intermittently open-circuiting 0.6-mfd. screen-grid by-pass condenser contained with another condenser in an oblong metallic housing having a green lead connected to the "G" terminal of the second r-f tube socket. Replace with a good quality ½- to 1-mfd. unit 2) defective volume control. Test by pulling control knob out and in several times, or rotate the knob, pulling it out at the same time. The carbon section usually becomes flaked and cracks, causing variations in resistance. Disconnect the lead from the 0.0001-mfd. condenser to the resistance strip and connect this lead to the antenna post 3) "floating" r-f coils, loosening from their supports within the shields. Tighten coils to their supports
Hum	1) vibration of power transformer shield. Test by placing the hand firmly on the shield and noting the change. If defective, pack the space inside the shield with soft paper, thereby damping the vibration. Removing the shield entirely, may be necessary. In some cases, it may be sufficient merely to tighten the lamination clamping screws 2) resistance of hum control resistor across the 2½-volt filament winding too high. Replace with unit of about 15-ohms, in order to obtain a finer adjustment 3) unbalanced secondary windings on push-pull input transformer. Replace with a new transformer 4) loose terminals on power pack. Fasten down all terminals
Inoperative	1) open-circuited second r-f grid wire. Locate the connection and resolder it
Noise	1) worn carbon resistance element in antenna portion of dual volume control 2) leaky detector plate by-pass condenser

KOLSTER K-60, K-62

Noisy reception, Intermittent rasping noises, (voltages and currents test O.K.)	1) critical r-f or first detector circuit 2) defective condensers in the r-f or i-f circuits. Replace with new units 3) replace the r-f input coil grid lead with a piece of waxed cotton-covered wire 4) poor contact between coil shields and chassis. Bond them with flexible pigtails

KOLSTER K-60, K-62 (cont'd)

(*Cont'd*)	5) loose grid cap clips. Replace with tight fitting clips 6) defective band-pass filter 7) short-circuited tuning coil

KOLSTER K-70

See also case histories listed for Kolster K-80- K-82

Fading to almost a whisper when tone control position is changed	1) leaky 0.1-mfd. coupling condenser connected between the plate of the second detector tube and the plate of the pentode tube (leak does not usually show up on ordinary tests—high voltage test necessary). Replace with new unit
High-pitched whistle	1) interaction between type '47 tube and push-pull input transformer. Bond the transformer case to the chassis in several places

KOLSTER K-80, K-82, K-90, K-92

Fading	1) gassy AVC tube
Noisy tuning, Oscillation	1) corroded condenser-gang rotor contacts. Solder flexible pigtail between rotor and condenser frame
Inoperative until AVC tube is withdrawn	1) open-circuited 2-megohm AVC grid resistor. (In models 90, 92, AVC grid resistor is 1 megohm)
Insensitive, Volume control critical, Volume control has time-lag, Difficult to tune	1) decrease value of AVC plate resistor from 250,000 to 750,000 ohms 2) increase value of AVC grid resistor to 5 megohms
Oscillation, Motorboating, Noisy	1) poorly grounded coil shields. Corroded shield rivets
High-pitched whistle	1) interaction bewteen type '47 tubes and push-pull input transformer. Bond the transformer case to chassis in several places

KOLSTER K-100

Same case histories as those listed for Kolster K-60, K-62

KOLSTER K-130, K-132

Oscillator inoperative, (oscillator tube tests O.K.)	1) change in value of grid condenser or grid resistor. Replace with new unit 2) defective oscillator plate resistor. Replace with new unit 3) increase in value of first a-f tube plate resistor, causing a drop in plate voltage. Replace with new unit 4) defective first a-f transformer. Replace with new unit
Failure of tuning indicator	1) change in value of 10,000-ohm resistor between the neon tuning indicator and ground
Low volume	1) defective r-f choke. Replace with a new unit
Insensitive, Poor AVC control	1) change in value of AVC resistor. Replace with new unit

KOLSTER K-140

Weak reception, Fading	1) change in value of 25,000-ohm, 1-watt resistor located at end of chassis farthest from power transformer (*R21*), and 10,000-ohm, 1-watt unit located near power transformer. Replace both with 10-watt units
Impossible to align receiver due to unstable i-f amplifier	1) align all i-f transformers to exactly 175-kc. Turn the trimmer of the one which is least stable all the way in. This gives better selectivity and stability than staggering. Locate unstable stage by placing screwdriver near each, noting in which the most change is introduced
Intermittent reception	1) replace defective type '56 tube
Hum	1) defective filter condenser. Replace with new unit

KOLSTER 6F, 6J, 6K, 6L, 6N, 6R

Fading	1) poor contact of volume control contact arm aganist resistance 2) clean and tighten socket prongs (Kolster 6K only)
Starting howl	1) connect 100,000-ohm resistor across secondary of first a-f transformer
Hum	1) shield detector tube and ground shield
Choked, Weak reception	1) short-circuited or leaky 2-mfd. speaker output condenser
No signals	1) open resistor in power pack 2) shorted condenser in power pack (for Kolster 6K only)

(*Cont'd*)

KOLSTER 6-F, 6-J, 6-K, 6-L, 6-N, 6-R (cont'd)

Distortion, (tubes and voltages test O.K.) (voltage on type '71 filament about 5½-volts)	1) defective push-pull line switch. Replace with long-necked toggle switch (For Kolster 6-K only)

LEWOL LW-4

Insensitive	1) increase in value of 2-megohm resistor connected in the grid lead of the type '6C6 detector tube. Replace with new unit

LYRIC A-65

Operative only over part of the dial	1) failure of oscillator over inoperative part of the dial. Drop the value of the oscillator cathode resistor to ½ its former value
Resistors burn out in the voltage-divider system	1) decrease in value of 15,000-ohm, 2-watt and 10,000-ohm, 1-watt resistors, causing them to draw a high plate current and burn up. Replace with new units of the proper value

LYRIC C-4, M-4

Set dead, Tubes do not light	1) locate open-circuited filament in one of the tubes, and all the tubes will light, since they are connected in series
	2) defective 16-mfd., 150-volt electrolytic condenser mounted on the top side of the chassis and tied to the speaker frame. Replace with a new unit

LYRIC D

Intermittent volume, Oscillation, Volume increases when light is switched on	1) defective volume control resistor. Replace with new unit
	2) add 0.25-mfd. condensers to the screen-grid and cathode by-pass units. This will cure the oscillation

LYRIC K-69

Low volume, Muffled tone	1) short-circuited 1-mfd. condenser in detector circuit, located in dual unit next to filter block. Replace both to avoid trouble with second condenser later on
Weak reception, (good tone)	1) partial short-circuit in screen-grid condenser

LYRIC S6

Distortion, (tubes and voltages test O.K.) ....1)	increase in value of 200,000-ohm resistor in circuit of unshielded tube in rear of chassis. Replace with new unit
Distortion at low volume ....1)	defective 1-megohm resistor located on power transformer. Replace with new unit

LYRIC S7

Inoperative, Pentode output tube gets red hot ....1)	open-circuited output transformer, leaving no voltage on the plate and causing the screen-grid to carry the full load. Replace the output transformer
Muffled reception, "Blare" ....1)	replace 250,000-ohm resistor in the type '47 pentode tube circuit and the ¼-mfd. condenser in the plate end of the screen-grid circuit

LYRIC S8

Distortion, Speaker rattle, (no grid bias on the type '47 tubes) ....1)	open-circuited ½-megohm resistor. Replace with new unit
Noisy reception, Intermittent noise ....1)	defective a-f input transformer (even though it may test O.K.). Replace with new unit
2)	short-circuited 0.1-mfd. condenser between the first detector grid coil and the tuning condenser

LYRIC S-80

Poor reception, Low volume, Fading ....1)	change in value of 16,000-ohm resistor connected between plate and screen circuits and the 15,000-ohm resistor connected between screens and cathodes. Replace with 10-watt units

LYRIC SA-90

Noisy reception, (sounds like defective volume control) ....1)	leaky or short-circuited type '27 tube. Replace with new tube
Hum after set operates for about an hour ....1)	connect a 2-mfd. condenser between the "low" side of the filter choke and ground
Poor sensitivity, Low volume ....1)	one-half of secondary of second push-pull transformer open-circuiting intermittently. Replace with new transformer or disconnect the secondary connections and connect the two grid

(Cont'd)

LYRIC SA-90 (Cont'd)

leads from the type '45 tubes in series with the 0.06-mfd., 400-volt condensers across the primary terminals of that transformer. Then connect two ½-megohm resistors in series across the grid leads of the '45s, grounding the point where they are connected in series to the chassis

LYRIC SA-91, SA-99, 91, 99, 900

No inter-station noise suppression, Microphonic	1) short-circuited or leaky first audio cathode by-pass condenser
Weak reception, Distortion	1) change type '55 tube which may test perfectly
Distortion at low volume	1) voice coil improperly centered
Distortion, Blasts at high volume, Tone control ineffective, Oscillation	1) isolate grids of parallel type '2A5 tubes with second coupling condenser and grid leak 2) Insert 250-ohm resistor in each '2A5 grid circuit
Distortion, Grids of type '2A5 tubes glow, Low '2A5 grid bias	1) short-circuited or leaky '2A5 cathode by-pass condenser
Intermittent reception, Oscillation	1) open-circuiting r-f screen by-pass condenser
Inoperative, Rectifier plates get red-hot	1) primary to secondary short-circuit or primary to shield short-circuit of i-f transformers
Oscillation, "Birdies," Unstable	1) i-f transformer out of adjustment
Inoperative, No 1st detector or i-f plate voltage, all other voltages low, D-C output shorted	1) primary of i-f transformer grounding to can. Melt out of can and line inside with paper or tape, etc.

LYRIC SA-133, 1300

Loud hum, Grids of type '2A5 tube glow	1) grounded r-f chokes in type '82 tube plate leads
Arcing at high volume	1) arcing from voice coils to field "pot". Connect resistor across voice coils

MAJESTIC M

Distortion ....1) replace the type '43 tube

MAJESTIC 15

Inoperative on part of dial ....1) change the value of the first detector-oscillator cathode resistor to 5,000-ohms, replacing the old 10,000-ohm unit

Inoperative, (tubes and voltages test O.K.) ....1) defective type '24-A oscillator tube (even though it tests O.K.). Replace by substitution

Inoperative, (no plate voltages on r-f and i-f tubes) ....1) short-circuited i-f transformer

Inoperative ....1) burnt-out antenna coil. Replace with new unit
2) defective antenna coupling condenser
3) open- or short-circuited 0.01-mfd. primary buffer condenser. Replace with a unit of higher voltage rating

Noisy reception, Intermittent reception ....1) corroded or high-resistance connection at the i-f coils. Test this by charging an 8-mfd. condenser and flashing each coil. The coil is in good condition if it stands this test

MAJESTIC 20, 21, 22, 23

Inoperative ....1) short-circuited 0.1-mfd. plate by-pass condenser within second i-f transformer
2) open-circuited 10,000-ohm oscillator grid leak

Inoperative with tone control in "bass" position........1) short-circuited 0.022-mfd. condenser in this circuit

Unstable operation............1) open-circuited 10,000-ohm oscillator grid leak

Hum at resonance............1) open-circuited detector cathode by-pass condensers

MAJESTIC 30

Type '80 rectifier tube filament burns out on one side ....1) short-circuited 2-mfd. filter condenser between the orange lead of the type '80 tube filament terminal and the filter pack. Replace with a new 600-volt unit

MAJESTIC 39

Intermittent reception, Fading ..1) check and replace audio coupling condenser

MAJESTIC 50

See also case histories listed for Majestic 52

No control of tuning condensers	1) replace drive cable
Noisy reception	1) defective volume control
Set dead, No plate voltage on second detector tube, All plate voltages about 15-volts below normal	1) remove small plate in back of chassis directly below mounting of types '80 and '45 tubes. Look for a charred 25,000-ohm resistor, with a short-circuited 1-mfd. condenser across it. Replace them

MAJESTIC 52

Hum	1) open-circuited filter choke "tuning" condenser 2) short-circuited filter choke "tuning" condenser
Fading, Intermittent reception	1) leaky 0.04-mfd. oscillator coupling condenser 2) open-circuiting 0.04-mfd. oscillator coupling condenser
Poor sensitivity, Tuning dial off calibration	1) r-f and oscillator circuits out of alignment

MAJESTIC 55, 59

Intermittent reception, Fading	1) short out grid filter resistor in type '6A7 tube secondary return circuit 2) leaky condensers in block located on outside of chassis near speaker 3) open-circuits or loose ends on tubular condensers. Check each one carefully
Inoperative, Motorboating	1) short-circuit or leakage between primary and secondary of last i-f transformer
Inoperative	1) defective electrolytic filter condensers. Replace both condensers
Weak reception	1) shorted 0.003-mfd. tone-control condenser. When this happens, inspect the tone control, as a shorted condenser allows high voltage to pass through it, ruining the carbon strip; (tone-control value 50,000-ohms)

MAJESTIC 60 SERIES

Inoperative .... 1) short-circuited 0.1-mfd. plate by-pass condenser within first or second i-f transformer

Fading, Erratic meter operation, Weak reception .... 1) leakage between porous cotton-covered leads
2) leaky 0.067-mfd. r-f secondary return by-pass condensers
3) leaky 0.067 first detector secondary-return by-pass condenser
4) porous 57,000-ohm blue carbon resistor
5) absorption of moisture by cotton-covered leads and resistors throwing receiver out of alignment. It is advisable to rewire the entire receiver using rubber-covered wire for tuning condenser leads, control-grid leads, AVC plate leads, r-f and first detector secondary return leads; new, good condensers and wire-wound resistors

MAJESTIC 70

Inoperative .... 1) shorted r-f by-pass condenser in chassis
2) shorted filter condenser between "B+ r-f", and "ground" in power pack
3) defective "on-off" switch
4) open-circuited ballast resistor

MAJESTIC 71, 72

Same case histories as those listed for Majestic 70

MAJESTIC 75

Same case histories as those listed for Majestic 55

MAJESTIC 90 SERIES

See also case histories listed for Majestic 91, 92, 93

Weak reception .... 1) shorted detector filter-condenser in block in power pack. Disconnect leads, then solder a 2,000-ohm resistor between "B+ HIGH" and "B+ DETECTOR" (externally) and a 2-mfd. condenser between "B+ DETECTOR and "grid"
2) re-balance and re-neutralize circuits
3) worn-out sensitivity equalizer, which is a variable resistance working together with the condenser shaft. Replace
Note: if the new equalizer resistor is thicker than old one and throws the condenser shaft out of position, remove the metal back-plate on equalizer, allowing condenser shield to take its place

Indistinct reproduction ...... 1) repair seam on loud speaker cone

MAJESTIC 91, 92, 93

Noisy tuning ....1) burrs on tuning condenser plates (burn with high voltage—all leads disconnected)

Intermittent reception ..2) worn carbon element in equalizer control mounted on condenser-gang shaft

Inoperative..............................1) lugs on audio transformers or phono input transformer grounding to core
2) loose power pack terminal-strip nuts
3) broken carbon resistance element of equalizer control
4) open-circuited detector filter choke or resistor (in condenser block) in power pack

Weak reception, (low plate voltage) ....1) leaky or short-circuited detector plate-voltage-supply filter condenser

Slipping dial drive .... 1) replace with the new Majestic dial drive having heavy metal bearings

MAJESTIC 95

Intermittent reception caused by oscillator ceasing to function ..1) short-circuit the resistor (*R8*) in the A-minus lead. *Note*: This is only possible if a 2-volt storage cell is used for the "A" supply

MAJESTIC 101, 102, 103

Same case histories as those listed for Majestic 91, 92, 93

MAJESTIC 105

Same case histories as those listed for Majestic 95

MAJESTIC 116-A

Noisy reception ....1) short-circuited 1-mfd. vibrator buffer condenser. Replace with new unit
2) poor terminal connections or short-circuited 0.008-mfd. vibrator transformer secondary buffer condenser. Replace with new unit

MAJESTIC 130, 131, 132

Noisy tuning .... 1) corroded copper friction contact on rotor of condenser gang. Solder flexible pigtails between rotor and condenser frame

Inoperative .... 1) terminal lugs of push-pull input transformer "shorting" to core beneath the terminal strip

Inoperative, (high cathode voltage on first and second r-f tubes) .... 1) blue wire torn away from volume control

Fading, Intermittent reception, Weak reception .... 1) leaky or open-circuited 0.04-mfd. first r-f, second r-f, and detector secondary-return by-pass condensers. Use only finest grade replacements.
2) terminal lugs of push-pull input transformer shorting to core
3) leaky or open-circuiting r-f screen by-pass condensers
4) leaky or open-circuiting r-f cathode by-pass condensers

MAJESTIC 160, 163

Same case histories as those listed for Majestic 60 Series

MAJESTIC 181

Condenser drive cable broken .... 1) remove gang assembly to re-string

Fading, ... 1) loose power-pack terminal-strip nuts

Intermittent reception, Inoperative .. 1) open-circuited bias resistors in r-f, first audio or power stages

No reception .... 1) short-circuited filter condenser in power pack

Indistinct reproduction .... 1) repair seam on speaker cone

MAJESTIC 195

Same case histories as those listed for Majestic 55

MAJESTIC 210

Inoperative .... 1) defective electrolytic condenser, replace both condensers

MAJESTIC 233

Same case histories as those listed for Majestic 130, 131, 132

MAJESTIC 300 SERIES

Inoperative ....1)	open-circuited center plate winding of pilot-light reactance transformer
Blows fuses ....1)	carbonized type '82 tube rectifier socket
2)	inoperative type '82 tubes (not burnt-out)
Noisy reception ....1)	change position of type '82 tube rectifier high-voltage and filament leads
Pilot light does not dim when tuning ....1)	leaky or short-circuited electrolytic condenser connected across plate winding of reactance transformer

MAJESTIC 307

See also case histories listed for Majestic 300 Series

Highly distorted, Weak reception ....1)	open-circuited or leaky 0.1-mfd. audio coupling-condenser
Poor tone, Weak reception ....1)	inoperative type '58 phase-rotating tube (not burnt-out)

MAJESTIC 310-A

See also case histories listed for Majestic 300 Series

Poor sensitivity ....1)	place a 20,000- or 30,000-ohm resistor across the grid return of the i-f transformer and ground
Intermittent reception ....1)	high-resistance connection between poorly cleaned enameled voice-coil wire and speaker leads

MAJESTIC 324

Same case histories as those listed for Majestic 300 Series

MAJESTIC 344

See also case histories listed for Majestic 300 Series

Highly distorted, Weak reception ....1)	open-circuited or leaky 0.1-mfd. audio coupling condenser
Poor tone, Weak reception ....1)	inoperative type '58 phase-rotating tube (not burnt-out). Replace with new tube

MAJESTIC 363

Same case histories as those listed for Majestic 300 Series

MAJESTIC 560, 566

Same case histories as those listed for Majestic 55

MARCONI (CANADIAN) 1930 "STANDARD", "JUNIOR", "SENIOR"

Inoperative, No signals, Low volume	1) receiver circuits out of alignment 2) dirty variable resistor which tracks with the tuning condenser gang. Clean the resistor with graphite

MARCONI (CANADIAN) 35

"Crackling" noise, "Bubbling" sound	1) high-resistance rotor contacts. Clean contacts and solder flexible pigtails between rotors and condenser frame 2) connect a direct ground lead to the tuning condenser section

MIDWEST 12

Excessive hum	1) open-circuited 5-mfd. condenser in the cathode circuit of the type '58 second a-f tube. Replace with new unit 2) lug on power transformer grounding to bolt on it. This lug is connected to the shield which shields the lead from the secondary of the last i-f transformer to the volume control. Ground this lug to the chassis

MIDWEST 16 TUBE

Insensitive, Weak, Broad tuning, Incorrect dial calibration	1) align i-f transformers 2) align r-f circuits 3) align oscillator circuits
Distortion at resonance	1) AVC i-f transformer out of alignment
Poor tone (especially on phono reproduction)	2) replace the cathode by-pass condensers on all the audio tubes with 5-mfd., 25-volt units
Noisy reception (sounds like tearing cloth)	1) short-circuited trimmer condenser under the chassis. Replace with new unit
Type '82 tube flashes	1) two short-circuited 8-mfd. filter condensers

MIDWEST 16-34

Poor selectivity, Weak reception	1) receiver circuits out of alignment due to shifting of windings on coils. Coat all coils with wax or liquid cement and realign the circuits 2) go over with a soldering iron all the grounded joints of the shielded cables, condenser frames, trimmer frames, etc. Do not depend upon rivets for good contact

MOHAWK RECEIVERS

See case histories listed for All-American Mohawk receivers

MONTGOMERY WARD RECEIVERS

See case histories listed for Airline receivers

MOTOROLA "GOLDEN VOICE"

Intermittent reception Low volume	1) low battery voltage delivered to the receiver. Check all wiring between the car battery and receiver
	2) replace the type '0Z-4 rectifier tube with a type '6X5 metal filament type rectifier tube. The filament connections are usually already wired in these receivers. If not, wire one contact to ground and the other to the 0.5-mfd. condenser located next to the "A" filter choke

MOTOROLA DUAL 6

Poor tone	1) defective type '75 tube
	2) defective type '42 tube
	3) defective 500,000-ohm type '75 tube plate resistor. Replace with a new unit
Insensitive	1) short-circuited diode secondary winding in i-f transformer
	2) short-circuited i-f trimmer condenser
	3) open-circuited antenna primary coil
Speaker rattle	1) dirt or filings in speaker air-gap
Buzzing noise from vibration pack, Vibrator "hash"	1) tighten self-tapping screw in bottom of set which holds vibrator pack in its housing
	2) connect a 0.5-mfd. automotive-type condenser between the hot "A" lead at the terminal lug and the ground

MOTOROLA SUPER 6

Poor tone	1) defective power tube
	2) defective tone-control condenser
	3) grounded tone control
	4) defective input transformer
Poor sensitivity	1) defective i-f transformer coil
	2) defective type '78 tube
	3) defective antenna coil
	4) high cathode bias on type '78 i-f tube
Low volume	1) speaker mounting bolt improperly grounded
	2) plate voltage below normal
Intermittent reception	1) pitted vibrator contact points. If points are not worn too far, trim them with an ignition file; otherwise, replace

MOTOROLA S-10

Light in Tun-A-Lite rises too high or not enough	1) change the value of the 7,500-ohm resistor between the B-plus and terminal *No.* 2 of the Tun-A-Lite. To increase the column reduce the resistance; increase the resistance to lower it 2) aerial wire is too short. At least 75 feet is required 3) low line voltage 4) weak type '83-V rectifier tube 5) weak type '78 r-f tube
Tubes do not light	1) open filament circuit in the remote control cable 2) "open" connection at the speaker plug
Amplifier tubes fail to light	1) open contacts on the relay. Decrease the tension on the relay spring
Excessive hum	1) defective filter condenser 2) cathode of the type '86 tube short-circuiting to the filament

MOTOROLA TWIN 8

Excess vibrator "hash," Buzzing noise from vibrator pack	1) tighten self-tapping screw in bottom of set which holds pack in place 2) connect a 0.5-mfd. automatic-type condenser between the hot "A" lead at the terminal lug and the ground
Excessive hum	1) unmatched last audio tubes 2) improperly adjusted "Elkonodes" 3) high-resistance "A"-hot line or "ground" 4) poor grounding of power pack in housing 5) defective type '84 tube 6) defective filter condenser
Poor tone	1) defective last audio tubes 2) defective audio coupling condenser 3) defective type '37 tube plate resistor 4) defective type '85, 75,000- or 30,000-ohm plate resistor
Poor sensitivity	1) i-f amplifier out of alignment 2) short-circuited i-f trimmer condenser 3) defective 30,000-ohm screen resistor
Inoperative or intermittent oscillator action	1) defective type '77 tube 2) defective 10,000-ohm oscillator bias resistor
Poor sensitivity at 550 kc	1) defective r-f plate choke 2) defective 600-kc padder

MOTOROLA 5-T-71A

Poor tone ....1) defective type '71A tube
2) defective input choke
3) weak "B" batteries

Poor sensitivity ....1) defective r-f coupling condenser
2) receiver circuits out of alignment
3) defective coil

MOTOROLA 6-T-12

Poor tone ....1) defective type '112 tube
2) defective input transformer
3) defective 50-mfd. electrolytic condenser

Poor sensitivity ....1) defective r-f coupling condenser

Oscillation ....1) poor grounds on condenser wipers
2) defective cathode condenser
3) high capacity r-f coupling condenser

MOTOROLA 7T-38

Poor tone ....1) defective type '38 tube
2) open-circuited 650-ohm bias resistor. Replace with new unit

Poor sensitivity ....1) receiver circuits out of alignment
2) defective r-f coupling condenser
3) defective r-f coil

MOTOROLA 34

Failure of oscillator ......1) defective 10,000-ohm oscillator tube grid-bias resistor. Replace with new unit
2) defective type '77 tube (even though it may test O.K.). Replace by substitution

Poor tone ....1) defective speaker
2) defective 500,000-ohm resistor

Poor sensitivity .... 1) short-circuited i-f trimmer condenser
2) defective type '77 or '78 tube
3) i-f amplifier out of alignment
4) open-circuited screen resistor. Replace with new unit

"Hash" interference ......1) improper grounding of wiping contacts against set housing

MOTOROLA 55

Poor tone	1) short-circuited 30-mfd. electrolytic condenser. Replace with new unit
No plate voltage	1) short-circuited filter condenser 2) "shorted" "Elkonode" point condenser 3) short-circuited "hash-filter" condenser
Short life on Elkonode unit	1) to prolong life, connect a 50,000-ohm resistor across output of replacement unit
Poor sensitivity	1) receiver circuits out of alignment 2) defective antenna coil 3) defective i-f transformer coil
Tubes do not light Power supply inoperative	1) open-circuit in power switch
Excessive hum	1) "A" battery leads too long or improperly connected

MOTOROLA 61

Oscillator "hiss"	1) substitute a type '36 tube in the oscillator-modulator socket
"Elkonode" operates spasmodically, "B-R" tube does not glow	1) short-circuited 0.05-mfd. buffer condenser across secondary of power transformer
"B-R" tube does not ionize	1) open-circuited 0.05-mfd. buffer condenser across sec. of power transf.

MOTOROLA 77

Poor tone	1) defective last audio tube 2) defective plate choke 3) no bias on last audio tubes 4) defective 65-mfd. electrolytic condensers
Poor sensitivity	1) defective type '39 tube 2) short-circuited i-f trimmer condenser 3) defective untuned r-f transformer 4) open-circuit in AVC network

MOTOROLA 77-A

Distortion, Loud whistles	1) open-circuited connection between tone control and small fixed condenser mounted behind it. Replace with flexible wire connector
Set dead, Inoperative	1) defective vibrator. Check the two 0.007-mfd. condensers shunted across the contact points, which do the rectifying

(Cont'd)

MOTOROLA 77-A (Cont'd)

	2) short-circuited shunting condensers across rectifier points in vibrator. Replace with 0.007-mfd., 1600-volt oil-filled units
Static when car is in motion	1) broken soldered joints between antenna coil shield and chassis
	2) corrosion of spring contact grounding the variable condenser rotors. Bond rotors to chassis with flexible pigtails
Poor tone	1) defective power tube
	2) defective coupling condenser
	3) no bias on type '12A5 tubes
Poor sensitivity	1) excessive bias on type '85 cathode. Reduce value of resistor to 500-ohms
	2) i-f amplifier out of alignment
	3) open-circuited resistor

MOTOROLA 88

Same "case histories" as those listed for Motorola 61

MOTOROLA 100

Hum, Filament ripple ....1) excessively long "A" leads. These leads should be as short as possible
2) high-resistance connection at either "hot" or grounded "A" terminal
3) improperly matched power output tubes
4) induced currents in the grid circuit of the type '85 tube. Remove the black lead from the 4-contact dummy lug strip to the cathode of this tube. Next remove the volume control ground lead from terminal *2* of the same dummy strip and re-ground it to the i-f coil can directly behind the type '85 tube

NORTHERN ELECTRIC (CANADIAN) 81, 101

Poor reception on short-wave bands (especially on the high-frequencies) ....1) open the ground connection at the wave-band switch contact arms, connect these two arms in common to a 0.005-mfd. condenser and connect the other terminal of this condenser to ground
2) in the Model 101, reduce the bias on the third i-f tube

Broad tuning ....1) replace the first and second i-f transformers. These are incorrectly designed

OLDSMOBILE AUTO RADIO

No signal, Inoperative ....1) defective type '6F7 tube (even though it may test O.K.). Replace with new tube

OZARKA 93, 94AVC

No control of volume ....1) open-circuiting of 250,000-ohm resistor connected between the movable arm of the volume control and the center tap of the high-voltage secondary. Replace with new unit

Hum ....1) open-circuited 350,000-ohm resistor in the type '47 tube control-grid circuit

PARAVOX K-482

Distortion ....1) defective two section 8-mfd. filter condenser. Replace with new unit

PATTERSON 70-AW, 107-AW, 207-AW, 210-AW

60-cycle hum ....1) defective type '82 tube. Replace with new tube

Poor quality at low volume ....1) aerial too long

I-f tubes block on local stations ....1) disconnect the antenna. Install a switch in this circuit for receiving local stations

PEERLESS 20 SERIES

Ballast tube "blows"........1)	carbonized type '80 tube rectifier socket. Replace socket
Intermittent reception ..1)	defective condenser between detector grid coil and ground

PEERLESS COURIER 65

Choked, Weak reception ....1)	open-circuited 0.01-mfd. audio coupling-condenser
Distortion, Poor control of volume ....1)	carbonized 5,000-ohm r-f screen cathode carbon resistors
Noisy, Weak reception ....1)	leaky or open-circuited 0.00035-mfd. r-f plate by-pass condensers across split primary winding
2)	sparking sections of Kylectron speaker
3)	dirty volume control or contact arm
Inoperative ....1)	short-circuited terminals or sections on Kylectron speaker
2)	short-circuited r-f plate by-pass condensers
3)	short-circuited screen by-pass condensers
4)	open-circuited sections of voltage divider
Fading, Intermittent reception ....1)	open-circuited 0.01-mfd. audio coupling-condenser
2)	short-circuiting terminals on Kylectron speaker
3)	leaky detector plate by-pass condenser

PEERLESS 70, 71, 72

Inoperative ....1)	detector tuning condenser lug shorting to tube shield
Rectifier tube "blows"........1)	temporary breakdown of first or second filter condenser (test each under load)
Weak, Noisy reception ....1)	leaky 0.00035-mfd. r-f plate by-pass condensers across split primary winding
2)	dirty volume control resistance winding or contact

PHILCO (CANADIAN) RECEIVERS

Fading ....1)	connecting wires drawn too tightly around the edges of projecting condenser cases causing permanent or intermittent short-circuits to chassis. Insulate all such places by winding tape around edges

PHILCO TRANSITONE 3

Inoperative (tubes and voltages test O.K.)	1)	water in the compensating condensers. This usually gets into them during a rainstorm or while the car is being washed. Remove the mica insulation and dry it thoroughly
	2)	loosening of field connections in speaker. Test for this condition by carefully sticking a piece of steel wire through the screen cover of the speaker with the set turned on, touching the wire to the centering screw of the cone. If the wire fails to stick, the field circuit is "open"

PHILCO TRANSITONE 5

Oscillation, "Birdies"	1)	pull the 15,000-ohm resistor in the '6A7 tube circuit up toward the front of the set
"Swishing" noise	1)	Replace defective type '78 tube
Inoperative, (no plate or screen voltage) (primary draws 10 to 15 amps.)	1)	breakdown of power transformer windings. Rewind windings or replace with new unit
Intermittent reception (plays satisfactorily when the chassis is jarred)	1)	loose nuts holding the i-f coil in place. Tighten them
Fuses blow	1)	defective vibrator unit. Adjust or replace with new unit

PHILCO TRANSITONE 6, 6F, 9

Inoperative	1)	battery connections to dynamotor reversed
Oscillator inoperative at high frequencies	1)	defective type '36 tube (even though it tests O.K.). Replace with new tube by substitution
	2)	lower the value of the type '36 cathode bias resistor from 5,000- to 7,000-ohms
Fading, Insensitive	1)	intermittent increase in resistance of oscillator coil from 4- to about 45-ohms. Replace with new coil and realign the receiver circuits

PHILCO TRANSITONE 11

Fuses blow (vibrator tests O.K.)	1)	short-circuit between speaker field housing and "on-off" switch mounted on volume control. Tape field section close to volume control and place insulating material around switch

PHILCO 1936 TRANSITONE RECEIVERS

Intermittent reception	1)	loose antenna plug insulator preventing good contact. File long insulator to almost the level of the plug

PHILCO 14, 14X, 14LZX

Inoperative at high or low frequencies	1)	poor type '36 tube
	2)	reduce value of detector-oscillator cathode bias resistor
No control of tone	1)	check type '37 tube in first audio stage
Inoperative	1)	open-circuited shadowgraph
Intermittent reception	1)	snapped coil leads at lugs of oscillator coil
Insufficient shadowgraph action	1)	small antenna. Increase size of antenna
	2)	weak type '44 tubes in r-f and i-f stages
	3)	increase value of diode detector secondary-return resistor
Shadowgraph inoperative on local stations	1)	receiver circuits out of alignment
	2)	defective type '6A7 tube
Motorboating, Hum	1)	eliminate by connecting 100,000-ohm resistor from first audio grid to chassis
Broad tuning	1)	r-f and i-f compensating condensers out of alignment
Oscillation	1)	compensating condensers out of adjustment
	2)	move all leads adjacent to oscillator coil further away from it.

PHILCO 16, 16B, 16X, 16RX, (Codes 121, 122)

Intermittent reception, Hum, Fading	1) replace volume control 2) open-circuiting diode audio coupling condenser 3) open-circuiting resistor in second i-f tube plate circuit 4) defective type '78 tube (even though it may test O.K.). Replace with a new tube by substitution
Fading (condensers and resistors check O.K.)	1) intermittent open-circuit in the third i-f transformer. Replace with new unit if defective
Fading on short-waves	1) bond tuning gang to chassis
Oscillator drift	1) bond tuning gang rotors to chassis with flexible pigtails
Weak reception on very low wavelengths	1) increase oscillator plate voltage. Replace plate resistor with 15,000 ohm unit
Inoperative below 15 mc	1) high resistance tuning condenser gang rotor contacts. Bond rotor to tuning condenser frame with flexible wire pigtails
Two resonance peaks indicated on shadowgraph, Widening of shadow upon resonance	1) replace shadowgraph
Insensitive, Plate voltages low	1) defective dry-electrolytic filter condensers. Replace with wet units
Choked	1) open-circuited 2-mfd. by-pass condenser *B* in condenser block 2) open-circuited 0.5-mfd. first audio plate by-pass condenser
Audio distortion	1) leaky electrolytic condenser *No. 75*. Replace with new unit
Noisy reception	1) defective shadowgraph bracket. Replace

PHILCO 16, 16-X, 16-RX (Code 123)

See also case histories listed for Code 121, 122 models

Inoperative on S-W band	1) high-resistance contacts in waveband switch. Replace wtih new switch
Intermittent reception	1) intermittent connection between coil lead and hook-up wire in third i-f transformer

PHILCO 16, 16B, 16X (Codes 125, 126)

Distorted reproduction, Grids of type '42 tubes glow	1) center-tap of push-pull input transformer grounded to core or can (Insulate from chassis with insulating bushings and washers)
Intermittent reception, Very weak signals (shadowgraph operates)	1) open-circuiting diode audio coupling condenser
Dial sticks, Dial slips	1) excessive pressure exerted by felt rests against dial 2) dial cable worn or frayed
Weak reception, No plate voltage on second i-f tube, Wide shadowgraph indication	1) open-circuited second i-f tube cathode bias resistor
Spasmodic operation, Distortion	1) open-circuited first-audio screen resistor 2) first-audio screen resistor increased in value
Weak reception	1) gassy type '5Z3 tube
Distortion, Type '42 screens get red hot	1) leakage between insulation and chassis of first filter condenser
Cutting off of volume, Intermittent reception	1) open-circuiting by-pass condenser. Trouble in lead contacts 2) open-circuiting 250-ohm resistor assembly blocks in i-f plate circuit
Distorted, Intermittent reception	1) open-circuiting, or change of resistance of first audio tube 1-megohm screen resistor

PHILCO 17

See also case histories listed for Philco 16

Spasmodic operation, Distortion	1) open-circuited first-audio screen resistor 2) first-audio screen resistor increased in value
Weak reception	1) gassy type '5Z3 tube
Inoperative with volume control at minimum setting and QAVC switch in "on" position	1) replace condenser *6* (circuit diagram) with a 0.01-mfd—0.002-mfd. unit

PHILCO 17-X

Distortion, Type '42 screens get red hot ......1)	1st filter condenser leakage between insulation and chassis

PHILCO 18

Distorted reproduction, No power tube bias ......1)	center tap of push-pull input transformer grounded to core or can. Insulate transformer from chassis with fibre washers and bushings
Choked, distorted reproduction ......1)	open-circuited 1-mfd. by-pass condenser
No short-wave reception ..1)	open contacts on wave-band switch
Mechanical hum ......1)	loose, vibrating laminations of power transformer. Tap core with a hammer to test for decrease in hum
Inoperative ......1)	control grid of type '75 tube shorting to shield can
2)	open-circuited audio coupling-condenser
No signal, Shadowgraph insensitive ......1)	short-circuited trimmer condensers. Insert larger insulating washers after bending up plates
Intermittent reception ..1)	leaky AVC coupling condenser
2)	broken wire connection in bakelite case of coupling condenser making intermittent contact. Replace condenser
3)	open-circuiting first i-f transformer primary winding

PHILCO 18-X

Distortion, Type '42 screens get red hot ......1)	leakage between insulation and chassis of first filter condenser
Cutting off, Intermittent reception ......1)	open-circuiting type '75 tube grid-coupling condenser
2)	open-circuiting coupling condenser from diode load resistors to volume control

PHILCO 19

Inoperative (completely),..1)	replace type '36 oscillator tube
Inoperative over a portion of the dial, 2)	change first det.-oscill. cathode-bias resistor from 15,000-ohms to 10,000-ohms
Intermittent operation, Fades after playing for some time, resuming operation after the switch is turned off for 15 minutes or more .. 3)	change first i-f compensating condensers to new type Philco Part *No. 31-6016*
4)	replace fibre washers in compensating condensers with new bakelite washer and metal washer on top (Philco Part numbers *27-4109*, *W-1331*)

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PHILCO 19 (Cont'd)

5) replace extremely thin or cracked mica which separates the leaves of the high-frequency oscillator compensating condensers
6) snapped coil leads at lugs of oscillator coil
7) wire from oscillator tuning condenser to oscillator coil should be rubber-covered
8) re-impregnate oscillator coil, dip entire coil in hot paraffin for twenty seconds—leaving only a portion of the mounting lug undipped, to assure a good ground connection. Allow both the coil and the pot of paraffin to cool until the paraffin becomes of somewhat heavier constituency, when the coil should be dipped again to give it a fairly heavy coating
9) in extreme cases, detector-oscillator tube socket should be replaced

Shadowgraph inoperative, but receiver operates	1) replace shadowgraph (open-circuited)
Low volume	1) remove the 5,000-ohm resistor in the r-f tube plate lead
Weak, distorted reception	1) poor '75 tube in second detector AVC stage
Shadow on shadowgraph widens	1) snapped lugs at oscillator coil leads
Wide shadow on shadowgraph	1) insufficient antenna (connect 2,000-ohm resistor across shadowgraph)
Insufficient action	2) remove shadowgraph from i-f plate circuit
Intermittent operation of shadowgraph	1) intermittently open-circuiting shadowgraph coil. Replacement is necessary
Hum	1) dried-up electrolytic condensers. Replace with new units

PHILCO 20, 20A

Oscillation	1) open-circuited r-f plate and by-pass condensers (connecting leads snap at lugs or within case) 2) open-circuited first audio coupling-condensers (connecting leads snap at lugs or within case) 3) connect a large mica condenser in the detector plate circuit 4) solder pigtails from the condenser gang rotor shaft to chassis 5) place drops of mineral oil on the condenser gang bearings
Oscillation, Fading, Noisy reception (tubes and voltages test O.K.)	1) defective volume control resistor. Replace with a new unit
Fading, Intermittent reception	1) defective type '24-A tubes
Severe static, Sputtering (voltages vary with varying intensities of crashes, then drop to zero value)	1) grounded filter choke, caused by wire in winding short-circuiting to core. Rewind or replace filter choke
Noisy tuning Oscillation at high volume	1) solder a pig-tail from the condenser-gang rotor shaft to chassis
Distortion, "Mushy" noise	1) intermittent fluctuation in value of 500,000-ohm grid leak resistor in the type '27 tube grid circuit. Replace with new unit
Poor tone	1) install a new cone with a flexible center 2) receiver circuits out of alignment
Slipping tuning drive	1) insufficient tension upon bearings in tuning-gang. reduction gear

PHILCO 21, 21A

High-pitched whistle at high volume levels	1) place a 4-mfd. filter condenser between the yellow terminal of the condenser block connected to the high voltage side of the voltage-divider system and ground

PHILCO 28, 28-C

Distortion	1) defective speaker cone 2) defective type '25Z5 tube
Distorted reproduction, Weak reception, Low plate voltage on type '75 tube	1) leaky plate by-pass condenser in plate circuit of type '75 tube
Noisy tuning, Noisy reception at high-frequency end of short-wave band	1) oil on dial drive shaft bearings and pulley
Noisy tuning, Inoperation at some point of scale	1) burrs or flakes on condenser gang plates. Burn with high voltage—all terminals disconnected
Intermittent reception	1) short-circuited i-f transformer. Replace with new unit
Intermittent reception, Hum, Volume control operation difficult	1) replace volume control
Intermittent reception, Noisy reception	1) defective volume control. Test by pulling on shaft 2) loose lead from antenna post to antenna coil 3) intermittent connection in second i-f transformer
Noisy volume control	1) isolate volume control from diode load circuit with condenser and complete diode circuit with additional resistor
Slipping dial	1) insufficient tension of roller spring at end of drive shaft
Inoperative, No plate voltage on type '75 tube	1) short-circuited 0.1-mfd. by-pass condenser connected from junction of two 70,000-ohm resistors in type '75 plate circuit to ground 2) open-circuited resistor in type '75 tube plate circuit
No short-wave reception	1) open or poor wave-band and switch contacts
No short-wave reception, Fading on local stations	1) receiver circuits out of alignment 2) defective tubes. Check by replacement tests
Code interference on broadcast band	1) wave-trap in antenna circuit out of adjustment
Oscillation, Weak reception	1) open-circuited first i-f tube cathode by-pass condenser

PHILCO 29

See also case histories listed for Philco 28

Fading ....1)	defective third i-f transformer. Replace with new unit
Intermittent oscillation ..1)	intermittently open-circuiting 0.1-mfd. tubular condenser connected between the i-f transformer secondary coils and ground. Replace with new unit
Audio whistle, "Bubbling" hum ....1)	intermittently open-circuiting 0.09-mfd. common bias by-pass condenser for the two type '39 tubes. Replace with new unit

PHILCO 30

Fading ....1)	intermittently open-circuiting 0.05-mfd. blocking condensers in the grid circuits of the r-f stages. Test by squeezing each unit and noting the effect. Replace if defective

PHILCO 38

Inoperative (entirely), Inoperative over a portion of the dial, Intermittent operation ....1)	see remedies listed under *inoperative* or *intermittent operation* of Philco Model 19 receiver (except remedies 2 and 3)
2)	low "A" or "B" battery resulting in failure of oscillator to function
3)	change first det.-oscill. cathode bias resistor from 6,000 ohms to 4,000 ohms
4)	permanent or intermittent short-circuit between i-f transformer leads as a result of the staples used to anchor these leads being driven into the wooden dowel so that they damage the insulation or touch at opposite ends. Replace with a new coil, making sure that this condition does not exist in the new replacement
Oscillation all over the dial ....1)	replace the 0.5-megohm resistor in the second detector screen circuit with a 0.35- or 0.4-megohm, 1-watt unit

PHILCO 39

Intermittent reception ..1)	intermittent connection in oscillator transformer

PHILCO 41 D.C.

Fading to very low volume which can be restored to normal value by turning the volume control ....1)	defective by-pass condenser across 5,000-ohm resistor in the detector grid-return circuit. Replace with a new unit

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PHILCO 41DC (Cont'd)

Intermittent reception ..1)	re-wire all the grid leads
Distortion ....1)	defective input transformer. Replace with new unit
Fading ....1)	defective first r-f tube (even though it may test O.K.). Replace with new tube
2)	defective antenna coil. Replace with new unit

PHILCO 44, 44B, 44H

Distortion, Type '42 screen red hot ....1)	insulation of electrolytic condenser leaky, or can shorting to chassis
Volume increases, Selectivity poor on broadcast band ....1)	due to improper setting of waveband switch. Moving contact of third section of switch engages second wiping contact before disengaging the first one
Weak on short-waves, Station hiss .. 1)	open-circuited 0.00025-mfd. postage-stamp type condenser connected between two bottom contacts of 3rd and 4th switch sections
Inoperative, Very weak reception, Slightly distorted reproduction ....1)	open-circuited type '75 tube grid-coupling condenser
2)	short-circuited or leaky condenser connected from junction of two 70,000-ohm resistors in plate circuit of type '75 tube to ground
Intermittent reception . 1)	intermittent connection in 2nd i-f transformer
2)	open-circuiting type '75 tube coupling condenser
No volume ....1)	short-circuited i-f transformer

PHILCO 45

See also case histories listed for Philco 28

No plate voltage on the type '75 tube	1)	defective 0.1-mfd. plate condenser. Replace with new unit of higher voltage rating
Intermittent reception	1)	bolts holding tuning condenser to chassis too long or too tight, thereby short-circuiting to the stator section. Repair by loosening the bolts or cutting off their ends
Low volume	1)	short-circuited terminals on dual section, 8-mfd. electrolytic condenser. Replace with new unit
	2)	short-circuited turns in i-f transformer secondary. Replace with new unit
	3)	re-balance the receiver circuits
Distortion, Poor reception	1)	defective type '6A7 tube (even though it may test O.K.). Replace with new tube
Loud buzzing sound from chassis	1)	loose power transformer laminations. Tighten them
Sharp tuning, Oscillation at resonance	1)	replace first i-f tube cathode resistor with 500-ohm unit

PHILCO 60

Inoperation at low frequencies	1)	short-circuited end plates on tuning condenser gang
Noisy tuning, Inoperation at some point of dial	1)	burrs or flakes on condenser gang plates Burn with high voltage—all terminals disconnected
Intermittent noise	1)	replace type '6A7 oscillator tube even though it tests O.K.
Weak, distorted reproduction, Low plate voltage on type '75 tube	1)	leaky plate filter condenser for this stage
Intermittent reception, Fading	1)	snapped oscillator coil connections at lugs
	2)	defective volume control
Oscillation, General instability	1)	add second by-pass condenser across type '6A7 tube cathode bias resistor
	2)	employ separate biasing resistor and by-pass condenser for i-f stage

PHILCO 65

Intermittent reception, Fading, Inoperative, Weak reception ....1)	leaky or short-circuiting 0.001-mfd. detector plate by-pass condenser
Hum, Distortion ....1)	pilot-light socket lugs shorting to mounting bracket
2)	corroded speaker plug and socket contacts
Low volume ....1)	weak detector tube. Replace with a new type '56 tube
Weak reception on high frequencies ....1)	r-f circuits out of alignment
Oscillation ....1)	intermittently defective cathode by-pass condensers. Replace with new units
2)	connect a 0.00025- or 0.0005-mfd. mica condenser from the "low" side of the detector plate choke to ground
3)	bond both ends of the tuning condenser gang rotor to the frame and the latter in turn, to the chassis with flexible pigtail leads
Crackling noise ....1)	loose rivets on combination resistor and cartridge-type condenser in the first r-f tube plate circuit

PHILCO 66

Set "dead" ....1)	short-circuited type '75 tube plate by-pass condenser connected between the two 70,000-ohm resistors. Replace with a 0.1-mfd. 600-volt unit
Inoperation at low frequencies, Cuts off at low end of dial ....1)	end plates of tuning gang short-circuited
Noisy tuning, Inoperation at one or more points ....1)	burrs or flakes on condenser gang plates. Burn with high voltage—all terminals disconnected
Noisy reception, Intermittent reception if set is subjected to any vibration ....1)	defective volume control
Noisy volume control ....1)	isolate volume control from diode load circuit

PHILCO 70, 70A

Inoperative Type '27 tube lights up brightly	1) second i-f transformer secondary winding short-circuited to primary winding. Dis-assemble and move leads
Fading, Intermittent reception	1) open-circuiting r-f by-pass and audio coupling condensers, usually at the eyelet of the case. Replace with new style condensers having stranded wires at eyelets *Note*: the above condition is usually difficult to test but can usually be induced by shorting across the blocking condenser several times in succession, causing the condenser to open; a 0.01-mfd. condenser bridged across it should bring the set back to full volume 2) defective type '47 tube. Replace with new tube
Weak reception all over the dial I-f transformers will not peak (serial No. below 22,000)	1) open-circuited auxiliary fixed condenser across the i-f padding condenser terminals 2) open-circuited high-frequency feedback condenser. Replace with new unit 3) defective r-f choke
Low volume at the low-frequency end of the dial Distortion	1) defective type '24 second detector tube (even though it may test O.K.). Replace by substitution with new tube
Low-freq. "padder" cannot be peaked	2) open-circuited auxiliary low-frequency padding condenser
Weak reception at high frequencies	1) open-circuited low-frequency condenser across the low-frequency padder and the oscilliator cathode bias resistor. Replace with a new condenser
Suppressor grid of the type '47 tube turns red-hot	1) section of voltage divider between the high-voltage center tap of the power transformer and ground short-circuits when it becomes hot. Replace with a 240- to 300-ohm, 10-watt unit
Erratic tone control operation, Loud howl, Microphonics	1) change in capacity or open-circuit in 0.00025-mfd. condenser connected to the plate lead of the second detector tube next to the choke coil. Replace with a new unit 2) vibrating tuning condenser plates. Place a pair of rubber washers under the chassis so as to "float" it.
Feedback not traceable to missing rubber cushions	1) caused by vibration of oscillator coil. Repair by dropping wad of paper in coil and with chassis upside down, drop

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PHILCO 70, 70A (Cont'd)

or floating condenser gang)		beeswax from hot soldering iron point onto the paper. This will steady the coil
Microphonics, Noisy reception	1)	re-adjust padder condensers, until the trouble disappears
Intermittent noise	1)	defective type '47 tube bias section on voltage divider resistor. Replace with 180-ohm unit
Noisy reception	1)	check grid connections on all tubes
	2)	check condition of volume control
	3)	peeling plates on tuning condensers. Burn with high voltage—all terminals disconnected

PHILCO 71

Inoperative	1)	open-circuited shadowgraph
Inoperative between 800 and 1500 kc, Detector-oscillator tube fails to oscillate	1)	defective type '36 tube (even though it may test O.K.). Replace with new tube
	2)	replace the 15,000-ohm detector-oscillator cathode resistor with a 10,000-ohm unit
	3)	moisture in oscillator coil. Replace with a well-impregnated coil
	4)	high-resistance connection to pigtails of r-f stage plate choke
Insufficient action of shadowgraph	1)	insufficient antenna. Lengthen antenna
	2)	weak type '44 tubes
	3)	remove shadowgraph from i-f plate circuit
Intermittent reception	1)	snapped coil leads at lugs of oscillator coil
Oscillation, Fading	1)	open-circuited r-f plate and screen by-pass condensers (connecting leads at eyelets or within housing)
	2)	open-circuited first detector or oscillator cathode by-pass condenser (connecting leads at eyelets or within housing)
Intermittent reception, Loss of volume (operation restored when analyzer plug is inserted for test)	1)	defective voltage-divider section between screen grid and cathode of second detector tube
Oscillation at high frequencies only	1)	open-circuited first detector-oscillator tube cathode by-pass condenser
	2)	compensating condensers out of alignment

PHILCO 71B

Intermittent reception	1) intermittently defective condenser *No. 3*

PHILCO 76, 76A

See also case histories listed for Philco 77, 77A

Hum Inoperative (about 15 minutes after set starts)	1) loose wire on r-f or i-f coil short-circuiting to soldering lug, thereby short-circuiting primary to secondary. Put wire back into original place and cement it in position

PHILCO 77, 77A

Inoperative	1) open-circuited 0.1-mfd. audio coupling condenser (connecting leads at eyelets or within case)
Weak reception, Distortion	1) open-circuited 0.1-mfd. audio coupling condenser
Distortion at low volume	1) improperly centered dynamic speaker voice coil
Tuning condenser shifts off frequency	1) stretched dial-drive cord 2) weak dial-drive cordspring. Replace with heavy duty type

PHILCO 80

No control of volume	1) replace the 0.05-mfd. r-f by-pass condenser (*C35*)
Set dead (no plate voltage on type '36 second detector tube)	1) open-circuited 1-megohm screen-grid resistor. Replace with new unit
Noisy reception	1) high-resistance short-circuit on first i-f transformer primary wire

PHILCO 81

Intermittent oscillation	1) replace the 0.006-mfd. type '42 tube output by-pass condenser 2) by-pass one side of the a-c line
Weak reception	1) defective type '77 tube 2) open-circuited i-f pickup coil. *Note*: This being a bank-wound coil, is most deceptive, as the set will balance without it

PHILCO 84

Weak reception	1) defective type '77 tube 2) open-circuited i-f pickup coil *Note*: This being a bank-wound coil is most deceptive as the set will balance without it

PHILCO 86

Low hissing sound (tubes test O.K.) ....1)	defective first audio transformer. Substitute with new unit

PHILCO 87

Hum ....1)	corroded or open friction contact on range control
2)	receiver out of neutralization
3)	defective filter condenser
4)	defective 0.5-mfd. by-pass condensers across the type '26 tube filaments. Replace if their d-c resistance is less than 25 megohms
Weak reception ....1)	short-circuited neutralizing condenser
No plate voltage on any r-f tube ....1)	open-circuited resistor in plate circuit (contained in by-pass block for that stage)
Unstable, Neutralization of tuned circuits impossible ....1)	check all resistors which are wound directly on 0.1-mfd. condensers. These usually open-circuit, causing excessive oscillation

PHILCO 89

Inoperative (completely), Inoperative over a portion of the dial, Intermittent operation ..1)	See remedies listed under *inoperative* operation for Philco Model 19 receiver
Weak, distorted reception..1)	poor type '76 tube in second detector AVC stage
Weak reception on low-frequency end of dial ....1)	reverse the primary leads on first i-f transformer
Hum ....1)	dried-up electrolytic condensers
Oscillation ....1)	open-circuited first detector grid coil
Noisy reception ....1)	rewire oscillator coil

PHILCO 90 SERIES (ALL MODELS)

Weak reception all over the dial	1) open-circuited fixed condenser across the i-f padding condenser terminals 2) open-circuited high-frequency feedback condenser. Replace with new unit
Weak, distorted reception	1) open-circuited audio coupling-condensers (connecting leads at eyelets, or within housing)
Feedback (untraceable to missing rubber cushions or floating condenser gang)	1) caused by vibration of the oscillator coil. Repair by dropping wad of paper in coil and with chassis upside down, drop beeswax from hot soldering iron point onto the paper. This will steady the coil
Microphonics, Noisy reception	1) re-adjust padder condensers until the trouble disappears
Microphonic howl (stops if i-f or oscillator coil cans are squeezed)	1) loose leads in coil forms. Remove coil assemblies and melt paraffin over coil forms so as to hold leads solidly in place
Interference from airport radio beacon stations transmitting at 260-kc (the i-f of the receiver)	1) re-adjust the i-f compensating condenser at 250- or 270-kc
Fading after set operates satisfactorily for some time (turning switch off and on restores set to normal operation for awhile)	1) intermittently open-circuiting 0.01-mfd. coupling condenser connected between the plate of the type '27 second detector tube and the grid of the type '27 first a-f tube
Intermittent reception	1) see remedies listed under *fading* for Philco 70 receiver 2) defective i-f trimmer condenser, usually the first i-f secondary trimmer that can be reached from the back of the chassis. Push this trimmer gently with a balancing tool with the set on and note the result
Inoperative	1) open-circuited audio coupling-condensers (connecting leads at eyelets, or within housing)
Low motorboating	1) replace first audio grid resistor with 100,000-ohm unit

PHILCO 90 (TYPE '45 OUTPUT TUBES

Fading only when chassis is touched (tubes and voltages check O.K.) (normal volume resumed when test is made)	1) open-circuiting 0.01-mfd. condenser connected between the detector plate and the grid of the first audio tube . Replace with a new unit
No control of volume Low volume	1) intermittently open-circuiting coupling condenser connected between the "detector-rectifier" output resistor and the volume control. Replace with a new unit

PHILCO 90 (PENTODE OUTPUT TUBES)

Noisy reception	1) defective 0.01-mfd. coupling condensers connected from the diode detector to the detector amplifier tube; the plate of the detector-amplifier tube to the grid of the first a-f tube; and the plate of the first a-f tube to the grid of the pentode tube. Replace with 0.1-mfd. tubular condensers and the a-f grid-leak resistors with 100,000-ohm units
Hum	1) caused by coupling as a result of the close proximity of the audio stages to the rectifier. Insert a shield plate (obtainable from the manufacturer) between the pentode tube and the rectifier tube
	2) slow-heating or defective type '27 first audio tube (even though it tests O.K.). Replace with new tube
	3) defective type '47 pentode tube (even though it tests O.K.). Replace with new tube
Intermittent reception	1) open-circuited 0.01-mfd. condenser connected between the plate of the type '27 second a-f tube and the grid of the type '47 pentode tube. Replace with a new unit
Fading after operating normally for about 5 minutes	1) defective pentode tubes (even though they may test O.K.).
Weak reception	1) open-circuited a-f coupling condensers. Replace with new units

PHILCO 91

Inoperative between 800 and 1500 kc. Detector-oscillator tube fails to oscillate	1) defective type '36 tube (even though it may test O.K.). Replace with new tube 2) replace the detector-oscillator cathode resistor with a 10,000-ohm unit 3) moisture in oscillator coil. Replace with well-impregnated coil
No control of tone	1) defective type '37 tube in the first a-f stage (even though it tests O.K.). Switch the tubes in the second detector and first a-f tube sockets
Tuning dial slips	1) increase the tension on the dial cord by moving up the tension spring one or a few notches 2) apply some rosin or warm tallow from a candle to the dial cord
Cuts off at 750 kc	1) lowered value of 8,000-ohm cathode resistor

PHILCO 91B

Cuts off at 750 kc	1) decrease in value of 8,000-ohm cathode resistor

PHILCO 91X

Inoperative at high or low frequencies	1) poor type '36 tube 2) reduce value of detector-oscillator cathode bias resistor
No control of tone	1) check type '37 tube in first audio stage
Inoperative	1) open-circuited shadowgraph
Intermittent reception	1) snapped coil leads at lugs of oscillator coil
Insufficient shadowgraph action	1) small antenna. Increase size 2) weak type '44 tubes in r-f and i-f stages 3) increase value of diode detector secondary-return resistor
Motorboating, Hum,	1) eliminate by connecting 100,000-ohm resistor from first audio grid to chassis
Broad tuning,	1) r-f and i-f compensating condensers out of alignment
Oscillation	1) compensating condensers out of adjustment 2) remove all leads adjacent to oscillator coil

PHILCO 95, 96, 96A

Intermittent reception (volume increases to high level and drops back to normal when test instruments are applied to circuit)	1) intermittently defective by-pass condenser on "low" side of volume control Replace with a 0.5-mfd. tubular condenser between the "low" end of the volume control and the grounded lug of the nearest trimmer
Intermittent reception, Fading, Weak reception	1) open-circuited or open-circuiting 0.05-mfd. r-f secondary-return by-pass condensers (at eyelets or within housing)
Oscillation, Intermittent reception	1) open-circuited screen by-pass condensers (at eyelets or within housing)
Serious oscillation, Not traceable to open-circuited condenser or resistor	1) replace screen feeder resistor with 50,000-ohm, 1-watt replacement, and by-pass with 2-mfd. condenser 2) by-pass the a-c line with a 0.001-mfd. condenser 3) add a 0.1-mfd. condenser to the center of grid resistor network in the audio channel
Tuning condenser shifts off frequency	1) stretched dial-drive cord 2) weak dial-drive cordspring. Replace with heavy-duty type
No screen-grid voltage on second and third r-f tubes	1) open-circuited 200-ohm screen resistor feeding the second and third r-f tubes. This resistor is moulded in one unit with a by-pass condenser

PHILCO 111, 111A, 112, 112A

Tuning condenser shifts off frequency	1) stretched dial-drive cord 2) weak dial-drive cordspring. Replace with heavy-duty type
Intermittent volume (low voltages on the types '27 and '45 tubes)	1) open-circuited primary and secondary a-f input transformer windings. Replace the transformer
Intermittent reception, Fading, Weak reception	1) open-circuiting or open-circuited 0.05-mfd. r-f and i-f secondary-return by-pass condensers
Inoperative	1) open-circuited section of 70-ohm center-tapped resistor in high voltage secondary-return circuit
Inoperative (high control-grid voltages on the type '24 tubes) (resistors and condensers check O.K.)	1) dial-lamp receptacle or wiring to it short-circuiting to chassis
Crackling or sputtering at high volume	1) breakdown of output transformer. Replace with new unit
Crackling noises	1) burnt-out field coil. Replace with new unit
Audio howl	1) high-resistance connection in i-f or r-f coil, where leads are soldered to lugs 2) vibration of tin-enclosed by-pass condensers. Squeeze the tin covers so they will not vibrate

PHILCO 112X

Distortion, High-pitched whistle	1) shorten pentode tube plate leads 2) keep pentode plate leads free from 2nd i-f primary compensating condenser

PHILCO 116

Intermittent oscillation	1) loose i-f transformer shield. Spread mounting feet so that good contact is made

PHILCO 116X

See also case histories listed for Philco 16X, 16RX

Hum	1) high-resistance ground between pilot lamp wires and chassis
Noisy reception	1) noisy type '6A3 tubes (even though they may test O.K.). Replace with new tubes by substitution

PHILCO 118

Intermittent reception ..1)	defective wave-band switch. Replace switch
Distortion at low volume, Shadowgraph action incorrect ....1)	intermittent high-resistance leak in the 0.00018-mfd. mica plate coupling condenser connected between the type '78 tube plate and the type '6A7 tube grid. It is located inside the oscillator coil and its defect does not show up until some time after the receiver is in operation
Vibration on certain notes ....1)	loose escutcheon plate in resonance with these notes

PHILCO 118X

See also case histories listed for Philco 18X

Hum ....1)	high-resistance ground on pilot-lamp wires
Noisy reception ....1)	noisy type '6A3 tubes
Shadowgraph does not function ....1)	open-circuited shadowgraph
High-pitched reproduction ....1)	open-circuited resistor connected in series with condenser across plates of type '42 output tubes
Distortion, Glowing type '42 output tube grids ....1)	push-pull input transformer secondary return "grounding" to core or shield. Insulate from chassis
Slipping dial drive ....1)	insufficient tension of roller spring at end of drive shaft
No short-wave reception 1)	open-circuited 0.003-mfd. postage stamp type series condenser for this band
Intermittent reception, Two-spot tuning ..1)	open-circuiting 0.05-mfd. grid-filter condenser in r-f stage
2)	leaky or short-circuited grid-filter condenser in r-f stage

PHILCO 144

Motorboating ....1)	defective gang condenser. Replace with new unit
2)	defective type '6A7 tube (even though it may test O.K.). Replace with new tube
Intermittent reception, Hum ..1)	defective i-f transformer. Replace with new unit
No short-wave reception..1)	defective wave-band switch

PHILCO 144X

Same case histories as those listed for Philco 44

PHILCO 200X

Rattle (similar to speaker rattle)	1) resonant vibration of the metal sound diffuser mounted in front of the speaker. Bend the blades slightly until the rattle is eliminated

PHILCO 211, 211A

Same case histories as those listed for Philco 111, 111A

PHILCO 221, 221A

Same case histories as those listed for Philco 21, 21A

PHILCO 270

Same case histories as those listed for Philco 70, 70A

PHILCO 296

See also case histories listed for Philco 95, 96, 96A

Oscillation	1) connect two 0.5-mfd. by-pass condensers in series across r-f, detector and first a-f heater winding with the junction point grounded

PHILCO 370

Same case histories as those listed for Philco 70, 70A

PHILCO 470

See also case histories listed for Philco 70, 70A

Intermittent reception, Hum (snapping power switch off and on restores set to normal operation)	1) short-circuited a-f coupling condenser. Replace with new unit
No reception on second and third band	1) poor switch contacts on wave-band switch

PHILCO 500, 501

Same case histories as those listed for Philco 16, 16X (Codes 125, 126)

Spasmodic phono reproduction	1) poor contacts on the radio-phono transfer switch. Be careful not to bend the contact blades too far as they may lose their tension

PHILCO 506

Same case histories as those listed for Philco 44

PHILCO 507

Same case histories as those listed for Philco 118X

PHILCO 511

Poor tone ....1) defective bias resistor
2) defective by-pass condenser

PHILCO 570

Same case histories as those listed for Philco 70, 70A

PHILCO 600-C

Poor tone ....1) connect a 25-mfd., 50-volt electrolytic condenser between the ground and the center-tap of the power transformer high-voltage secondary. Shunt this across the present condensers in that circuit

PHILCO 624

Hum ....1) extension cable in "A" lead too light. Use a heavier cable
2) low "A" battery
3) poor ground connection to "B" power unit

PHILCO 630

Oscillation, Motorboating ....1) loose shielding eyelets on chassis. Bond shields to chassis with flexible pigtails
2) loose spade clamps on shield cans

PHILCO 645

Hum ....1) input transformer primary wires reversed. Reverse the terminal connections

PHILCO 680

Noisy reception ....1) defective type '6A3 tube (even though it may test O.K.). Replace
2) defective 300-ohm resistor connected in second audio tube circuit (part *No. 151*)

Distortion Muffled tone at high volume levels (especially with tone control on "bass") ....1) open-circuiting 1-mfd. electrolytic condenser in the plate circuit of the second audio tube. Replace with new single unit, or the entire section in which this unit is contained

PHILCO 800

Inoperative ....1) sticking vibrator points. Replace with new vibrator unit
2) open- or short-circuited buffer condensers, causing arcing at the vibrator points. Test by unsoldering one lead in the power transformer primary
3) oscillator circuit out of alignment

PHILCO 806

Rattling sound ....1) bond all riveted "ground" terminals to the chassis

PIERCE-AIRO 524

Motorboating .... 1) high-resistance connection between the ground of the by-pass condenser block and the chassis

PILOT "DRAGON" 10

Excessive 60-cycle hum .. 1) grounded reflector mounted behind the pilot lamp. Insulate the sharp corner of the reflector with a piece of fibre to prevent the short-circuiting of tube filaments to ground

PILOT X-63

Noisy reception .... 1) loose or dirty contacts in band switch
2) intermittently open-circuiting phono jack contact
3) defective type '42 tube (even though it may test O.K.). Replace with new tube
4) change type '6A7 tube

Hum .... 1) reverse the speaker field terminal connections
2) a-c leads too close to volume control. Re-route them
3) open-circuited or leaky filter condensers. Replace with new units
4) short-circuited r-f by-pass condenser. Replace with new unit
5) short-circuited type '42 tube cathode condenser. Replace with new unit
6) defective type '75 tube (even though it may test O.K.). Replace with new tube
7) change type '6A7 tube

Distortion .... 1) grounded short-circuiting contact
2) short-circuited i-f or r-f grid return by-pass condenser. Replace with new unit
3) leaky audio coupling condenser. Replace with new unit
4) change type '75 tube
5) change type '42 tube
6) defective type '42 tube cathode by-pass condenser. Replace with new unit
7) voice coil requires recentering
8) i-f amplifier out of alignment

Microphonics .... 1) chassis too far forward in cabinet
2) defective type '6A7 tube (even though it may test O.K.). Replace with new tube
3) tuning dial assembly touching front of cabinet

(Cont'd)

PILOT X-63 (cont'd)

Insensitive in center of band	1) i-f amplifier out of alignment 2) r-f amplifier out of alignment 3) "short-circuiting" contact in band switch not shorting
Weak audio reception	1) high-resistance phono jack contact

PILOT X-73

Noisy reception	1) weak batteries 2) defective type '19 tube (even though it may test O.K.). Replace with new tube
Inoperative, No signal	1) open-circuited fuse 2) reversed battery connections
Distortion	1) grounded short-circuiting contact 2) leaky audio coupling condenser. Replace with new unit 3) open-circuited audio transformer. Replace with new unit 4) wrong "C" battery voltage 5) low filament voltage 6) short-circuited cathode by-pass condenser. Replace with new unit
Weak reception	1) low battery voltage 2) receiver circuits out of alignment
Weak audio reception	1) defective type '19 tube. Replace with new tube 2) weak permanent magnet in speaker
Insensitive in center of band	1) "short-circuiting" contact in band switch not shorting 2) receiver aligned on image frequency
Speaker rattle	1) metal filings in speaker

PILOT 7, 8

Distortion, Low sensitivity, Oscillation	1) carbonized voltage-divider system. Replace with wire-wound resistors
Distortion, Grids of type '2A5 tube glow	1) leaky or short-circuited type '2A5 tube cathode by-pass condenser

PILOT 31-81 (RAINBOW SUPER)

Intermittent reception, Fading	1) replace the 10,000-ohm, ½-watt resistor in the cathode circuit of the detector-oscillator tube with a 6,000-ohm unit
Erratic operation	1) defective 10,000-ohm resistor connected between the screens of the first detector-oscillator and the second detector tubes. Replace with a 1-watt unit

PILOT 33

Same case histories as those listed for Pilot 403

PILOT 43, 55

Oscillation ....1) set minimum setting of volume control for 100- or 200-ohms

PILOT 81, 84

Same case histories as those listed for Pilot 7, 8

PILOT 93

Whistles all over dial ....1) receiver circuits out of alignment

Fading ....1) defective triple-unit 0.1-mfd. condensers just below 170-ohm filament resistor—usually leaky or open-circuited. Replace with separate tubular condensers

PILOT 103

Audio oscillation ....1) tone control condenser too close to volume control. Shift the position of this unit

Noisy reception ....1) change type '42 tube
2) change type '6A7 tube

Hum ....1) open-circuited or leaky filter condenser
2) short-circuited cathode condenser on type '42 tube
3) short-circuited r-f by-pass condenser

Insensitive in center of band ......1) i-f amplifier out of alignment
2) r-f amplifier out of alignment

Microphonics ....1) chassis too far forward in cabinet
2) defective type '6A7 tube
3) tuning dial assembly touching front of cabinet
4) defective type '75 tube
5) defective type '6A7 tube

Distortion ....1) defective type '75 tube
2) defective type '42 tube
3) defective type '42 tube cathode by-pass condenser
4) speaker voice coil rubbing on pole piece
5) i-f amplifier out of alignment

PILOT 114

Distortion ....1) leaky audio coupling condenser. Replace with new unit
2) leaky i-f or r-f grid return by-pass condenser. Replace with new unit
3) grounded short-circuiting contact

(Cont'd)

PILOT 114 (cont'd)

Noisy reception	1) dirty or corroded rotor wiping contacts on gang condenser. Clean contacts or solder flexible pigtails between rotor and condenser frame 2) dial-drive disc touching chassis 3) change type '42 tube 4) change type '6A7 tube
Hum	1) open-circuited or leaky filter condenser 2) short-circuited cathode condenser on type '42 tube 3) short-circuited "r-f by-pass" condenser 4) defective type '75 tube 5) defective type '6A7 tube
Distortion	1) defective type '75 tube 2) defective type '42 tube 3) defective type '42 tube cathode by-pass condenser 4) speaker voice coil rubbing on pole piece 5) i-f amplifier out of alignment
Microphonics	1) chassis too far forward in cabinet 2) defective type '6A7 tube 3) tuning dial assembly touching front of cabinet
Insensitive in center of band	1) i-f amplifier out of alignment 2) r-f amplifier out of alignment
No signal	1) open-circuited voltage divider

PILOT 123

Inoperative, No signals	1) short-circuited field coil
Noisy reception	1) defective tube 2) intermittent contact in band switch 3) speaker cone out of alignment
Hum	1) open-circuited or leaky filter condenser 2) short-circuited cathode condenser on type '43 tube 3) short-circuited r-f by-pass condenser 4) defective type '75 tube 5) defective type '6A7 tube
Distortion	1) defective type '76 tube 2) defective type '43 tube 3) defective type '43 tube cathode by-pass condenser 4) speaker voice coil rubbing on pole piece 5) i-f amplifier out of alignment
Microphonics	1) chassis too far forward in cabinet 2) defective type '6A7 tube 3) tuning dial assembly touching front of cabinet
Insensitive in center of band	1) i-f amplifier out of alignment 2) r-f amplifier out of alignment 3) "shorting" contacts on band switch not shorting

PILOT 153

Noisy reception	1) weak batteries 2) defective type '35 tube
No signal	1) open-circuited fuse 2) reversed battery connections
Distortion	1) open-circuited audio transformer 2) wrong "C" battery voltage 3) low filament voltage 4) short-circuited cathode by-pass condenser. Replace with new unit
Weak reception	1) low battery voltage 2) receiver circuits out of alignment
Weak reception in center of band	1) receiver aligned on image frequency
Speaker rattle	1) metal filings in speaker

PILOT 183

Noise	1) change type '6F6 tube 2) change type '6A8 tube

(Cont'd)

PILOT 183 (cont'd)

Hum ....1) open-circuited or leaky filter condenser
2) short-circuited cathode condenser on type '6F6 tube
3) short-circuited r-f by-pass condenser
4) defective type '6H6 tube
5) defective type '6A8 tube

Distortion ....1) defective type '6H6 tube
2) defective type '6F6 tube
3) defective type '6F6 tube cathode by-pass condenser
4) speaker voice coil rubbing on pole piece
5) i-f amplifier out of alignment

Microphonics ....1) chassis too far forward in cabinet
2) defective type '6A8 tube
3) tuning-dial assembly touching front of cabinet

Insensitive in center of band ....1) i-f amplifier out of alignment
2) r-f amplifier out of alignment

PILOT 193

Noisy reception ....1) intermittent contact between tube elements
2) weak contact finger on wave-band switch

Hum ....1) defective tube (even though it may test O.K.). Replace with new tube
2) defective filter condenser. Replace with new unit
3) defective audio cathode by-pass condenser. Replace with new unit

Distortion ....1) short-circuited r-f and i-f grid return condenser
2) grounded short-circuiting contact
3) short-circuited cathode by-pass condenser. Replace with new unit

Insensitive ....1) defective tube (even though it may test O.K.). Replace with new tube
2) i-f amplifier out of alignment
3) r-f amplifier out of alignment
4) wave-trap tuned to wrong frequency. (*Note*: this will also cause interference)

PILOT 203

Noisy reception	1) change type '43 tube
	2) change type '6A7 tube
Hum	1) open-circuited or leaky filter condenser
	2) short-circuited cathode condenser on type '43 tube
	3) short-circuited r-f by-pass condenser
	4) defective type '76 tube
	5) defective type '6A7 tube
Distortion	1) defective type '76 tube
	2) defective type '43 tube
	3) defective type '43 tube cathode by-pass condenser
	4) speaker voice coil rubbing on pole piece
	5) i-f amplifier out of alignment
Microphonics	1) chassis too far forward in cabinet
	2) defective type '6A7 tube
	3) tuning-dial assembly touching front of cabinet
Insensitive in center of band	1) i-f amplifier out of alignment
	2) r-f amplifier out of alignment

PILOT 213

Noisy reception	1) change type '6F6 tube
	2) change type '6A8 tube
Hum	1) open-circuited or leaky filter condenser
	2) short-circuited cathode condenser on type '6F6 tube
	3) short-circuited r-f by-pass condenser
	4) defective type '6H6 tube
	5) defective type '6A8 tube
Distortion	1) defective type '6H6 tube
	2) defective type '6F6 tube
	3) defective type '6F6 tube cathode by-pass condenser
	4) speaker voice rubbing on pole piece
	5) i-f amplifier out of alignment
Microphonics	1) chassis too far forward in cabinet
	2) defective type '6A8 tube
	3) tuning-dial assembly touching front of cabinet
Insensitive in center of band	1) i-f amplifier out of alignment
	2) r-f amplifier out of alignment
	3) "shorting" contact in band switch not shorting

PILOT 243

Noisy reception	1) change type '6F6 tube
	2) change type '6A8 tube

(Cont'd)

PILOT 243 (cont'd)

Hum ....1) open-circuited or leaky filter condenser
2) short-circuited cathode condenser on type '6F6 tube
3) short-circuited r-f by-pass condenser
4) defective type '6H6 or '6A8 tube

Distortion ....1) defective type '6H6 or '6F6 tube
2) defective '6F6 tube cathode by-pass cond.
3) speaker voice coil rubbing on pole piece
4) i-f amplifier out of alignment

Microphonics ....1) chassis too far forward in cabinet
2) defective type '6A8 tube
3) tuning-dial assembly touching front of cabinet

Insensitive in center of band .....1) i-f amplifier out of alignment
2) r-f amplifier out of alignment
3) "shorting" contact in band switch not shorting

Type '6E5 tube inoperative ....1) grid filter short- or open-circuited
2) plate resistor short circuiting

PILOT 253

Noisy reception ....1) defective vibrator unit
2) defective tube (even though it may test O.K.). Try a new tube
3) connection wires not in original positions
4) by-pass condenser not connected to original ground connection.
5) weak battery

Hum ....1) open-circuited or leaky filter condenser*
2) "shorted" cathode cond. on '41 tube
3) short-circuited r-f by-pass condenser*
4) defective type '75 or '6A7 tube

Distortion ....1) defective type '75 or '41 tube
3) defective '41 tube cathode by-pass cond.*
4) speaker voice coil rubbing on pole piece
5) i-f amplifier out of alignment

Microphonics ....1) chassis too far forward in cabinet
2) defective type '6A7 tube
3) tuning-dial assembly touching front of cabinet

Insensitive in center of band .....1) i-f amplifier out of alignment
2) r-f amplifier out of alignment
3) "shorting" contact in band switch not shorting

Weak audio reception .....1) defective vibrator unit
2) defective tube (even though it may test O.K.). Replace with new tube
3) weak speaker magnet

*Important Note: *When replacing condensers, be sure to make the connections exactly the same as they were originally.*

PILOT 293

Noisy reception ....1) defective tube (even though it may test O.K.). Replace with new tube
2) intermittent contact in band switch

Hum ....1) defective tube (even though it may test O.K.). Replace with new tube
2) defective filter condenser. Replace with new unit
3) reverse the speaker field terminal connections
4) open- or short-circuited audio tube cathode condenser. Replace with new unit

Distortion ....1) defective tube (even though it may test O.K.). Replace with new tube
2) short-circuited r-f grid return by-pass condenser. Replace with new unit
3) grounded short-circuiting contact
4) voice coil requires recentering

Microphonics ....1) microphonic tube
2) condenser gang not properly cushioned
3) i-f amplifier not aligned to correct frequency (trimmers are loose)

Insensitive ....1) "short-circuiting" contact in band switch not making contact
2) r-f amplifier out of alignment
3) i-f amplifier out of alignment
4) defective tube (even though it may test O.K.). Replace with new tube

PILOT 304

Noisy reception ....1) defective tube (even though it may test O.K.). Replace with new tube
2) defective wave-band switch contacts

Hum ....1) defective type '25A6 tube. Replace with new tube
2) defective type '25Z6 tube. Replace with new tube
3) defective filter condenser. Replace with new unit

Distortion ....1) defective tube (even though it may test O.K.). Replace with new tube
2) grounded short-circuiting contact

Microphonics ....1) r-f amplifier not properly cushioned
2) chassis not properly cushioned in cabinet (table model only)

Insensitive ....1) defective tube (even though it may test O.K.). Replace with new tube
2) r-f amplifier out of alignment

PILOT 364

Noisy reception	1) change type '6F6 tube 2) change type '6L7 tube
Hum	1) open-circuited or leaky filter condenser. 2) short-circuited cathode condenser at type '6F6 tube 3) short-circuited r-f by-pass condenser 4) defective type '605 or '6L7 tube
Distortion	1) defective type '605 or '6F6 tube 2) defective type '6F6 tube cathode by-pass condenser. Replace with new unit 3) speaker voice coil rubbing on pole piece 4) i-f amplifier out of alignment
Microphonics	1) chassis too far forward in cabinet 2) defective type '6L7 tube 3) tuning dial assembly touching front of cabinet
Insensitive in center of band	1) i-f amplifier out of alignment 2) r-f amplifier out of alignment 3) "shorting" contact in band switch not shorting
Type '6E5 tube inoperative	1) grid filter cond. short- or open-circuited 2) plate resistor short-circuiting

PILOT 403

Noisy reception	1) defective tube (it may test O.K.). Replace with new tube by substitution 2) dirty or corroded band switch contacts
Hum	1) defective filter condenser. Replace 2) defective audio by-pass cond. Replace 3) reverse speaker field connections
Insensitive	1) i-f amplifier out of alignment 2) r-f amplifier out of alignment 3) defective tube (even though it may test O.K.). Replace with new tube 4) band aligned to image frequency
Insensitive on short-wave band	1) wave-trap tuned to frequency in broadcast band, causing interference
Microphonics	1) microphonic tube 2) condenser gang not properly cushioned
Distortion	1) defective tube (even though it may test O.K.) Replace with new tube 2) short-circuited r-f grid return condenser. 3) short-circuited audio cathode by-pass condenser. Replace with new unit 4) voice coil requires recentering

RADIOLA 17

Hum, Weak reception, No bias on first r-f tube	1) volume control arm not making contact
Hum	1) clean contacts on all hum-control potentiometers and adjust for minimum hum
Oscillation	1) open-circuited type '26 tube filament by-pass condenser
Inoperative	1) open audio transformer winding 2) open-circuited voltage divider resistor 3) shorted condenser in block in power pack
Weak reception, Foul odor	1) defective power transformer
Weak reception,	1) open-circuited grid resistor
Noisy reception, Fading	1) clean volume control contacts and resistor strip 2) clean tube socket prongs 3) tighten all connections on terminal board

RADIOLA 18

Oscillation over entire dial	1) open-circuited by-pass condenser across split primary winding of second and third r-f stages
Oscillation at high frequencies	1) adjust r-f compensating condenser
Noisy, Intermittent reception	1) poor contact, or snapped tabs of by-pass condensers across primary winding
Noisy reception, Fading	1) clean contacts and resistance strip on volume control 2) clean tube socket prongs
Noisy reception, Intermittent "crackling" (volume control at minimum setting; antenna and ground connected), Noise stops when second r-f tube is removed	1) intermittently open-circuiting coil in series with the primary winding of the third r-f transformer. Replace this coil with a small choke coil of similar design
Crackling noises at all volume control settings	1) partial open-circuit in one of the r-f coil primary link circuits
Low volume	1) this may be improved by disconnecting the antenna lead from one side of the volume control potentiometer and connecting that lead to the movable arm, disconnecting the lead to the grid of

(Cont'd)

RADIOLA 18 (cont'd)

	the first r-f tube from that point. Now, between the grid of the first r-f tube and the side of the potentiometer to which the antenna was formerly connected, connect an r-f choke. This will increase the receiver output considerably
Poor selectivity, Low sensitivity	1) adjust r-f compensating condenser
Inoperative	1) shorted condenser in block in power pack 2) open plate resistor in power pack. Replace with one of higher wattage rating
Distortion, Higher detector plate voltage	1) detector plate limiting resistor "open"
Distortion	1) defective type '47 tube (even though it may test O.K.). Replace with new tube

RADIOLA 28A

Low volume, Oscillation (impossible to align receiver circuits)	1) ground the case of the oscillator padding condenser

RADIOLA 30A

Fading, Intermittent reception, Fluctuating voltages	1) poorly soldered connections to voltage dividers 2) loose contact arms on rheostats
Oscillation over entire dial	1) adjust r-f neutralizing condenser
Noisy, Intermittent reception	1) oxidized rheostat resistance element and slider
Insensitive, Tuning off scale	1) check antenna coupler connections

RADIOLA 30, 32

Weak reception	1) one of the parallel resistors in type '876 ballast tube open; shunt a 60-watt electric light bulb in parallel with ballast tube socket for permanent operation, or temporary repair.
No reception, (type '876 ballast tube lights very brightly	1) "shorted" filter condenser in power pack
Noisy tuning	1) clean variable condenser plates with pipe cleaner
Noisy reception or fading	1) clean volume control contacts and resistance strip

RADIOLA 33

See also case histories listed for Radiola 18

Hum	1) pilot-light socket shorted to chassis
Inoperative	1) replace plate resistor with one of higher wattage rating
Weak reception, Oscillation	1) re-adjust detector trimming condenser
Noisy reception, Fading	1) clean volume control contacts 2) clean tube socket prongs

RADIOLA 41

Choked reception Distortion, No output tube bias voltage	1) short-circuited type '210 tube bias resistor by-pass condenser
Hum	1) partially "shorted" section or sections of speaker rectifier stacks 2) volume control arm not making contact 3) poor ground connection to speaker frame
Strong hum	1) remove ground connection to speaker frame
Noisy reception	1) corroded volume control resistance element and contact arm 2) loose volume control contact arm 3) noisy audio transformer primary
Line fuse blows	1) short-circuited rectifier stack sections
Oscillation	1) shunt 100,000-ohm resistor across 3rd r-f transformer primary 2) increase value of grid suppressors
Broad tuning	1) reduce value of grid suppressors
Inoperative	1) shorted filter cond. in block power pack 2) open voltage-divider resistor

RADIOLA 42

Fading on local stations	1) defective type '24 tubes 2) check volume control resistor

RADIOLA 44, 46

Noisy tuning, Oscillation	1) corroded seats on r-f shield cans
Inoperative, Intermittent reception	1) open-circuited or open-circuiting 0.01-mfd. audio coupling-condenser
Insensitive, Oscillation at low frequencies	1) re-align condenser gang

(*Cont'd*)

RADIOLA 44, 46 (cont'd)

Low, or no detector plate voltage	1)	grounded detector-plate audio choke. Place insulation between choke and chassis
No r-f screen voltage	1)	volume control slider arm not making contact
	2)	shaft of volume control shorting to chassis
Hum, Insensitive	1)	add a 4-mfd. electrolytic condenser between field lug and "ground"
	2)	variable condenser stator plates off-center
Oscillation	1)	poorly soldered connections on r-f coils
	2)	leads on r-f chokes (inside of coil) shorting

RADIOLA 47

Noisy tuning, Oscillation	1)	corroded seats on r-f shield cans
Broad tuning, Set does not tune to settings on the tuning dial, especially at the high-frequency settings	1)	worn-out rotor bearings, which allow the rotor to slip slightly in a side direction, thus changing the tuning condenser capacity and throwing the set out of alignment. Realign the rotor plates and tighten them in position
	2)	realign the trimmers at the high-frequency settings of the tuning dial
Spasmodic radio operation (lack of screen-grid voltage on the r-f amplifier tubes)	1)	corroded radio-phono transfer-switch prong, the other prong making good contact. Clean the prong and bend it to increase its tension
Inoperative, Intermittent reception	1)	open-circuited or open-circuiting 0.01-mfd. audio coupling-condenser
Intermittent reception No r-f screen or plate voltages	1)	corroded or open contacts of phono-radio transfer switch
Insensitive, Oscillation at low frequencies	1)	re-align condenser gang
Low, or no detector plate voltage	1)	grounded detector plate audio choke. Place insulation between choke and chassis
No r-f screen voltage	1)	volume control slider arm not making contact
	2)	vol. control shaft shorting to chassis
Fading on local stations volume can be brought back by snapping a-c switch on and off	1)	poor contact on phono switch through which plate supply of first and second r-f tubes feeds through. Replace with new switch

RADIOLA 48

Choked reception, Distortion, Hum, Positive grid bias on type '45 tubes, Weak reception	1) short-circuited 0.025-mfd. audio coupling condensers
Noisy tuning, Intermittent reception	1) plating peeling from variable condenser plates. Burn with high voltage—all leads disconnected 2) corroded gang-condenser rotor shaft clips
Oscillation	1) corroded gang-condenser rotor shaft clips
Fading, Intermittent reception, Noisy reception	1) broken resistance elements in dual volume control. Replace
No r-f screen voltage	1) open-circuited r-f choke in screen circuit
Hum	1) change type '24 detector tube

RADIOLA 48 (CANADIAN)

Same case histories as those listed for Radiola 48

RADIOLA 50

Same case histories as those listed for Radiola 17

RADIOLA 51

Same case histories as those listed for Radiola 18

RADIOLA 60, 62

Distortion, Weak reception	1) open-circuited audio transformer primary
Distortion at low volume	1) broken spider on speaker cone
Inoperative	1) open-circuited i-f coil
Weak reception	1) increase in value of 20,000-ohm bleeder resistor in power pack from about 2,500 to 3,700-ohms. Replace with a 20,000-ohm, 10-watt unit
Insensitive, Oscillation	1) re-adjust neutralizing condensers, and tuning condensers of i-f coils. To do this, variable condenser tube must be removed
Insufficient sensitivity	1) shunt 400-ohm section of flat wire-wound voltage divider near volume control with 500-ohm unit

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RADIOLA 60, 62 (cont'd)

Insensitive at high frequencies ....1)	connect two small trimmer condensers made of 0.001-inch thick brass, ½-inch square, mounted properly. Align the receiver circuits completely
Inoperative above 600 kc, Dial settings incorrect ....1)	snapped tabs on oscillator series condenser
Unstable operation, Oscillation, "Birdies" ....1)	open-circuited oscillator grid leak
Oscillation all over dial ..1)	connect a 0.05-mfd. condenser from the i-f B-plus terminal in the power pack to chassis
Hum (on Model 62)........1)	partially shorted speaker rectifier stacks
2)	remove gnd. connection to spk'r. frame
House fuse blows (on Model 62) ....1)	short-circuited sections of speaker rectifier stacks
No control of volume .....1)	defective type '71-A tube. Replace with new tube
Intermittent volume ....1)	open-circuited secondary winding in audio transformer
2)	defective 20,000-ohm resistor in power pack. Replace with new unit
Noisy reception ....1)	defective r-f plate choke in r-f transformer assembly

RADIOLA 64

See also case histories listed for Victor 9-18

Hum ....1)	interaction between the speaker field power supply and the receiver power supply. Remove the terminal shield between them, thereby eliminating their common connection
Inoperative, Tuning meter not working ....1)	open-circuited 3,850-ohm section in resistor block in chassis
2)	open-circuited section of voltage-divider resistor
3)	inoperative volume control
Inoperative ....1)	shorted filter condenser in block
Weak oscillations........1)	re-adjust i-f condensers

RADIOLA 66

Distortion .... 1) open-circuited 250,000-ohm resistor in audio transformer secondary-return circuit

Fading, ... 1) snapped tabs on oscillator series condenser
Intermittent reception,
Dial settings shift
Inoperative below 600 kc

Insensitive at high .... 1) oscillator trimmers out of adjustment
or low frequencies 2) r-f compensating condenser out of adjustment

RADIOLA 67

See also case histories listed for Radiola 64

Loud hum .... 1) place wads of felt on the speaker cone to muffle the 60-cycle hum

Oscillation .... 1) "local-distance" switch, on "local" side, cutting out the aerial. In some localities the aerial is necessary in the circuit and must be connected

Inoperative .... 1) open-circuited 115-ohm voltage divider section
2) open or corroded contacts of phono-radio transfer switch
3) open-circuited 1-megohm AVC grid resistor

Inoperative, ... 1) open-circuited 100-ohm section of voltage divider
Tuning meter needle off scale

Fading .... 1) corroded contacts on phono-radio transfer switch

No control of volume .... 1) open-circuited 310-ohm end section of voltage divider in tuning chassis. Replace with 25-watt resistor

RADIOLA 80, 82

See also case histories listed for Westinghouse WR-5

Distorted reproduction, ... 1) open-circuited 60,000-ohm resistor in push-pull input transformer secondary return circuit
Hum

Poor control of volume .... 1) remove 6,000-ohm resistor across volume control

Distortion, ... 1) "open" audio transformer primary
Low volume 1) increase in value of 10,000-ohm "C" bias resistor connected between the cathode of the second detector tube and the ground. Replace with a 7,500 to 10,000-ohm resistance *(Cont'd)*

RADIOLA 80, 82 (cont'd)

Fading, Intermittent reception Shifting of station dial settings	1) snapped tabs on oscillator series condenser
Inoperative below 600 kc	1) snapped tabs on oscillator series condenser
Weak reception, Slight distortion, Volume control must be turned to maximum	1) screen drop resistor carbonized to low value and screen-cathode bleeder carbonized. Replace with new wire-wound units
Noisy reception (Model 82 only)	1) loose connection in local-distance switch 2) defective type '24-A tube

RADIOLA 80, 82 (CANADIAN)

Same case histories as those listed for Radiola 80

RADIOLA 86

Same case histories as listed for Radiola 80

RCA SUPERETTE

Weak oscillations, High screen-grid voltage	1) carbonized 14,300-ohm screen resistor Replace with wire-wound type resistor.

RCA-VICTOR (AMERICAN) RECEIVERS

See also listings under Radiola

(RCA-Victor (Canadian) receivers are listed following the end of the RCA-Victor (American) group. See also the RCA-Victor Canadian-American receiver Cross Index on page 1B-1)

RCA-VICTOR AVR-1

Same case histories as those listed for RCA-Victor 140, 141, 240

RCA-VICTOR R-4

See also case histories listed for RCA-Victor R-6

"Sputtering," Motorboating (only at "low" setting of volume control)	1) connect a 0.01-mfd. condenser from the screen-grid circuit to ground
Crackling noise	1) loose eyelet through which grid lead of type '24 tube is brought up, causing a variation in capacity between the grid lead and ground. Remove or solder eyelet in place

RCA-VICTOR R-6

Distortion at any volume level ....1)	voltage divider resistors carbonized. Install wire-wound unit for screen-drop resistor
Noisy tuning, Oscillation, Motorboating ....1)	corroded condenser-gang rotor contacts. Solder flexible pigtails between rotors and condenser frame

RCA-VICTOR R-7

See also case histories listed for RCA-Victor R-6

Loss of volume, Oscillation ....1)	decrease in value of 14,300-ohm screen resistor to about 5,000-ohms, causing a high screen-grid voltage. Replace with new unit
2)	increase in resistance of 8,000-ohm resistor between the screen-grids and the cathodes. Replace with new unit
3)	clean the contact springs on the condenser rotor or bond with flexible pigtails to the condenser frame
4)	receiver circuits out of alignment
Acoustic "howl" ....1)	hardening of rubber chassis supports. Replace them
Microphonics ....1)	chassis not swinging freely—touching cabinet
Oscillation in r-f or i-f circuits ....1)	high-resistance shielding contacts. Clean contacts or bond shields to chassis with pigtails
2)	open-circuited by-pass condensers
3)	ungrounded electric light line. Connect the *ground* to both the chassis and ground lead
Abnormal screen-grid voltages ....1)	change in value of screen-grid resistors. Check all resistors in the screen circuits and replace with new units if defective

RCA-VICTOR R-8

Distortion at any volume level ....1)	carbonized voltage-divider resistors (install wire-wound resistors)
Inoperative until AVC tube is withdrawn, Fading, Insensitive, Weak reception ....1)	leaky 0.1-mfd. AVC grid-return by-pass condensers
Noisy tuning, Oscillation, Motorboating ....1)	corroded condenser-gang rotor contacts. Solder flexible pigtails between rotors and condenser frame (*Cont'd*)

RCA-VICTOR R-8 (cont'd)

Motorboating ....1) defective 4-mfd. pack condenser in the plate-to-ground circuit of the r-f and detector-oscillator plate voltage filter. Replace this condenser on the outside of the pack

Intermittent reception, Oscillation ......1) open-circuiting or open-circuited r-f and i-f secondary-return by-pass condensers

RCA-VICTOR R-9

Same case histories as those listed for RCA-Victor R-4, R-6, R-7

RCA-VICTOR R-10

Weak oscillations, Distortion ....1) carbonized 16,000-ohm screen resistor. Replace with wire-wound type resistor

RCA-VICTOR R-11

Fading ....1) "open" 5-meg. resistor in AVC ck't
2) leaky 0.1-mfd. AVC grid-return by-pass condensers

Weak reception, Insensitive, Inoperative until AVC tube is withdrawn ....1) leaky 0.1-mfd. AVC grid-return by-pass condensers

Distortion at any volume level .1) carbonized voltage-divider resistors. Install wire-wound unit for screen-drop resistor

Stations tune in with "plop" ....1) reduce AVC tube heater voltage

Fading, Noisy, Intermittent reception ....1) corroded contact of volume control shaft
2) loose volume control resistance winding

Very weak, distorted reception ......1) open-circuited coupling winding in second i-f transformer

Distortion, Weak reception, High positive bias on one output tube ....1) primary to secondary "short" in push-pull input transformer

Noisy tuning, Oscillation, Hum ....1) corroded condenser-gang rotor contacts. Solder a pigtail from rotor shaft to chassis

Motorboating if a '47 tube is withdrawn 1) 1-megohm resistor on phono terminal strip shorting to terminal *No. 4*

Motorboating ....1) connect a 0.1-mfd. condenser across the resistor mounted inside of the ant. coil

RCA-VICTOR R-12

See also case histories listed for RCA-Victor R-8

Motorboating	1) defective type '47 tubes 2) connect a 5,000-ohm resistor in series with the screens of the type '47 tubes

RCA-VICTOR R-17

Poor tone	1) replace the 0.004-mfd. condenser across the primary of the output or speaker transformer with a 0.01-mfd. condenser (tubular type)

RCA-VICTOR R-17A

Same case histories as those listed for RCA-Victor R-6

RCA-VICTOR R-17-M

Weak, distorted reproduction	1) armature of magnetic speaker not centered
Inoperative	1) open-circuited detector-plate resistor
Inoperative, Intermittent reception	1) antenna lead shorted or shorting to eyelet of bracket

RCA-VICTOR R-21

Same case histories as those listed for RCA-Victor R-11

RCA-VICTOR R-28

Intermittent reception Noisy reception	1) defective type '2A7 tube
Inoperative	1) short-circuited filter condenser section

RCA-VICTOR R-28-P

Inoperative on short-wave band	1) short-circuited trimmer condensers on band switch
Oscillation all over dial	1) open-circuited 4-mfd. electrolytic screen by-pass condenser, mounted in dual container under chassis. Replace complete unit

RCA-VICTOR R-31

Fading	1) defective filter condenser

RCA-VICTOR R-32

Intermittent reception, Low volume (tubes and voltages check O.K.)	1) cone torn around fibre washer at center. Remove speaker to find tear

RCA-VICTOR R-35

Weak, or no reception........	1) open 1st a-f plate-supply resistor (10,000 ohms)
	2) carbonized screen-grid drop resistor (8,000-ohms)

RCA-VICTOR R-37, R-38

Same case histories as those listed for RCA-Victor R-28

RCA-VICTOR R-39

Same case histories as those listed for RCA-Victor R-35

RCA-VICTOR R-43

Erratic operation	1) low "B" batteries. Replace when battery voltage (with set turned on) drops to less than ¼ of normal voltage

RCA-VICTOR R-50

See also case histories listed for Graybar GB-100

Weak reception, Cannot peak 1st detector stage	1) open-circuited trimmer series resistor for this stage
Inoperative, No plate voltage on 2nd detector tube	1) open-circuited portion of primary of push-pull input transformer. Use good portion only
Hum	1) open-circuiting of end section of tapped filter choke—install jumper
Distorted reproduction, Weak reception, Fading, Oscillation	1) carbonized voltage-divider system. Use wire-wound screen voltage drop resistor as replacement
Intermittent reception, Low phono volume (RAE-59, RE-20)	1) corroded contact segments of radio-phono transfer switch

RCA-VICTOR R-52

Same case histories as those listed for RCA-Victor R-32

RCA-VICTOR R-55

Same case histories as those listed for RCA-Victor R-50

RCA-VICTOR R-71, R-72

Sharp volume cut-off, Oscillation, Station hiss	1) open-circuiting or open-circuited 0.05-mfd. r-f, first detector and i-f secondary-return by-pass condensers
Weak reception, Station hiss, Oscillation	1) open-circuiting or open-circuited 0.05-mfd. r-f, first detector and i-f secondary-return by-pass condensers
Motorboating between stations, Distorted, Poor control of volume	1) leaky 0.05-mfd. r-f first detector and r-f secondary-return by-pass condensers
Noisy tuning, Oscillation, Motorboating between stations	1) corroded condenser-gang rotor contacts. Solder flexible pigtails between rotors and condenser frame

RCA-VICTOR R-73

Fading, Intermittent reception, Station hiss, Oscillation	1) decrease in value of one of the 0.05-mfd. by-pass condensers in the secondary return circuits of the r-f, first detector and i-f stages. Replace if the value is lower than rated. This is usually due to a high-resistance connection at the condenser terminal or an internal open-circuit 2) intermittently open-circuiting condenser in one of the secondary return circuits. Test by flashing with high a-c. voltage. Replace all condensers which break down after this test
Distortion, Poor control of volume, Motorboating, Oscillation	1) leaky 0.05-mfd. r-f, first detector and i-f secondary-return by-pass condensers
Noisy tuning, Oscillation, Motorboating between stations	1) corroded condenser-gang rotor contacts. Solder flexible pigtails between rotors and condenser frame
Weak, Distorted reception	1) open-circuited 60,000-ohm resistor in push-pull input transformer secondary return circuit 2) open-circuited 0.2-mfd. a-f blocking condenser
Low volume	1) change the three 0.1-mfd. by-pass condensers in the AVC circuit

RCA-VICTOR R-74

Fading, Sharp drop in volume, Weak reception, Station hiss	1) open-circuited 0.05-mfd. r-f, first detector and i-f secondary-return by-pass condensers

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RCA-VICTOR R-74 (cont'd)

Poor control of volume, Distortion, Distortion at resonance	1) open-circuited screen-grid or cathode by-pass condenser. Replace with new unit 2) open-circuited first detector 0.05-mfd. grid filter condenser connected between the secondary winding of the second r-f transformer and ground, located to the left of the volume control. Replace with new unit *Note*: the same trouble also occurs in similar condenser located in the i-f or r-f stages; the former being connected near the antenna coil; the latter near the second i-f transformer
Noisy tuning, Oscillation, Motorboating between stations	1) corroded condenser-gang rotor contacts. Solder pigtails between rotors and condenser frame
Intermittent reception, Inoperative	1) open-circuiting or open-circuited 0.1-mfd. audio coupling-condenser

RCA-VICTOR R-75

Same case histories as those listed for RCA-Victor R-73

RCA-VICTOR R-76

Same case histories as those listed for RCA-Victor R-74

RCA-VICTOR R-77

Same case histories as those listed for RCA-Victor R-74

RCA-VICTOR R-78, R-78A

Fading, Sharp drop in volume, Weak reception, Station hiss	1) open-circuited 0.1-mfd. r-f, first detector and i-f secondary-return by-pass condensers
Poor control of volume, Distortion, Distortion at resonance	1) leaky 0.1-mfd. r-f, first detector and i-f secondary-return by-pass condensers
Noisy tuning, Oscillation, Motorboating between stations	1) corroded condenser-gang rotor contacts. Solder pigtails between rotors and condenser frame
Mechanical hum	1) loose laminations of filter choke—heat in oven
Noisy reception	1) noisy volume control
Fading, Dial settings incorrect	1) snapped tabs on oscillator series condenser

RCA-VICTOR R-90

Weak, Distorted reception	1) open-circuited AVC coupling condenser and grid resistor within first i-f transformer shield

RCA-VICTOR RAE-26

See also case histories listed for RCA-Victor R-11

Weak reception	1) carbonized 14,300-ohm screen-drop resistor. Replace with wire-wound resistor 2) carbonized 18,000-ohm screen-bleeder resistor

RCA-VICTOR RAE-59

Same case histories as those listed for RCA-Victor R-50

RCA-VICTOR RAE-68

Cannot be switched on	1) copper contacts on relay burned away
Cannot be switched off	1) relay arm welded to copper contacts of relay
Chattering of tuning control when "remote" is used	1) adjust friction screw
Distorted reproduction, Hum	1) open-circuited 60,000-ohm resistor in push-pull input transformer secondary return circuit
Poor control of volume	1) remove 6,000-ohm resistor from across volume control
Distortion, Low volume	1) open-circuited audio transformer primary
Fading, Intermittent reception, Shifting of station dial settings	1) snapped tabs on oscillator series condenser
Inoperative below 600 kc	1) snapped tabs on oscillator series condenser
Weak reception Slight distortion, Volume control must be turned to maximum	1) screen-drop resistor carbonized to low value and screen-cathode bleeder carbonized
Automatic phono mechanism troubles	1) see Case Histories listed for RCA-Victor RAE-79

RCA-VICTOR RAE-79

Cannot be switched on	1) copper contacts on relay burned away
Cannot be switched off	1) copper contacts on relay welded to armature of relay

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RCA-VICTOR RAE-79 (cont'd)

Phono-radio change-over switch inoperative ....1)	open-circuited 17-ohm pilot indicator shunt resistor
Remote control does not respond ....1)	break in remote control cable at control box
Bottom record dislodged ....1)	magazine roller incorrectly adjusted
Record not deposited upon turntable ....1)	adjust record transfer lever
2)	increase tension of spring in turntable spindle nose
Pickup lowers on outer smooth rim on record, failing to slip into first groove or slides across several grooves ....1)	too much tension on flat spring pressing against the tone-arm locating lever. Bend the flat spring out in order to decrease the tension
Continuous rejecting ....1)	riveted joint on which four finger lever is mounted working loose, causing the long finger to dislodge, so that it swings into position against the flat side of the clutch pawl, starting another cycle. Hammer down the rivet, so as to tighten lever, but not so that it will stick
2)	insufficient tension of four-finger lever spring
3)	long arm of four-finger lever bent out of shape
Continuous tripping, Cannot be stopped by pressing "off" button ....1)	incorrect timing
2)	improper adjustment of switch actuated by the bracket at the rear of the slide. The contacts of this switch should open and close only when the mechanism has tripped. Adjust switch by loosening the two mounting screws, one of which slides in a slotted adjusting hole
Intermittent phono operation ....1)	corroded contact segments of phono-radio transfer switch
2)	corroded copper center contact of phono volume control
Weak record reproduction. Weak home and radio recording ....1)	dismantle phono pick-up and clean wax from armature and rubber dampers
Noisy reception ....1)	high-resistance connection at wiping contact between movable arm of volume control, and lug at the center of the cover. Solder a flexible pigtail between these two points

RCA-VICTOR RAE-84

Fading, Sharp drop in volume, Weak reception, Station hiss ....1)	open-circuited 0.1-mfd. r-f, first detector and i-f secondary-return by-pass condensers
Poor control of volume, Distortion, Distortion at resonance ....1)	leaky 0.1-mfd. mfd. r-f, detector and i-f secondary-return by-pass condensers
Noisy tuning, Oscillation, Motorboating between stations ....1)	corroded condenser-gang rotor contacts. Solder pigtail from rotor shaft to chassis
Mechanical hum ....1)	loose laminations of filter choke—heat in oven
Noisy reception ....1)	noisy volume control
Fading. Dial settings incorrect ....1)	snapped tabs on oscillator series condenser
Phono troubles ....1)	see Case Histories listed for RCA-Victor RAE-79
Manual lever jammed ....1)	manual lever bent

RCA-VICTOR RE-18

Same case histories as those listed for RCA-Victor R-11

RCA-VICTOR RE-20

Same case histories as those listed for RCA-Victor R-50

RCA-VICTOR RE-40

See also case histories listed for RCA-Victor R-28

Interference, Noisy reception ....1)	pickup of noise from cable sheath by tuning cable, which is connected to variable condenser rotors. Bond sheath to triangular plate (mounted on rubber) to which sheath is attached

RCA-VICTOR RE-45

Same case histories as those listed for RCA-Victor R-32

RCA-VICTOR RE-57

Same case histories as those listed for RCA-Victor R-35

RCA-VICTOR RE-80

Oscillation, No AVC action, Loud volume, Motorboating, Distortion, Oscillation ....1)	pilot-lamp socket short-circuiting to the chassis. Since this is connected across the power amplifier filament lines, the power amplifier bias resistor is short-circuited and the cathode voltage from the type '55 tube is removed, thus preventing AVC action. Wrap a layer of tape around the socket lugs to prevent further short-circuiting

RCA-VICTOR RE-81

Intermittent radio or phono reception	1) corroded contact segments at master change-over switch
Fading, Sharp drop in volume, Weak reception, Station hiss	1) open-circuited 0.05-mfd. r-f, first detector and i-f secondary-return by-pass condensers
Poor control of volume, Distortion, Distortion at resonance	1) leaky 0.05-mfd. r-f, first detector and i-f secondary-return by-pass condensers
Noisy tuning, Oscillation, Motorboating between stations	1) corroded condenser-gang rotor contacts. Solder pigtail lead from rotor shaft to chassis
Intermittent reception, Inoperative	1) open-circuiting or open-circuited 0.1-mfd. audio coupling-condenser
Inoperative home recording meter	1) remove meter and decrease tension upon pivot of meter needle

RCA-VICTOR 28-P

Intermittent reception, Fading	1) open-circuited detector secondary return by-pass condenser 2) open-circuited r-f cathode by-pass condenser
Oscillation, Motorboating	1) loss in capacity of second section of dual filter condenser

RCA-VICTOR 66

Inoperative (tubes and voltages test O.K.), Oscillator signal cannot pass through second detector stage	1) open-circuited primary coil in last i-f transformer (has a 7,000-ohm resistor shunted across it

RCA-VICTOR 68

Remote-control switch inoperative	1) burned or corroded contacts at the power switch relay caused by switching when the phonograph is in the circuit. Replace if burned; clean if corroded. Connect a 2-mfd., 150-volt paper condenser across the contacts to reduce the arc when switching takes place

RCA-VICTOR 100

Modulation hum at low volume setting	1) connect a 0.1-mfd. (400-volt) by-pass condenser from one side of the power transformer primary to ground 2) reverse the line-plug in its socket

RCA-VICTOR 117

Intermittent reception, Inoperative, No screen voltages	1) open-circuiting 10,000-ohm screen drop resistor
Choked, distorted reception Weak reception	1) leaky or short-circuited type '6B7 tube cathode by-pass condenser
Inoperative, No screen voltage on oscillator tube	1) open-circuited oscillator plate series resistor 2) "shorted" oscill. plate by-pass condenser
Oscillation Weak, choked signals	1) loss in capacity of oscillator plate by-pass condenser
Fading, Intermittent reception, Station hiss	1) open-circuiting grid filter condensers in oscillator and i-f stages
Slipping dial in "fast" tuning position	1) insufficient tension of three copper spring clips on dial-drive shaft

RCA-VICTOR 118

Distortion, Poor control of volume	1) tap on volume control grounding to chassis
Inoperative, Oscillation	1) open-circuited 4-mfd. oscillator plate by-pass condenser
Inoperative, No oscillator (anode) plate voltage	1) burnt-out 30,000-ohm oscillator plate voltage-drop resistor. (Usually due to short-circuited-4 mfd. by-pass condenser)
Intermittent, Fading, Noisy reception	1) snapped tabs on oscillator series condenser. Solder if possible or replace 2) open-circuiting type '6B7 tube grid coupling condenser 3) open-circuiting type '6A7 or '6D7 grid-return by-pass condensers

RCA-VICTOR 121

See also case histories listed for RCA-Victor 122

Instability after replacing a filter condenser	1) long lead on new condenser too near wave-change switch. Re-route this lead
Poor selectivity	1) defective oscillator coil
Motorboating	1) "open" 4-mfd. capacitor pack section

RCA-VICTOR 122

Inoperative	1) open-circuited 10,000-ohm screen voltage-dropping resistor 2) short-circuited oscillator plate by-pass condenser

(Cont'd)

RCA-VICTOR 122 (cont'd)

	3) open-circuited oscillator plate series resistor
Fading, Oscillator drift	1) snapping of connecting tabs of oscillator series condenser 2) excessive solder at ends of oscillator series condenser contacting metal jacket
Two-spot reception of stations about 20 kc apart	1) short-circuited or leaky i-f grid filter condenser
Inoperative, Oscillation	1) open-circuited 4-mfd. oscillator plate by-pass condenser
Inoperative, No oscillator plate voltage	1) burnt-out 30,000-ohm oscillator plate dropping resistor. (Check for shorted 4-mfd. by-pass condenser at same time) 2) open-circuiting screen-voltage dropping resistor
Intermittent reception Fading Noisy	1) open-circuiting type '58 or '2A7 grid return by-pass condensers

RCA-VICTOR 128

Inoperative except at one point on broadcast band	1) short-circuited oscillator section of condenser gang. Separate bonding pigtail from stator connection
Choked reproduction, Weak reception	1) short-circuited or leaky type '6B7 tube cathode by-pass condenser
Two resonance peaks of stations, about 20 kc apart	1) short-circuited or leaky i-f grid filter condenser
Slipping dial in "fast" tuning position	1) insufficient tension of three spring clips on drive shaft
Intermittent reception, Inoperative	1) open-circuiting 10,000-ohm screen voltage-dropping resistor
Fading, Oscillator drift	1) snapped tabs on oscillator series condensers 2) lumps of solder at soldered connections of oscillator series condenser contacting metal jacket
Dial slips	1) push down three copper fingers on reduction device (with dial set for vernier tuning) to increase tension
Vibration, Rattle	1) make dial glass window and frame secure
Inoperative	1) grid lead to type '6B7 tube grounding to shield cable

RCA-VICTOR 140, 140-E, 141, 141-E

Hum at resonance	1) change type '2B7 second-detector tube 2) shunt first audio '56 grid choke with 0.1-mfd. by-pass condenser
Noisy, Intermittent reception	1) loose elements in type '2A7 tube
Inoperative	1) leakage or short-circuit between cathode and heater of type '2A7 tube
Code interference	1) use 445-kc i-f transformer as wave trap in antenna circuit
Intermittent reception, Inoperative	1) insufficient tension of wave-band switch contacts 2) open-circuiting coils in tuner assembly 3) short-circuiting trimmers within 1st i-f transformer
Weak, distorted reception, Hum	1) open-circuited section of output transformer primary
Distortion (in 140 Model only)	1) shunt a 40,000-ohm resistor across the 2-megohm unit located in the grid circuit of the second detector tube

RCA-VICTOR 143

Very weak response, Volume control ineffective	1) replace volume control
Inoperative, No plate voltage on 1st type '76 tube	1) open-circuited 10,000-ohm series resistor
Noisy reception, Grinding, rasping, with volume control turned to minimum	1) noisy primary of push-pull input transformer
Slipping dial in "fast" tuning position	1) insufficient tension of three spring clips on drive shaft
Intermittent reception, Station hiss	1) open-circuiting grid filter condensers in r-f, i-f and first detector stages
Fading, Oscillator drift	1) snapped connecting tabs of oscillator series condenser 2) end connections to oscillator series condenser contacting metal jacket
Weak reception, No change in volume	1) defective volume control. Arm not making contact
Intermittent, Noisy reception	1) open-circuiting by-pass condensers in grid-return circuits of '6D6 or '6A7 tubes
Dial slips	1) push down three copper fingers, with dial set for vernier tuning *(Cont'd)*

RCA-VICTOR 143 (cont'd)

Intermittent, Noisy reception Fading	1) poor contact on wave-band switch
Inoperative	1) control-grid lead of type '75 detector tube grounding to shield

RCA-VICTOR 211

Same case histories as those listed for RCA-Victor 117, 118

RCA-VICTOR 220, 221

Inoperative, No oscillator plate voltage	1) open-circuited 20,000-ohm oscillator plate series resistor 2) "shorted" oscill. plate by-pass cond.
Oscillation, Motor-boating, Distortion	1) oscillator out of alignment 2) loss in capacity of oscillator plate by-pass condenser 3) defective type '2B7 tube (even though it may test O.K.). Replace 4) poor shielding on leads running to the control grid and diodes of '2B7 tube 5) replace the 1.5-megohm type '2A5 tube grid resistor with a 150,000-ohm unit (in Model 220)

RCA-VICTOR 224

Same case histories as those listed for RCA-Victor 128

RCA-VICTOR 226

Same case histories as those listed for RCA-Victor 128

RCA-VICTOR 240

Same case histories as those listed for RCA-Victor 140, 141

RCA-VICTOR 241-B

Intermittent reception	1) corroded joints at points where leads are welded to coils in both input and output transformers

RCA-VICTOR 242

Same case histories as those listed for RCA-Victor 143

RCA-VICTOR 260, 261

Distortion, Lowered sensitivity	1) open-circuited type '58 AVC—i-f tube cathode bias resistor
Distortion at resonance	1) open-circuited AVC coupling condenser
Intermittent reception, Station hiss	1) open-circuiting grid filter condensers in r-f, i-f and first detector stages 2) open-circuited secondary return by-pass condenser in second detector stage

RCA-VICTOR 262, 263

Abrupt volume increases—1)	pigtail of type '6A7 tube bias resistor grounding to oscillator padding condenser
Intermittent reception, —1) Volume level falls, Station hiss	open-circuiting grid filter condensers in r-f, i-f and first detector stages
Intermittent reception, —1) Noisy, Hum, Erratic operation of volume control	replace volume control
Noisy volume control —1)	isolate volume control from diode load circuit with condenser and resistor
Slipping dial —1)	insufficient tension of spring clips on drive shaft
Intermittent reception, —1) Fading 2)	defective volume control poor contacts on wave-band switch
Intermittent reception, —1) Noisy	open-circuiting type '6D6 or '6A7 grid-return by-pass condensers
Dial slips —1)	push three copper fingers down (with dial set for vernier tuning) to increase tension
Hum, —1) Distortion Usually weak reception	leaky or short-circuited type '76 AVC cathode tube by-pass condenser

RCA-VICTOR 280

Same case histories as listed for RCA-Victor 260

RCA-VICTOR 281

Abrupt volume increases—1)	pigtail of type '6A7 tube resistor grounding to oscillator padding condenser
Intermittent reception, —1) Station hiss	open-circuiting grid filter condensers in r-f, i-f and first detector stages
Slipping dial —1)	insufficient tension of spring clips on drive shaft

RCA-VICTOR 321

Only phono reception, —1) No radio reception	short-circuited 4-mfd. condenser near oscillator padding condenser (condenser with blue lead) *Note*: be sure to include 30,000-ohm resistor in original position when replacing

RCA-VICTOR 330

Weak reception, Distortion	1) open-circuited field coil
Noisy volume control	1) isolate volume control from diode load circuit with condenser and two resistors
Noisy tone control	1) clean resistance element 2) clean slider arm contact surfaces
Radio or phono inoperative,	1) open-contacts on radio-phono transfer switch. Replace switch
Intermittent radio or phono operation No plate voltage on type '58 r-f tube	1) open contacts on radio-phono transfer switch. Replace switch
Poor control of record volume, Sharp drop in record volume control action	1) disconnect lead to center tap of volume control resistance element
Wavering, vibrating record reproduction, Strong hum	1) remove phono panel shipping blocks

RCA-VICTOR 331

See also case histories listed for RCA-Victor 330

Radio or phono inoperative, intermittent	1) open contacts on radio-phono transfer switch. Replace switch
No plate voltage on type '58 r-f tube	1) open contacts on radio-phono transfer switch. Replace switch
Poor control of record volume, Sharp drop in record volume-control action	1) disconnect lead to center tap of volume control resistance element
Wavering, vibrating record reproduction Strong hum	1) remove phono panel shipping blocks
Pick-up lowers upon record, but needle does not slip into first groove	1) re-adjust switch-lever locating screw
Pick-up lowers upon record, but needle skips several grooves	1) re-adjust switch-lever locating screw
Mechanism fails to trip	1) re-adjust tension of pawl trip
12" records bind against mechanism cover	1) raise turntable by small washer inserted between turntable and spindle
Slow speed, Inoperative	1) bend up notched lever 2) raise lever assembly with small washers

RCA-VICTOR 341, 381

(See last 3 items for RCA-Victor 331)
(For RCA-Victor 381 see also items listed for RCA-Victor 281)

RCA-VICTOR (CANADIAN) RECEIVERS

(All RCA-Victor American) receivers are listed on pages immediately ahead of this section)

(See also the RCA-Victor Canadian-American receivers Cross-Index on page 1B-1)

RCA-VICTOR (CANADIAN) R-7, R-7A

Same case histories as those listed for RCA-Victor R-4

RCA-VICTOR (CANADIAN) R-8

Same case histories as those listed for RCA-Victor R-8, R-10

RCA-VICTOR (CANADIAN) R-8A, R-9A

Same case histories as those listed for RCA-Victor R-4

RCA-VICTOR (CANADIAN) R-10, R-12

Same case histories as those listed for RCA-Victor R8, R10

RCA-VICTOR (CANADIAN) R-15

Same case histories as those listed for RCA-Victor R-11

RCA-VICTOR (CANADIAN) R-20R

Same case histories as those listed for RCA-Victor R-11

RCA-VICTOR (CANADIAN) R-20, R-21

Same case histories as those listed for Radiola 17

RCA-VICTOR (CANADIAN) R-22

Same case histories as those listed for RCA-Victor R-78

RCA-VICTOR (CANADIAN) R-28

Same case histories as those listed for RCA-Victor R-28

RCA-VICTOR (CANADIAN) R-29, R-31

Same case histories as those listed for RCA-Victor R-28P

RCA-VICTOR (CANADIAN) R-35

Same case histories as those listed for Radiola 80

RCA-VICTOR (CANADIAN) R-37

Same case histories as those listed for RCA Victor R-28

RCA-VICTOR (CANADIAN) R-39

Same case histories as those listed for Radiola 80

RCA-VICTOR (CANADIAN) R-49
Same case histories as those listed for RCA-Victor 330

RCA-VICTOR (CANADIAN) R-50
Same case histories as those listed for RCA-Victor R-71

RCA-VICTOR (CANADIAN) R-52
Same case histories as those listed for RCA-Victor R-71

RCA-VICTOR (CANADIAN) R-53
Same case histories as those listed for RCA-Victor R-73

RCA-VICTOR (CANADIAN) R-54, R-56
Same case histories as those listed for RCA-Victor R-74

RCA-VICTOR (CANADIAN) R-78
Same case histories as those listed for RCA-Victor R-4

RCA-VICTOR (CANADIAN) R-104
Same case histories as those listed for RCA-Victor R-10

RCA-VICTOR (CANADIAN) R-107
Same case histories as those listed for RCA-Victor R-10

RCA-VICTOR (CANADIAN) R-109
Same case histories as those listed for RCA-Victor R-11

RCA-VICTOR (CANADIAN) RAE-59
Same case histories as those listed for RCA-Victor RAE-59

RCA-VICTOR (CANADIAN) RAE-84
Same case histories as those listed for RCA-Victor RAE-84

RCA-VICTOR (CANADIAN) RE-33
Same case histories as those listed for RCA-Victor R-28

RCA-VICTOR (CANADIAN) RE-41
Same case histories as those listed for RCA-Victor R-11

RCA-VICTOR (CANADIAN) RE-80
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RCA-VICTOR (CANADIAN) RE-81
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RCA-VICTOR (CANADIAN) 90
Same case histories as those listed for RCA-Victor R-90

RCA-VICTOR (CANADIAN) 118
Same case histories as those listed for RCA-Victor 118

RCA-VICTOR (CANADIAN) 122
Same case histories as those listed for RCA-Victor 220

RCA-VICTOR (CANADIAN) 128
Same case histories as those listed for RCA-Victor 128

RCA-VICTOR (CANADIAN) 140

Same case histories as those listed for RCA-Victor 140

RCA-VICTOR (CANADIAN) 143

Same case histories as those listed for RCA-Victor 143

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RCA-VICTOR (CANADIAN) 331

Same case histories as those listed for RCA-Victor 331

RCA-VICTOR (CANADIAN) 381

Same case histories as those listed for RCA-Victor 281

ROCKOLA (all models using type '6B5 output tubes)

Intermittent noise .... 1) type '6B5 tube becomes too hot. Substitute a new tube in place
2) replace condenser in tone-control circuit with a 0.001-mfd. tubular unit

ROGERS (CANADIAN) "BATTERYLESS" 200A

"Popping" noise .... 1) intermittent short-circuiting of tuning condenser plates, caused by vibration transmitted to chassis. Straighten out plates or replace tuning-condenser gang

ROGERS (CANADIAN) R-561

Distortion at low volume on local stations ..... 1) change the value of the 50,000-ohm resistor connected between the cathode and B-plus of the first type '58 i-f tube

ROGERS (CANADIAN) 725-A, 740-A, 755-A
(using the spray-shielded tubes)

Noisy reception (replacing volume control does not cure the trouble) .... 1) connect 0.3-megohm resistor and a 0.05-mfd. condenser in the grid circuit of the first a-f tube

Intermittent reception .. 1) defective 0.05-mfd. condensers under the tuning condenser shield

ROGERS (CANADIAN) 951

Poor sensitivity (tubes and voltages check O.K.)	1) defective 0.003-mfd. ground coupling condensers connected to either of the coils in the first i-f transformer (even though they may test O.K.). Replace 2) open-circuited primary winding in the push-pull input transformer, not usually apparent on account of the 20,000-ohm plate resistor which is shunted across it

ROYAL A.C.-D.C. RECEIVER

Poor tone, Distortion (tubes test O.K.) (voltages slightly low on type '43 tube)	1) solder a No. *16* copper wire to all grounded terminals including the tuning condenser rotor contacts. Then solder this wire in turn to chassis, thereby obtaining a good low-resistance ground to chassis

SENTINEL 550

Same case histories as those listed for Silvertone 550

SERENADER 160

Noisy reception, Intermittent reception	1) defective r-f tube socket split at the plate prong, thus allowing the plate voltage to arc to ground. Replace

SILVER 30

Cross modulation when used near a powerful local station	1) replace the first r-f tube with a type '27 tube, making the following changes in the circuit: remove the 400-ohm resistor connected to the cathode prong and the 2600-ohm resistor at the grid terminal. Remove the red condenser lead from this terminal to the cathode terminal. Clip off the screen-grid lead. Remove the grid clip from the wire leading to the antenna choke and push it through a ⅛-inch hole to be drilled near the tube socket. Solder this wire to the grid terminal and resolder the 2600-ohm resistor between the cathode and chassis

SILVER-MARSHALL A

Low volume, Poor tone	1) by-pass condenser across the type '47 tube bias resistor not of sufficient capacity. Replace with a 10-mfd., 25-volt electrolytic condenser

SILVER-MARSHALL "BEARCAT"

Volume control inoperative at low settings	1) increase in value of the bleeder resistor connected from the volume control to B-plus, from 6,000- to over 35,000-ohms. Replace with a new unit

SILVER-MARSHALL C

Hum, Poor tone, Low volume, Oscillation between stations (plate voltages low)	1) defective 2-mfd. filter condenser (*C21*) Replace with a new unit of large capacitance (about 4- or 8-mfd.).
Intermittent reception	1) defective 0.08-mfd. coupling condenser (*C16*). Replace with a 0.1-mfd. unit 2) intermittently defective resistors, *R5* and *R3*. Replace with 25,000- and 10,000-ohm units respectively

SILVER-MARSHALL F

Inoperative	1) defective 10,000-ohm screen-grid feeding resistor. Replace with a 5-watt unit 2) defective 3-section by-pass condenser between the ground, the detector cathode and the plate and screen circuits. Replace with a 500-volt unit

SILVER-MARSHALL Q

Motorboating only at resonance and strong signals	1) decrease in value of AVC plate resistor. Replace with new unit 2) leaky AVC tube plate by-pass condenser. Replace with new unit

SILVER-MARSHALL R (10 Tube)

Inoperative (set tests O.K.)	1) i-f amplifier out of alignment
No signal when set is turned on but starts to play during first 5 or 10 minutes	1) replace first filter condenser with 8-mfd. electrolytic unit 2) poor filtering in circuit acts as a signal on the AVC tube grid. If distortion and loud volume results when the AVC tube (first type '227 tube of row of three next to type 551) is withdrawn, and the set is tuned to a local station, then the fault lies in the AVC system
Motorboating, Excessive hum	1) excessively high resistance in tone control (which is the plate resistor in detector circuit). If control checks O.K. replace 0.5-mfd. condenser from lower contact to ground with a 0.25-mfd. condenser, and connect a ¼-megohm resistor across the outer points of the tone control

SILVER-MARSHALL 36A

Intermittent oscillation (insertion of analyzer cable clears up trouble, making testing difficult)	1) defective r-f choke in series with cathode of first i-f amplifier tube

SILVER-MARSHALL 37, 38, 39, 782

Distortion at low volume on local signals	1) replace type '24 tube (second from front of set) with a type '35 or '51 tube 2) change "minimum" resistor on bakelite strip to 100-ohm unit, grounding one end and connecting the other to the volume control 3) connect a 25,000-ohm resistor between the screen of the type '35 tube and the high-voltage side of the volume control

SILVER MARSHALL 1480

Distortion, Tun-a-lite inoperative, Weak reception	1) replace Tun-a-lite 2) one side of high-voltage secondary open-circuited
Inoperative	1) 1,500-ohm section of voltage divider open-circuited
Hum	1) two negative sides of condenser block short-circuited internally

SILVERTONE 36, 37, 41

Low volume, Insensitive	1) loosen the set screw on the rear end of the volume control shaft where the movable primary coil is attached, moving it about ⅛- to ¼-inch into the secondary coils, and tightening the set screws on the shaft 2) replace the type '24 tubes in the r-f section with type '35 tubes
Oscillation	1) condenser gang out of alignment

SILVERTONE 42

No reception between 540 and 950 kc Oscillation	1) ground one side of the antenna coil to the chassis 2) apply an external ground to the chassis
Poor reception between 540 and 950 kc (noise and whistles accompanying signals)	1) ground one side of the antenna coil to the chassis 2) connect an external ground to the chassis to reduce hum and improve DX reception

SILVERTONE 550

Inoperative (tubes and voltages test O.K.), Oscillator inoperative unless lead is touched to grid of i-f or second detector tube	1) connect an 8-mfd. filter condenser from the set side of the filter choke to the common negative return lead on the chassis

SILVERTONE 1172

Same case histories as those listed for Silvertone 36

SILVERTONE 1506

No reception ....1) short-circuited 0.01-mfd. by-pass condenser between the plate and grid of the type '47 tube

SILVERTONE 1570, 1574

Electrolysis in output transformer ....1) due to use of paper winding form whose composition contains some chemical which is electrolytic. Repair by replacing with Bakelite form and impregnate winding with some moisture-proofing compound

SILVERTONE 1584

Continual blowing of 0.003-mfd., 600-volt condenser connected across power-transformer primary ....1) due to surge built up in primary when line switch is operated. Replace with 800-volt condenser across line side of the on-off switch and the chassis

SILVERTONE 1620, 1622

Ballast lamp burns out ....1) volume control short-circuiting to chassis

SILVERTONE 1640

Undesirable time lag in AVC system, Weak stations interrupted during static bursts ....1) replace the 0.1-mfd. condenser in AVC circuit with 0.01-mfd. unit

Feedback unit, Hiss ....1) insert r-f chokes in the red plate leads of type '283 tube

"Blurping" at high volume levels ....1) reverse transformer secondary leads to grids of type '46 tubes

SILVERTONE 1652, 1654

Poor selectivity in models with 0.005-mfd. condenser in i-f stage ....1) replace second i-f untuned transformer *under chassis* with a tuned unit (part *R6115A*) and re-align both i-f stages. If oscillation should result, reverse connections on plate coil in second i-f stage, being careful not to disturb connections from plate and B-plus to trimmer. The rotor must go to *plus*

SILVERTONE 1700

Speaker rattle ....1) speaker cone off center

SILVERTONE 1711

Audio "Howl," Microphonics ....1) coil shield on right front of chassis (looking from rear of cabinet) touching a nut which holds the speaker to the front of the grille. Enlarge the chassis

(*Cont'd*)

SILVERTONE 1711 (cont'd)

bolt holes on the back side of the chassis and "float" the speaker to the front of the chassis on a concentric circle of cardboard

SILVERTONE 1712, 1713

Distortion, Weak reception ....1) full or partially short-circuited 35-mfd., 20-volt condenser across 700-ohm carbon resistor. This is found together with two 8-mfd. condensers in a square cardboard box bolted to the chassis

Fading ....1) corroded band-switch contacts. Clean with sandpaper

SILVERTONE 1721, 1722

Hum ....1) defective type '2A3-H power tubes in push-pull. Substitute others until a hum-balance combination is obtained

Power transformer burns up ....1) inter-element short-circuit in the type '2A3 or '2A3-H tubes

Insensitive on short-wave band ....1) poor antenna installation. Outdoor antenna necessary
2) defective type '56 oscillator tube. Substitute other tube
3) increase the coupling of the short-wave antenna coils
4) re-align the r-f amplifier by tuning in a station at about 6,000-kc, spreading the turns of enameled wire on the coils until maximum volume is secured. *Note*: The trimmer condensers should not be touched in this alignment procedure

SILVERTONE 1732

See also case histories listed for Silvertone 1721

Low volume ....1) increase the screen-grid voltage from 55- to 80-volts by replacing the 15,000-ohm screen-grid resistor with a 10,000-ohm unit

SILVERTONE 1750

Filter condensers blow out, Type '25Z5 tube burns out ....1) short-circuit the 200-ohm fixed resistor in series with the speaker field and ground. Connect a 40-ohm resistor in series with the plate of the '25Z5 tube, connecting to the line cord and eliminating the original connection

SILVERTONE 1762

Same case histories as those listed for Silvertone 1700

SILVERTONE 1801 A.C.-D.C.

Hum after regular filter replacement	1) connect the cathodes of the type '25Z5 tube together

SILVERTONE 1904

Volume cannot be reduced to zero	1) volume control coil slipping on shaft 2) defective type '6C5-G AVC tube (even though it may test O.K.). Substitute other tubes in socket 3) leakage between the type '6A7 grid-return lead and the B-plus lead. Isolate the grid return lead from it 4) shield the fixed coil of the volume control, by fastening a small shield to the mounting screw by means of a nut. With the volume control at minimum setting make adjustments by bending the shield toward, or away from, the coil
Image interference, Whistles	1) remove wire from broadcast antenna-coil primary to wave-band switch, and run a wire from the outside of the primary winding down through the hole alongside the electrolytic condenser across the top of the chassis down through the power transformer mounting slot to the wave-switch terminal from which the original lead was removed
"Fluttering" on short-wave band	1) volume control setting too high 2) signal of station too strong *Note*: The above condition may be remedied by connecting an 8-mfd. condenser across the terminal furthest removed from the condenser on the triple terminal board, and the wiper on the dial-end section of the variable condenser (the negative terminal being connected at this point). The leads should be as short and direct as possible

SILVERTONE 1905

Loose selectivity control shaft	1) convex washer on shaft should face the back end, otherwise the shaft will work loose

SILVERTONE 1906, 1914

Same case histories as those listed for Silvertone 1904

SILVERTONE 1915

Same case histories as those listed for Silvertone 1905

SILVERTONE 1954

Same case histories as those listed for Silvertone 1904

SILVERTONE 1955

Same case histories as those listed for Silvertone 1905

SILVERTONE 1964

Same case histories as those listed for Silvertone 1904

SILVERTONE 1965

Same case histories as those listed for Silvertone 1905

SILVERTONE 1967C (Early Models)

Hum	1) replace 14-mfd. electrolytic condenser with a 25-mfd. unit
Modulation hum	1) connect a 75,000-ohm resistor between the screen-grids of the r-f and translator tubes and the B-plus 2) connect a 0.2-mfd. condenser between the r-f and translator tubes to ground 3) replace the 20,000-ohm section of the voltage-divider section with a 10,000-ohm, 2-watt unit

SIMPLEX MODEL R

Set smokes	1) short-circuited 4-mfd. condenser in the power supply system

SONORA A

Inoperative at the low-frequency setting of the tuning dial, Noisy reception at the high-frequency setting	1) short-circuiting tuning condenser plates

SONORA A30, A32, A36

Fading, Weak reception, Intermittent reception	1) leaky 0.1-mfd. r-f coupling condensers 2) open-circuiting or open-circuited 0.1-mfd. r-f coupling condensers
Oscillation	1) add 2-mfd. by-pass condenser across terminals *7* and *8* to audio unit terminal strip 2) open-circuited 135-volt bleeder resistor 3) bleeder resistor changed to higher value
Hum, Distortion	1) unmatched power output tubes
Weak, Distorted reproduction	1) high-resistance coupling between voice coil and output transformer secondary. Clean and solder connections

SONORA A40, A44, A46

See also case histories listed for Sonora A30, A32, A36

Weak, Distorted phono reproduction
1) high-resistance coupling between voice coil and output transformer secondary. Clean and solder connections
2) contacts of phono-radio transfer switch corroded
3) movable arm of phono volume-control corroded

Automatic stop inoperative, Motor stops before record is completed
1) loosen motor mounting bolts. Shift motor so that distance between center of turntable spindle and center of pickup mounting screw is 9"

SONORA D-70

Fading, Distortion about 15 minutes after set is switched on
1) leaky 0.05-mfd. audio coupling condenser. Becomes defective only when heated. Replace with new 200-volt unit

SPARTON EQUASONNE A.C. MODELS

Low volume
1) open-circuited 110-ohm wire-wound resistor connected between terminals 5 and 7 on terminal strip. Replace

Inoperative (set operates only when antenna is touched to coupling pin (under the back of the drum dial) between selector and r-f amplifier can, with volume control at "max" setting)
1) defective component in the r-f amplifier
2) r-f circuits out of alignment

SPARTON JR. D.C. RECEIVERS

Weak reception, Distortion
1) replace 22½-volt "C" battery
2) defective type '224 tubes

SPARTON 9-A

Oscillation over the entire dial
1) dirty or corroded condenser-gang contacts Clean contacts carefully or solder flexible pigtails between the rotor and the condenser frame

SPARTON 9-30

Intermittent reception
1) broken wire on one of the band-pass coils in r-f unit
2) broken wire in detector plate circuit choke in r-f unit
3) loose prongs on r-f tube sockets (*Cont'd*)

SPARTON 9-30 (cont'd)

No reception	1) shorted plate by-pass condenser 2) loose bolts holding r-f unit to common connector plate
Noisy reception	1) defective volume control
Hum	1) dial-light socket shorting to chassis
Weak reception on lower end of dial	1) readjust compensators 2) readjust antenna series condenser

SPARTON 12

Intermittent reception, Inoperative at low-frequency setting of tuning dial, (set resumes normal operation when chassis is jarred)	1) high-resistance connection between the tuning condenser rotor plates and the shaft. Replace with a new tuning condenser gang, or repair by drilling each rotor section through the shaft and inserting a copper dowel pin into each hole drilled

SPARTON 14

Intermittent reception (shaking cabinet restores normal operation)	1) wire from i-f transformer to type '58 tube short-circuiting to shield can of tube due to loss of insulation at this point
Fading, Intermittent reception	1) components mounted on terminal strip shorting to one another
Hum, Distorted reproduction, Pentode output tube grids bright red	1) partially "shorted" dynamic speaker field coil
Hum	1) electrolytic condensers dried up
Unstable, Weak reception at high frequencies	1) open-circuited 3,000-ohm resistor in first detector-oscillator cathode circuit 2) open-circuited 0.002-mfd. first detector-oscillator cathode by-pass condenser
Oscillation	1) electrolytic condensers lost capacity

SPARTON 16

Frequency drift, Fading, Oscillation	1) loose connections on oscillator coil, check and resolder these connections
Excessive motorboating	1) r-f signal from oscillator being impressed on second detector, causing periodic blocking of set through AVC action and periodic releases. Insert a static shield between the oscillator condenser stator and the adjacent r-f stator on the tuning condenser gang

SPARTON 18

AVC tube does not function ....1)	defective 0.01-mfd. condsener between the plate and cathode of AVC tube
Intermittent reception, Volume lowers ....1)	components mounted upon terminal strip shorting to one another
2)	unsoldered connections to wire-wound resistors
No control of volume ....1)	cathode-heater leakage in '58 AVC tube
2)	grounded noise-suppressor control lugs
Unstable, Weak reception at high frequencies ....1)	open-circuited 3,000-ohm resistor in cathode circuit of first detector-oscillator tube
2)	open-circuited 0.002-mfd. first detector-oscillator cathode by-pass condenser
Distortion, Hum, Poor control of volume ....1)	defective electrolytic filter condensers (high leakage)
Oscillation ....1)	capacity of electrolytic condensers abnormally low

SPARTON 25

Inoperative ....1)	short-circuited 0.1-mfd. screen by-pass cartridge condenser
2)	center terminal of screen by-pass cartridge condenser shorting to chassis
Set dead (plate and screen voltage check O.K.), High voltage between control-grid of first detector and ground. Receiver operates when the secondary coil is grounded, AVC inoperative ....1)	replace secondary coil in control-grid circuit of first detector tube
Oscillation, Motorboating, Weak reception ....1)	"open" 0.1-mfd. screen by-pass condenser
2)	add r-f choke in first i-f cathode circuit
3)	employ separate bias resistor and by-pass condenser for i-f stage
Fading ....1)	high-resistance contact between the die-cast rotor plates on the condenser gang and the condenser shaft. Drill and tap holes in each rotor through to the shaft and insert set-screws
Fading, Weak reception ....1)	gassy AVC tube
Fading, Poor control of volume ....1)	leaky 2-mfd. r-f, first detector and i-f secondary-return by-pass condensers
Hum ....1)	loose power transformer laminations

SPARTON 26

See also case histories listed for Sparton 25

Intermittent reception	1) replace the round metal-clad 1-mfd. condenser 2) leaky 0.2-mfd., 200-volt condenser. Replace with new unit 3) leaky 0.05-mfd., 400-volt condenser. Replace with new unit 4) leaky 0.006-mfd., 600-volt condenser. Replace with new unit

SPARTON 26AW

See also the case histories listed for Sparton 25

Intermittent condition Inoperative	1) open-circuiting i-f transformer windings. Coil leads snap at terminal lugs

SPARTON 27A

Low volume, Distortion	1) due to improper speaker phasing. Reverse coil connections on one of the speakers
No AVC action	1) change in value of AVC resistor. Replace with new unit of proper value
Noisy reception	1) defective inter-station noise-suppressor resistor. Replace with new unit

SPARTON 28

See also the case histories listed for Sparton 26AW

Noisy reception, Intermittent reception at around 600 kc	1) loose variable condenser plates. Secure plates to shaft with brass pins

SPARTON 30

See also "case histories" listed for Sparton 25, 26AW

Does not play 10 or 12" records	1) open contacts of indicating switch within kick-off arm compartment 2) plunger arm of solenoid binding to solenoid 3) insufficient tension of plunger arm spring 4) open-circuited solenoid
Fuse blows when record is rejected	1) indicating switch contacts shorting to kick-off arm compartment

SPARTON 36

Short life of vibrators	1) life can be prolonged by connecting a 0.01-mfd., 600-volt condenser across the power transformer secondary winding

SPARTON 45

Inoperative	1) type '45 tubes biasing resistor short-circuiting to chassis. Replace with a new 1250-ohm, 10-watt unit 2) defective 10,000-ohm carbon resistor connected from the chassis to one side of the volume control. Replace with a wire-wound unit

SPARTON 57

Hum	1) loose connection in the first detector coil. Resolder this connection, making sure that the joint is well soldered

SPARTON 61, 62

Distortion (tubes and voltages test O.K.)	1) defective 5-mfd. section of filter condenser connected across speaker field and tapped filter choke (yellow lead)
Tunable squeal all over dial	1) leaky 5-mfd., 165-volt section of filter condenser block. Replace with 8-mfd. 200-volt unit

SPARTON 65, 66

Oscillation	1) metal braid shielding on control-grid lead of type '78 tubes pushed back, leaving part of the lead unshielded. Shielding braid should cover full length of wire
Dial pointer does not turn	1) loosen the front chassis screw so that the chassis will "float" on its rubber cushions
Poor selectivity (early models only)	1) add a tuned circuit in the primary of i-f transformer *L-5*, by replacing with the new *L-5* unit and installing a new *C-3* unit. Connect one side of this condenser across the primary and the other side across the secondary 2) remove resistor *R-11* and replace with a 2,200-ohm, ¼-watt unit 3) replace resistor *R-15* with a 50,000-ohm, ¼-watt unit

SPARTON 67, 68

Mechanical vibration	1) replace small pieces of rubber in middle of rear edge of chasis base plate with small strips of 1-inch masking tape along the edges of the plate, thereby preventing it from vibrating against chassis frame. Stick one end of tape to top side of plate, and fold other end around so it sticks to bottom

SPARTON 71, 71B, 72, 78

Noisy reception .... 1) high-resistance connection to chassis caused by riveted joints at tube shields. Solder these in place

SPARTON 79

No control of volume (constantly plays at full volume level) .... 1) leaky cathode by-pass condenser allowing current to pass regardless of volume control setting. Replace with new unit

SPARTON 80, 83, 84

Inoperative .... 1) short-circuited 0.2-mfd., 200-volt condenser connected from the plate circuit of the AVC-controlled tubes to ground. Replace with a 600-volt unit

2) burnt-out 2,000-ohm resistor as a result of the above condition

SPARTON 99

Inoperative	1) short-circuited 0.25-mfd. plate by-pass condenser in r-f amplifier 2) 5th r-f transformer-primary short-circuiting to secondary
Weak reception, Distorted reception	1) leaky 0.25-mfd. plate by-pass condenser in r-f amplifier
Weak reception	1) open-circuited detector grid choke
Intermittent reception, Fading	1) r-f coil leads snapped at terminals 2) corroded band-pass tuner coupling pin
No control of volume	1) leaky 1-mfd. cathode by-pass condenser 2) leakage between cathode and heater of types '484 and 485 tubes
Noisy tuning	1) burrs on tuning condenser plates. Burn with high-voltage leads disconnected 2) defective first audio transformer. Replace with new unit or remove transformer and substitute resistance coupling in place
Inoperative, Rectifier tube plates red hot, Fuses blow	1) rubber covered leads under power unit shorting to shield (for Sparton 99 only)

SPARTON 104

Noisy reception (tubes and voltages check O.K.)	1) defective a-f transformer (even though it may test O.K.). Replace with new unit

SPARTON 109

Same case histories as those listed for Sparton 9-30 and Sparton 99

SPARTON 110, 111

Same case histories as those listed for Sparton 99

SPARTON 193

Inoperative except when antenna is placed on stator of fourth r-f stage tuning condenser, resulting in reception of local stations only (all r-f coils, condensers and tubes test O.K.)	1) open-circuited grid winding on one of the r-f band-pass coils 2) open-circuited soldered connection at one end of the coil connecting lugs. Resolder all connections at soldering lugs

SPARTON 210 MIDGET

Oscillation some time after set is switched on	1) insufficient r-f tube cathode bias-resistor-to-ground by-pass condenser capacity. Replace with a 0.1-mfd. condenser

SPARTON 235

Same case histories as listed for Sparton 110

SPARTON 301

See also case histories listed for Sparton 99

Distorted reproduction, Weak reception ..... 1) dynamic speaker field coil connections reversed

SPARTON 333

Intermittent reception, Noisy reception ..... 1) open-circuiting stator connections under condensers. Replace with stranded wire pigtails

Intermittent hum, Fading ..... 1) poor ground connection at the eyelet of the type '42 output tube, due to a loose eyelet. Solder direct grounding wires from the heater circuit at this point and at all other points where grounding is dependent upon eyelets

SPARTON 400

Short-circuit between i-f tube plate and chassis ..... 1) breakdown of insulation in red shielded leads which connect the plates and r-f coils, causing the wire to short-circuit to the grounded shield. Replace these leads with heavily insulated unshielded wires

Noisy reception ..... 1) dust and other foreign particles between condenser-gang plates. Clean out with pipe cleaners and burn with high voltage (terminals disconnected) if trouble is not entirely removed

SPARTON 410, 420

Inoperative ..... 1) insulated common B+ terminal shorting to chassis
2) r-f plate leads shorting to shielding braid

Noisy tuning ..... 1) burrs on tuning condenser plates. Burn with high voltage—all terminals disconnected
2) dust between plates
3) corroded rotor contacts. Bond rotors to condenser frame with flexible pigtails

Oscillation ..... 1) corroded rotor contacts

Oscillation ..... 1) replace both type '183 tubes
(set checks O.K.) 1) dirty or corroded condenser-gang contacts. Clean contacts carefully or solder flexible pigtails between the rotor and the condenser frame

SPARTON 478

Same case histories as those listed for Sparton 71

SPARTON 506

Speaker rattle	1) cardboard tube separator resting against speaker cone. This should be removed
Microphonics	1) remove wooden packing blocks from set

SPARTON 564, 570, 574, 578, 589

Same case histories as those listed for Sparton 99

SPARTON 591

See also case histories listed for Sparton 99

Noisy reception	1) noisy audio transformer primary

SPARTON 593

Same case histories as those listed for Sparton 99

SPARTON 600, 610

See also case histories listed for Sparton 99

Intermittent reception, Noisy reception	1) primary winding of audio transformer short-circuits to core intermittently
Weak reception	1) leads of band-pass coils snapped at lugs
Weak reception, Broad tuning at the lower frequencies	1) leaky by-pass condenser in the first type '484 tube cathode circuit. Replace with a 0.2-mfd. condenser if its terminal resistance is less than 10-megohms 2) leads of band-pass coils snapped at lugs
Hum, Distorted reproduction	1) partially shorted dynamic spkr. field coil 2) weak, gassy, or unbalanced power output tubes 3) unbalanced push-pull input transformer secondary
Hum at resonance	1) connect a 0.5-mfd. condenser from one side of power transformer primary to chassis
Oscillation, Distorted reproduction	1) open-circuited 15,000-ohm bleeder resistor 2) bleeder resistor increases in value
No control of volume	1) leaky 0.2-mfd. cathode by-pass condenser in pre-selector stage 2) pre-selector stage cathode by-pass condenser grounding to shield
Lack of sensitivity	1) high-resistance contacts between the socket prongs and tube prongs. Remove sockets and bend prongs back in shape. This is a result of rocking the tube while removing it from the tube socket, thereby bending the socket prongs

SPARTON 611

Same case histories as those listed for Sparton 99

SPARTON 612

Intermittent reception, Noisy reception	1) primary winding of audio transformer short-circuits to core intermittently
Weak reception	1) leads of band-pass coils snapped at lugs
Hum, Distorted reproduction	1) partially shorted dynamic field coil 2) weak, gassy, or unbalanced power output tubes 3) unbalanced push-pull input transformer secondary
Oscillation, Distorted reproduction	1) open-circuited 15,000-ohm bleeder resistor 2) bleeder resistor increases in value
No control of volume	1) leaky 0.2-mfd. cathode by-pass condenser in pre-selector stage 2) pre-selector stage cathode by-pass condenser grounding to shield
Hum at resonance	1) connect a 0.5-mfd. condenser from one side of power transformer primary to chassis

SPARTON 620

Same case histories as those listed for Sparton 600

SPARTON 691

Same case histories as those listed for Sparton 67

SPARTON 737 (Black Chassis)

See also case histories listed for Sparton 600

Inoperative	1) open-circuited 1200-ohm resistor located alongside of the type '80 rectifier tube 2) short-circuited primary or secondary power transformer windings. Repair or replace with new transformer 3) open-circuited type '80 or type '183 tube filament step-down resistors 4) audio transformer mounted so close to '183 tube next to it that it does not fit in socket properly, causing it to be forced to one side. Shift the transformer a bit more to one side
Low volume, Poor selectivity (low plate voltage and high plate current in fifth r-f tube)	1) open-circuited secondary in fourth r-f coil. Resolder all the coil terminals to avoid future trouble

SPARTON 737 (Serial Number 6502)

See also case histories listed for Sparton 600

Inoperative	1) open-circuited 13,000-ohm plate voltage dropping resistor
No type '80 tube filament voltages No type '183 tube filament voltage	1) open-circuited filament resistors
Fuses blow	1) power transformer breaking down

SPARTON 740, 750

See also case histories listed for Sparton 99

Hum, Oscillation, Distorted reception	1) loose common terminal connection of filter condenser block
Hum Poor control of volume	1) defective type '485 tubes, caused by short-circuited or loose elements. Test each tube by substitution, replacing if defective
Blasting, Poor tone, Oscillation	1) open-circuited 7,000-ohm bleeder resistor 2) bleeder resistor increased in value
Fading	1) leaky cathode of by-pass condenser in pre-selector stage 2) pre-selector cathode by-pass condenser grounding to shield
Fading, Intermittent volume	1) poor contact between band-pass pre-selector unit and r-f amplifier proper. Tighten spring in socket so that it makes good contact with the pin
Intermittent reception	1) intermittently open- or short-circuiting untuned r-f coil. Test carefully and replace any of the units which are found to be defective 2) nuts on grounding-strip bolts working loose. These should be tightened to insure uniform contact
No control of volume	1) short-circuited pre-selector stage cathode by-pass condenser 2) pre-selector cathode by-pass condenser grounding to shield

SPARTON 766M

"Magic eye" not closing enough	1) remove the 1.5-mgohm, ¼-watt resistor connected to the green wire of the cable leading to the "magic eye" tube. This will cause a more pronounced movement of the "magic eye" shadow *(Cont'd)*

SPARTON 766M (Cont'd)

Microphonics	1) remove wooden packing blocks from set

SPARTON 870

Noisy reception, Arcing	1) poor insulation of filter choke outlet at side of power unit

SPARTON 871

Same case histories as those listed for Sparton 99

SPARTON 930, 931

See also case histories listed for Sparton 99

Reception only between 850 and 1500 kc, (voltages and tubes test O.K.)	1) cold soldered joint at first r-f plate choke 2) increase in value of 15,000-ohm bleeder resistor. Replace with new unit
No plate voltage	1) short-circuited plate by-pass condenser. Replace with a 400-volt unit, as low voltage units are a frequent source of trouble
Low volume	1) high-resistance connection at movable arm lug of tone control. Resolder this connection
Intermittent reception Cutting off	1) loose tuning condenser rotor section causing plates to rock slightly 2) corroded rotor contacts, causing high-resistance connection between rotor and condenser frame. Bond with flexible pigtails
Double-spot reception Oscillation	1) worn bearing in tuning condenser shaft, causing plates to get out of alignment
Oscillation after replacing type '485 tubes (tubes and voltages test O.K.)	1) connect a 0.001-mfd., 600-volt condenser between the plate and cathode of the first r-f amplifier tube
Hum between stations	1) connect a 0.001-mfd., 600-volt condenser between one plate and the filament of the type '80 rectifier tube
Hum, Noisy reception	1) faulty contact of electrolytic filter condenser can to chassis

STEINITE 70, 80, 90

Inoperative, Tubes blow	1) rotting of rubber insulation on 5-wire speaker cable, causing short-circuits. Replace with new cable 2) defective screen and plate supply by-pass condensers. Replace with 0.5-mfd. units

STERLING G

Power transformer smokes, Fuses blow	1) short-circuited power transformer primary. Replace transformer coil or entire unit

STEWART-WARNER "COMPANION" A.C.-D.C.

Excessive hum, Poor sensitivity	1) leakage between the condenser block and chassis, caused by the soaking through of the liquid through the cardboard container. Wrap a layer of thick waxed paper around the condenser block and replace it in the chassis (*Note*: "Empire" cloth will be even more satisfactory)

STEWART-WARNER SERIES 50

Weak reception with the local-distance switch in the "local" position	1) realign the broadcast gang trimmers with the switch in the "local" position

STEWART-WARNER R100-A, R100-B, R100-E

Distortion	1) leaky 0.1-mfd. coupling condenser between the type '27 detector tube plate choke and the grid of the first audio tube
Weak reception, Low voltage on tubes	1) replace the 45,000-ohm, 1-watt carbon resistor connected between the r-f plates and the ground with a 2-watt unit
Set dead, Excessive hum	1) defective 0.25-mfd. condenser in cathode circuit of detector tube 2) defective speaker field resistor 3) defective filter condensers
Poor selectivity, Oscillation	1) high-resistance connection between rotor shaft and connecting springs. Solder flexible pigtails between the shaft and springs 2) replace the second r-f tube with a type '35 or '51 tube to eliminate oscillation
Intermittent reception (low r-f tube plate voltages)	1) defective smaller section of the wire-wound resistor under the condenser can. Replace with a 1,000-ohm, 10-watt unit

(*Cont'd*)

STEWART WARNER R100-A, R100-B, R100-E (Cont'd)

Noisy reception ....1)	due to volume control. Connect a 0.25-mfd., 200-volt condenser between the low potential side of the antenna coil and the ground
Volume control burns out ....1)	defective 20,000-ohm bleeder resistor connected between the screen circuit and the voltage divider
Oscillation when type '24 tubes are replaced with type '24A's ....1)	increase the value of the screen-grid resistor by-pass condenser to about 0.5 mfd.

STEWART-WARNER R102-A

Poor quality, No volume ....1)	defective 0.1-mfd. condenser near the type '51 tube socket
2)	defective 0.02-mfd. detector-audio coupling condenser
3)	defective 2-megohm second detector screen-grid resistor
Oscillation all over dial (voltages test O.K.) ....1)	open-circuited 0.1-mfd. by-pass condenser across 500-ohm cathode series resistor in the type '51 tube circuit. Replace with new unit
Intermittent hum (slight jar brings set back to normal when hum starts) ....1)	low end of type '47 tube grid resistor short-circuiting to chassis

STEWART-WARNER R-102 D-C.

Low volume ....1)	open-circuited 2-megohm, ½-watt second detector tube screen-grid resistor. Replace with a 1-watt unit

STEWART WARNER R-105 SERIES

Broadcast interference on short waves......1)	de-tune center short-wave i-f trimmer (counter clockwise)
Weak reception in "local" position ....1)	re-align broadcast circuits
2)	change AVC tube
Fading ....1)	open-circuited 2-megohm AVC tube grid resistor
Noisy, Intermittent reception ....1)	corroded contacts on wave-band switch
Microphonic ....1)	loose chassis-mounting bolts
No short-wave reception..1)	short-circuited trimmer condenser in short-wave detector plate circuit

STEWART-WARNER R-106

Fading ....1)	defective type '47 tube

STEWART-WARNER R-108

Low volume ....1)	change in value of type '36 detector tube plate resistor. Replace with 2.1-megohm, 0.25-watt unit
2)	defective type '36 detector tube cathode resistor and by-pass condenser. Replace both units
3)	replace the type '38 power amplifier tube (even though it may test O.K.)
Distortion ....1)	type '36 tube inefficient as a detector tube (even though it tests O.K.). Select proper tube by substitution

STEWART-WARNER R-111, R-115

Tunable hum ....1)	open-circuited line by-pass condenser *15*. Replace with new unit

STEWART-WARNER R-116

Weak reception at low end of dial Set goes off calibration ....1)	poor connections at soldered joints of trimmer condensers. Resolder joints and re-balance circuits
Inoperative on the broadcast band, Noise at several positions on the station selector ....1)	open-circuited section in the antenna coil. Re-wind with new wire of the same size
Hum ....1)	poor contact of the grounding lug of the vitreous enamel voltage-divider resistor
2)	cut out of the circuit the 230-ohm negative section of the bleeder resistor and substitute a separate 230-ohm wire-wound resistor in place
3)	power cord within set too close to the 0.05-mfd., 100-volt insulating condenser which is connected to one side of the volume control. Pull power cord away from condenser
4)	reverse connections on speaker field coil

STEWART-WARNER R116-AH

I-f trimmer requires frequent adjustment ....1)	temperature causes unit to contract and expand. In regions of wide temperature variation, adjustments are required every two or three months

STEWART-WARNER R-130

Oscillation on short-wave band	1) short-wave detector shunt trimmer screw set too far out 2) detector circuit tuned to the receiver oscillator frequency instead of to the frequency of the desired signal

STEWART-WARNER R142-A, R142-AS

Code interference at 456 kc	1) adjust the wave-trap for minimum output with the test oscillator set at 456 kc

STEWART-WARNER R202-A

Set dead (no voltage on first detector and i-f tube screen grids)	1) open-circuited 6,000-ohm screen-grid supply resistor. Replace with new unit

STEWART-WARNER R301, R301-A, R301-B, R301-E

Inoperative (especially on high frequencies)	1) plate voltage applied to type '27 oscillator tube low. Substitute a series plate resistor for the present one, which will drop the voltage so that 100-volts are applied to the plate 2) resolder all coil and high-frequency connections
Inoperative	1) defective 2-mfd. 600-volt electrolytic condenser. Replace with new unit

STEWART-WARNER 102A

Distortion at any volume level (tubes and voltages test O.K.) set resumes normal operation when detector screen-grid voltage is checked on 500-volt range of voltmeter	1) add a 500,000-ohm resistor between the plate and screen of the detector tube and the chassis 2) open-circuited 2-megohm resistor in screen circuit
Motorboating, Distortion	1) remove first 500,000-ohm resistor in pentode output tube grid circuit

STEWART-WARNER 1181, 1182, 1183

Inoperative unless "local" switch is turned on and off	1) change 50,000-ohm resistor on '6A7 tube 2) if set goes into oscillation place a 0.25-mfd. condenser from cathode to ground on type '6A7 tube
Bell-like rattle	1) loose tubular condensers inside power transformer cover. Remove cover and resolder and re-tape condensers to it
Faint response on powerful signals, Inoperative	1) broken lead on coupling condenser connected to movable arm of volume control

STEWART WARNER 1201

Hum	1) add filter choke and 8-mfd. filter condenser to power unit 2) add one or two 8-mfd. electrolytic condensers
Distortion at resonance, Unstable	1) open-circuited cathode section of AVC voltage divider
No short-wave reception	1) short-circuited trimmer condenser in plate circuit of short-wave detector
Slightly distorted, Lowered output, Noisy reception	1) open-circuited 0.02-mfd. audio coupling condenser 2) clean wave-band switch contacts

STEWART WARNER 1251—1259

Intermittent reception, Inoperative on short-wave band	1) poor contact of wave-band switch shorting contacts
Code interference	1) install wave-trap adjusted to 456 kc

STEWART WARNER 1261—1269

Intermittent reception or inoperation on broadcast band	1) open-circuiting oscillator coil for broadcast band at lug to which postage stamp type condenser is connected
Noisy reception	1) open-circuiting diode load by-pass condensers, a dual unit
Inoperative, Motorboating	1) open-circuited 0.25-mfd. screen by-pass condenser
Weak short-wave reception	1) increase oscillator plate voltage. Replace oscillator plate resistor with 15,000-ohm resistor
Distortion	1) leaky or short-circuited 0.1-mfd. grid filter condenser for triode of '75 tube
Slipping dial	1) free the action of dial pointer pivot

STROMBERG CARLSON 10, 11

Inoperative	1) insulated screws in condenser shields connected to stators of tuning condensers, grounding
Intermittent reception	1) open-circuiting 0.04-mfd. bi-resonator condensers
Weak, Distorted reception	1) primary of push-pull input transformer short-circuiting to secondary winding
Noisy reception	1) noisy primary of push-pull input transf.
Poor control of volume	1) breakdown of 0.015-mfd. condenser connected in series with the ground, as a result of stress imposed upon it when *(Cont'd)*

STROMBERG CARLSON 10, 11 (cont'd)

Poor control of volume (receiver operates at full volume regardless of volume control setting)	1) defective 100,000-ohm resistor connected between the grid returns of the first and third r-f tubes and the movable arm of the volume control potentiometer 2) short-circuited, or leaky, 0.3-mfd. by-pass condenser connected between the movable arm of the volume control potentiometer and the chassis
Fading	1) leaky 0.04-mfd. bi-resonator condensers
Fading (operative only with volume control at maximum setting)	1) open-circuited 700-ohm section of voltage divider resistor. Replace with a 10-watt unit

STROMBERG CARLSON 12, 14

No reception	1) shorted detector plate filter condenser 2) open detector plate filter choke
Poor tuning meter action	1) insufficient antenna 2) poor second type '24-r-f tube 3) change AVC tube
Noisy reception, fading	1) leaky 0.04-mfd. bi-resonator condensers 2) defective volume control. Replace with new unit
Intermittent reception	1) open-circuited 0.04-mfd. bi-resonator condensers
Both type '80 tubes spark	1) intermittently short-circuiting filter condenser

STROMBERG CARLSON 19, 20

Intermittent reception	1) oscillator coil leads snapped at lug 2) open-circuiting 0.04-mfd. bi-resonator condenser
Set does not light	1) defective '80 tube causes fuse to burn out

STROMBERG CARLSON 22, 22A

Poor action of tuning meter	1) insufficient antenna. Lengthen antenna 2) shunt 30-ohm resistor across meter terminals
Intermittent reception, Noisy reception	1) short-circuiting i-f trimmer condenser 2) poor connections to carbon resistors
Intermittent reception	1) open-circuiting 0.04-mfd. condensers used as bi-resonator and first detector secondary return by-pass units
Fading, Weak reception	1) grounding of screw passing through first tuning condenser shield and connected to stator of first tuning section

STROMBERG CARLSON 25, 26

Distortion at any volume level	1) leaky second detector cathode by-pass condensers
Distortion at low volume	1) change second detector type '24A tube
Intermittent reception	1) open-circuiting 0.04-mfd. bi-resonator condensers 2) shield cans cutting into connecting leads to coils
Inoperative, Intermittent reception	1) primary of push-pull input transformer shorting to core or to secondary winding
Distorted, Weak reception	1) primary of push-pull input transformer short-circuited to secondary winding
Noisy reception	1) noisy primary winding of push-pull input transformer 2) leaky 0.001-mfd. detector plate by-pass condenser 3) leaky second detector cathode by-pass condensers
No control of volume	1) leaky 0.05-mfd. bi-resonator condensers 2) leaky 0.3-mfd. r-f, first detector and i-f secondary-return by-pass condensers 3) 100,000-ohm resistor in control-grid secondary-return circuit shorting to chassis

STROMBERG CARLSON 27

Poor action of tuning meter	1) insufficient antenna. Lengthen antenna 2) open-circuited 30-ohm meter shunt
Volume cannot be made low	1) change volume control 2) insulation leakage in phono pick-up switch
Fading, Intermittent, Weak reception	1) leaky 0.04-mfd. bi-resonator condensers 2) open-circuiting 0.04-mfd. bi-resonator condensers
Weak reception, Poor action of tuning meter, Station hiss	1) open-circuited primary winding of pre-selector coil 2) open-circuited bi-resonator in r-f stage
Inoperative	1) short-circuited 0.0001-mfd. second i-f transformer coupling condenser
Inoperative below 800 kc, Poor action of tuning meter, Weak, Station hiss, Dial settings incorrect	1) open-circuited section of oscillator coil secondary winding; lead snapped at lug

STROMBERG CARLSON 29

Weak, Distorted reception, Station hiss	1) r-f coil leads shorting to shield can 2) open-circuited primary winding of pre-selector coil 3) open-circuited 0.04-mfd. bi-resonator condenser
Inoperative	1) open-circuited tuning meter 2) short-circuited 0.3-mfd. r-f and first detector plate by-pass condenser 3) defective line switch which is incorporated in tone control. In repairing this, it may be well to interchange tone control with volume control (both are of the same value) so that the latter will control the switching of receiver, in order to avoid future trouble
Noisy, Intermittent reception	1) poor contact of volume control slider arm
Very weak, distorted reception,	1) first audio grid lead shorting to plate prong of socket
Tuning meter operates normally	1) first audio grid lead shorting to plate prong of socket
Noisy volume control	1) replace first type '56 audio tube
Hum at resonance	1) cathode-heater leakage in oscillator tube 2) cathode-heater leakage in type '58 tubes
Hum	1) shield the a-f grid lead running through the bottom of the chassis to the volume control
Weak reception, Station hiss	1) open-circuited pre-selector coil primary 2) pre-selector coil primary grounding to metal shield of antenna binding post lead
Distortion at resonance	1) shield can grounding to second r-f, or first detector secondary-return leads

STROMBERG-CARLSON 38, 38A, 39, 40 (First Type)

Noisy reception	1) defective volume control. Replace with new unit 2) gassy first audio tube. Replace with new tube
Hum at resonance, Fading	1) cathode-heater leakage in type '56 tubes. Test by substitution, replacing defective tubes
Weak reception, Distortion	1) change in value of 600-ohm cathode resistor in the first r-f stage. Reception is improved when this resistor is short-circuited out of the circuit entirely

STROMBERG CARLSON 38, 39, 40, 41 (SECOND TYPE)

Noisy volume control	1) replace type '55 tubes
Weak reception, Station hiss, Background noise	1) open-circuited pre-selector coil primary 2) pre-selector primary grounded to metal braid of antenna binding post lead
Distortion at resonance	1) shield can grounding to r-f, or first detector secondary-return leads
Intermittent reception, Fading	1) unsoldered leads to terminals on oscillator tracking condenser 2) unsoldered lead to terminal lug of second i-f primary trimmer condenser
Inoperative	1) open-circuited tuning meter 2) short-circuited 0.3-mfd. r-f, first detector plate by-pass condenser
Weak reception, Tuning meter action normal	1) short-circuited demodulator plate 2-mfd. by-pass condenser
Inoperative, Intermittent reception, Meter swings to left and sticks	1) poor weld in type '56 oscillator tube 2) open-circuiting oscillator coil secondary

STROMBERG CARLSON 48, 49, 50

Slipping tuning drive	1) U washer on friction drive binding to opening in cabinet
Hum	1) replace type '55 tube 2) change position of detector plate audio choke 3) short detector plate audio choke out of circuit
Distortion at resonance; at low volume	1) faulty volume control. Replace with new units
Microphonic	1) loosen chassis mounting bolts 2) insert rubber cushions under chassis 3) change type '55 tubes 4) insulate type '55 control-grid cap from control-grid lead with tape
Distortion at resonance, Weak reception, Station hiss	1) open-circuited pre-selector coil primary 2) pre-selector coil primary grounding to metal braid of antenna binding post lead 3) broken lead to 2nd section of condenser gang from coil
Distortion at resonance	1) coil shields grounding to r-f, or first detector secondary-return leads
Inoperative	1) open-circuited tuning meter 2) short-circuited 0.3-mfd. r-f and first detector plate by-pass condenser *(Cont'd)*

STROMBERG CARLSON 48, 49, 50 (cont'd)

Inoperative (*Cont'd*)	3) open-circuited 600-ohm resistors in push-pull input transformer secondary-return circuit
Noisy reception	1) loose or shorted filaments of type '2A3 output tubes
Hum at resonance	1) cathode-heater leakage of type '56 oscillator tube 2) cathode-heater leakage of type '58 tube
Intermittent reception	1) open-circuiting 0.04-mfd. bi-resonator condensers
Meter burns out	1) short-circuited 0.3-mfd. meter by-pass condenser
Noisy reception	1) noisy primary winding of intermediate push-pull input transformer

STROMBERG CARLSON 51

(See also last item listed for Stromberg Carlson 48, 49, 50)

Record is released near turntable spindle	1) adjust pick-up shoe 2) adjust pick-up tongue 3) pick-up head too high or too low
Record released by carrying arm lever	1) adjust height of rails 2) adjust height of turntable spindle
Needle does not slip into first groove of record	1) shift position of pick-up head 2) increase tension of groove springs
Needle skips past several grooves	1) decrease tension of groove springs

STROMBERG-CARLSON 52

Hum, "Tweets," Poor selectivity	1) cable wires in base of chassis shifted from their original position

STROMBERG-CARLSON 54

See also case histories listed for Stromberg-Carlson 52

Noisy reception (noise ceases when type '27 detector tube is removed from socket)	1) defective double voltage divider resistor, which sparks in operation. Replace with new unit 2) noisy 0.0005-mfd. by-pass condenser in the detector filter unit. Replace with new unit

STROMBERG CARLSON 55, 56

Distorted reproduction........1) leakage of, and between, filter condenser block sections

STROMBERG CARLSON 60

Noisy reception, Crackling ....1) push-pull input transformer primary noisy
2) tone control noisy

Intermittent, Noisy reception ....1) tone control defective
2) loose voice coil lead

No short-wave reception .1) open-circuited section of oscillator coil. Lead snapped at lug
2) poor switch contacts

Hum ....1) poor contact of electrolytic condenser can to chassis

Fuses blow ....1) short-circuited section of line by-pass condenser
2) high-voltage winding of power transformer partially short-circuited

Intermittent reception, Inoperative ......1) defective type '6A7 tube—may test O.K.

Fading, Oscillation, Distortion ....1) poor electrical grounding of type '6B7 tube shield

Inoperative, Strong oscillation ....1) turn screw of second i-f transformer trimmer slightly

Stations received at two points 20 kc apart ....1) leaky 0.04-mfd. by-pass condensers for r-f and first detector secondary returns

STROMBERG CARLSON 60PR

Erratic operation of tone-arm ....1) counter-balance on tone-arm binding against back of cabinet. Move balance forward

STROMBERG CARLSON 64

Noisy reception ....1) noisy primary of first audio transformer

Oscillation, Motorboating, Intermittent reception ....1) open-circuiting 0.01-mfd. r-f and first detector secondary return by-pass condensers
2) increase value of above condensers

Hum, Distortion ....1) leakage between sections of electrolytic filter condenser block
2) leakage between contacts of filter condenser block socket

Intermittent reception, Fading .....1) open-circuiting bi-resonator condenser

(Cont'd)

STROMBERG CARLSON 64 (cont'd)

Intermittent reception, Inoperative	1) open-circuited first audio transformer primary
Oscillation at low frequencies	1) increase value of bi-resonator condenser
Hum	1) replace filter block or dried-up section
Fuses blow, Type '5Z3 tube blows, Power transformer smells and heats up	1) replace first filter condenser. (Leaky)

STROMBERG CARLSON 68

No control of volume, Distortion, No meter action, Needle off scale	1) primary and secondary winding of AVC i-f transformer shorting to one another. Transformer must be replaced
Loud hum, Inoperative	1) output transformer primary shorting to core of unit.
Loud hum, Tone control noisy	1) line-switch contact shoe shorting to tone-control lug within unit.
Noisy tone control, Receiver inoperative at one end of tone control	1) leaky or short-circuited tone-control condenser—0.2-mfd. (this condenser is in the power unit)
Intermittent reception, Noisy reception	1) short-circuiting i-f trimmer condensers 2) intermediate audio transformer primary noisy 3) push-pull input transformer primary noisy
Distortion at resonance	1) control-grid return-leads (bus-bar) of type '6D6 or '6A7 tube grounding to chassis 2) leaky 0.1-mfd. bypass condensers in type '6D6 or '6A7 secondary return circuit
Fuses blow	1) short-circuited or leaky 1.3-mfd. first filter condenser
Tubes in tuner do not light	1) check each tube for open heater (heaters wired in series)
Intermittent reception, Inoperative	1) open-circuited first audio transformer primary
Shorted d-c output	1) coupling lead between tuner and amplifier shorting to shield within cable
Noisy tuner	1) loose connection within i-f transformer
Fuses blow, Rectifier blows, Power transformer smells and heats up	1) leaky or short-circuited first filter condenser contained within second audio transformer

(Cont'd)

STROMBERG-CARLSON 68

Distortion, Hum .... 1) leakage between sections of electrolytic filter condenser block
2) leakage between contacts of filter condenser block socket

No control of volume, Distortion at resonance, No meter action, Meter needle off scale ..... 1) leakage or short-circuit between primary and secondary windings of AVC i-f transformer

"Popping" and "crackling" noise .. 1) leakage in audio transformer between first layer of wire and core. Replace with new unit (part *No. 24025*)
2) short-circuiting i-f trimmers
3) loose connections in tuner

No reception below 930 kc, 1300-kc station received at 940 kc, ... 1) oscillator section of tuning gang short-circuited. Clear bonding pig-tail from stator lead

150-kc station received at 1,140 kc .. 1) oscillator section of tuning gang short-circuited. Clear bonding pig-tail from stator lead

Weak reception, Low screen voltage on r-f and first detector tubes .... 1) leaky 4-mfd. electrolytic by-pass condenser for screen circuits in tuner

Stations around 700 kc heard at three points ... 1) change entire receiver for new 68-F chassis which employs an i-f of 465 kc

STROMBERG-CARLSON 70

Excessive hum .... 1) defective type '2A3 tubes. Substitute several different types until the hum is found to be least objectionable

STROMBERG-CARLSON 82

Audio howl on strong signals ..... 1) due to vibration of oscillator coil assembly. Place several tight-fitting soft rubber washers on discs inside the coil form

STROMBERG CARLSON 635, 636

Choked reception, Distortion .... 1) pilot light socket shorting to chassis
2) short-circuited speaker—output condenser

House fuse blows........ 1) short-circuited 0.01-mfd. buffer condensers

Noisy tuning, ... 1) corroded condenser-gang rotor contacts

STROMBERG CARLSON 635, 636 (cont'd)

Oscillation	1) inoperative volume control. Replace with new unit
Noisy reception, Fading	1) inoperative first or second audio transformer
Noisy or distorted reception	1) "open" 2,500-ohm section in voltage divider
No reception	2) "open" primary in first audio transformer

All Stromberg Carlsons from 635 to present

Dial sticks	1) remove dial shaft, take apart and clean with alcohol

STROMBERG CARLSON 641, 642

See also case histories listed for Stromberg Carlson 651 model

Distorted reproduction, No bias voltage on type '45 tube	1) grounded filament circuit of '45 at filter choke lug terminals. Disconnect '45 filament circuit from these terminals
Intermittent reception, Fading	1) loose lugs on 800-ohm volume control resistor
Noisy reception, Static (antenna and ground wires disconnected from receiver)	1) short-circuited turns or high-resistance joints in the first a-f transformer following the type '27 detector tube. Replace with new unit

STROMBERG CARLSON 651

Intermittent reception, Fading	1) worn carbon element in rear volume control
	2) leaky 0.0005-mfd. detector plate by-pass condensers
	3) open-circuiting detector plate choke
	4) intermittent short-circuiting of condensers in detector plate choke unit to can
Noisy reception, Arcing	1) arcing of voltage divider sections
No reception	1) shorted 0.4-mfd. by-pass condenser; shorted 2-mfd. condenser in same block with audio transformer
Record "wow" (Model 654)	1) change "felt" washers on the spindle, to "rubber" washers
	2) clean motor commutator and re-seat brushes
Noisy tuning, Oscillation	1) corroded condenser-gang rotor contacts

STROMBERG CARLSON 652, 654

Same case histories as those listed for Stromberg Carlson 641 and 651

STROMBERG CARLSON 734

No reception .... 1) "open" 5,000-ohm plate series resistor
2) poor contact in phono-radio switch

Weak reception .... 1) needle does not reach red line on meter. Defective tungar tubes

STROMBERG CARLSON 846

See also case histories listed for Stromberg Carlson 848

Inoperative until one of output tubes is removed .... 1) shorted primary-secondary push-pull input transformer

Motor-boating between stations, Oscillation, Noisy tuning .... 1) dirty or high-resistance tuning condenser rotor contacts. Clean contacts or solder flexible pigtails between rotors and condenser frame

Noisy reception, Static (antenna and ground wires disconnected from receiver) .... 1) short-circuited turns on high-resistance joints in the first a-f transformer following the type '27 detector tube. Replace with new unit

STROMBERG CARLSON 848

Intermittent fading, Antenna control inoperative .... 1) check small wire-wound resistor in series with antenna control, which is in turn shunted across the antenna coil. Disconnect resistor and tighten up rivet, holding one end

SUN-GLOW "MELODY CHEST"

Inoperative .... 1) defective 0.5-mfd. section of 4-unit metal-clad by-pass condenser pack, which connects to B-plus. Replace with new single-section unit externally connected

TCA CHASSIS

Scratchy sound (similar to defective audio transformer) .... 1) defective "Candohm" resistor. Cut wires in each section for a considerable distance with a sharp knife and solder a 10,000-ohm, 10-watt resistor across the high-voltage section and a 5,000-ohm, 10-watt unit across the low-voltage section. The original terminals of the unit are excellent for connecting lugs

(Cont'd)

TCA CHASSIS (cont'd)

Failure of the tuned filter system ....2) replacement of entire block is necessary. If this is difficult to secure, the following may serve as a substitute: Connect a 0.0005-mfd. condenser from the type '47 tube control grid to chassis, a 0.01-mfd. condenser from one side of switch to chassis, a 12-mfd. electrolytic condenser from the high-voltage end of the "Candohm" resistor to chassis and an 8-mfd. condenser from the type '80 tube filament to the center tap of the high-voltage winding. If necessary, a tone condenser may also be connected between the tone switch and the chassis (capacity 0.02-mfd.)

TEMPLE 8-80

Fading ....1) open-circuiting bias resistor in the third r-f stage

Low volume (tubes and voltages test O.K.) ....1) intermittently open-circuiting filament on the type '27 detector tube, shown by the intermittent incandescense of the filament. Replace with new tube

TEMPLE 10

Same case histories as those listed for TCA Chassis

TOM THUMB P45

Same case histories as those listed for Zenith A

TRAV-LER C

Weak reception ....1) increase in value of yellow resistor mounted next to red and blue resistor under the chassis. Replace with new unit

UNITED MOTORS 4037 SUPER

Weak reception, Inoperative at the 550-kc end of the dial ....1) defective type 6F7 tube. Replace with new tube

Inoperative ....1) defective vibrator unit. Replace with new vibrator
2) dirty vibrator contacts preventing vibrator from starting. Clean contacts if possible; if not replace with new unit

U S. RADIO & TELEVISION APEX 7-TUBE RECEIVER

Receiver dead, (test shows negative screen-grid voltage) ....1) leaky 0.1-mfd. condenser in the screen-grid circuit

U. S. RADIO & TELEVISION APEX 8 SERIES SUPER

Distortion, Low volume, Motorboating with volume control at maximum setting	1) defective type '27 second detector tube 2) decrease in capacity of the 8-mfd. condenser across the output of the filter unit. Replace with new unit
Loud hum immediately after switch is snapped on	1) open-circuited 8-mfd. cardboard electrolytic filter condensers. Replace with new units
Fading	1) defective 0.04-mfd. coupling condenser between the plate of the type '27 second detector tube and the type '47 output tube. Replace with new unit

U. S. RADIO & TELEVISION APEX 9A

Oscillation, Motorboating (voltages abnormally high)	1) open-circuited 7,100-ohm voltage divider section. Replace with new unit 2) defective condenser across the filter output. Replace with new unit 3) connect a 0.5-mfd., 600-volt condenser between the i-f screen or cathode circuits and ground 4) loss of capacity in filter condensers. Replace with new units

U. S. RADIO & TELEVISION APEX 10 SERIES

See also "case histories" listed for Airline 1955

Hum, Volume control will not reduce hum to zero	1) replace the 8-mfd. condenser under the resistance strip in the center of the chassis
Hum	1) short-circuited 25,000-ohm second detector plate filter resistor 2) short- or open-circuited 0.06-mfd. condenser connected across the filter choke 3) electrostatic shield in power transformer not grounded or ground is open-circuited

U. S. RADIO & TELEVISION APEX 12

R-f and i-f circuits dead, Audio circuit operative (plate-to-cathode voltages on r-f and i-f tubes about 10-volts; chassis-to-cathode voltages about 250-volts)	1) short-circuited turns on 4,600-ohm section of speaker *No. 2*. Rewind or replace with new coil

U. S. RADIO & TELEVISION "NEW YORKER"

Set dead ....1) (no screen or grid-bias voltage on the type '24A tubes. High plate current on the type '71A tube)	open-circuited 5,000-ohm section of the field coil forming part of the voltage divider system. If possible, locate the break and rewind the coil. If not, replace
Electrolytic condensers ..1) drawing too much current	leaky units. Replace with 8-mfd., 400-volt units
Inoperative, ...1) Low volume	short-circuited 0.01-mfd. r-f cathode resistor by-pass condenser. Replace with a new unit
2)	defective 0.05-mfd. detector control grid to cathode isolating condenser. Replace with new unit
3)	leaky 0.01-mfd. condenser connected between the detector plate and the type '71A control grid. Replace with a 600-volt unit
4)	leaky 0.1-mfd. condensers connected between the detector, screen-grid and ground and by-passing the type '71A tube control-grid resistor. Replace with new units
5)	both field windings opposing each other magnetically. Reverse the connections on one of the windings

U. S. RADIO & TELEVISION APEX 26-P

Poor control of volume, Intermittent volume ...1) defective volume control. Replace with a new 8,000-mfd. unit

Oscillation, (extremely high screen voltages) ...1) open-circuited 2,560-ohm resistor. Replace with 2,500-ohm, 20-watt unit

Inoperative (faint signals from local stations only) ...1) short-circuited 0.4-mfd. screen-grid by-pass condenser. Replace with a 0.5-mfd. tubular unit

U. S. RADIO & TELEVISION APEX 41, 42, 43, 44, 60, 60A

Same case histories as those listed for Airline AE-11

U. S. RADIO & TELEVISION APEX 80

Weak reception (jarring the receiver brings it back to normal) ...1) defective a-c receptacle of dynamic speaker, resulting in a loose connection and no field excitation current. Replace receptacle

U. S. RADIO & TELEVISION APEX 99

Low volume ...1) open-circuited or lowered capacity 4- and 8-mfd. filter condensers

U. S. RADIO & TELEVISION APEX 120

Same case histories as those listed for U. S. Radio & Television Apex 12

U. S. RADIO & TELEVISION RADIOTROPE 27

Oscillation ...1) open-circuited 0.4-mfd. by-pass condenser section. Replace with 0.5-mfd., 200-volt condenser

No plate voltage on type '27 tube, No screen voltages on type '24 tubes ...1) open-circuited 8,400-ohm voltage divider section. Replace with new unit

U. S. RADIO & TELEVISION 25 SERIES

Code interference ...1) overproduction of harmonics by the oscillator, causing strong short-wave code signals to be heterodyned. The tuned-in broadcast signal heterodynes these signals at audio frequencies, making them audible in the receiver. *Remedy*: increase the value of the type '57 oscillator first detector tube cathode bias resistor, by placing a variable resistor in the circuit and varying the bias until all the code interference disappears. A fixed resistor may be installed in place of the variable one when the proper value is found

U. S. RADIO & TELEVISION 28, 28A, 29

Oscillation, High-pitched whistle	1) decrease in value of 0.04-mfd. first audio by-pass condenser. Replace with a 0.05-mfd. unit

VICTOR R-32

Indistinct reproduction	1) defective cone (replace)
Peculiar odor	1) defective power transformer. Replace with one of higher wattage rating—not with original one
No reception	1) shorted by-pass condenser 2) shorted filter condenser, do not replace with original
Noisy, Intermittent reception	1) loose resistor in strips of volume control 2) corroded volume control resistance strip and contact arms 3) open-circuiting pigtail connection to dynamic speaker voice coil 4) loose contacts of radio-phono transfer switch
Hum	1) short-circuited 0.1-mfd. filter choke 2) defective 0.1-mfd. audio condenser across filter choke 3) clean and adjust hum control
Inoperative, No detector plate voltage	1) corroded or open contacts on radio-phono transfer switch
Distortion, Unstable	1) loose detector grid leak

VICTOR R-35, R-39

Weak, Distorted reception, Fading in a few seconds	1) open-circuited 1.5-megohm detector screen resistor
Inoperative	1) open-circuited detector plate resistor 2) open-circuited first audio plate resistor 3) open-circuited r-f plate chokes 4) open-circuited r-f screen chokes 5) open-circuited r-f cathode chokes
Intermittent radio-phono operation (RE-57)	1) corroded contact segments of master transfer switch
No volume	1) replace defective screen resistor

VICTOR R-52

Same case histories as those listed for Victor R-32

VICTOR R-57

Same case histories as those listed for Victor R-35, R-39

VICTOR RE-45, RE-75

Same case histories as those listed for Victor R-32

VICTOR 7-11

Same case histories as those listed for Radiola 18

VICTOR 7-25

Same case histories as those listed for Radiola 17

VICTOR 9-16

Same case histories as those listed for Radiola 18

VICTOR 9-18, 9-54

Tuning meter fluctuates	1) shunt 0.001-mfd. condenser across meter
Distorted, Weak	1) open-circuited audio transformer primary
Weak reception, No control of volume	1) open-circuited 1-megohm AVC grid resistor
Intermittent reception	1) snapped tabs on oscillator series condenser
Inoperative below 600 kc Dial settings incorrect	1) snapped tabs on oscillator series condenser
Insensitive at either high or low frequencies	1) oscillator trimmers out of adjustment 2) r-f compensator condenser out of adjustment

VICTOR 14, 15

Choked, distorted reception Hum,	1) short-circuited 0.025-mfd. audio coupling condensers
Positive grid bias on type '45 tubes, Weak reception	1) short-circuited 0.025-mfd. audio coupling condensers
Noisy tuning, Intermittent reception	1) plating peeling from variable condenser plates. Burn with high voltage—all leads disconnected 2) corroded-gang condenser rotor shaft clips
Oscillation	1) corroded-gang condenser rotor shaft clips
Fading, Intermittent reception, Noisy	1) broken resistance elements in dual volume control. Replace
No r-f screen voltage	1) open-circuited r-f choke in screen circuit
Hum	1) change type '24 detector tube

WELLS-GARDNER S-732 SERIES

Same "case histories" as those listed for Wells-Gardner 06Z

WELLS-GARDNER 05A UNIVERSAL

Excessive hum ....1) connect a 4-mfd. condenser (electrolytic) between the second detector cathode and ground

WELLS-GARDNER TRUETONE 052 SERIES

Weak reception ....1) defective 0.1-mfd. condenser from type '35 screen to ground
2) replace 250,000-ohm 8-watt resistor connected from second detector type '57 tube plate to the type '80 filament (even if it tests O.K.). On load it sometimes drops the plate voltage from 180- to 100-volts. Use a one-watt carbon replacement resistor

WELLS-GARDNER 06Z AUTO-RADIO

Set dead, No plate voltages ....1) defective filter condenser. Replace with new unit
2) short-circuited 0.02-mfd. condenser connected across the power transformer secondary. Replace with new unit
3) defective vibrator. Replace vibrator and transformer with new type units

Excessive vibrator noise in speaker ....1) ground the pigtail on the antenna lead
2) broken lead at terminal of 0.02-mfd. condenser across the power transformer secondary. Solder broken lead and anchor bulk of the secondary to power transformer
3) cathode leakage or short-circuits in tubes. Replace tubes one at a time, noting the difference in the noise

Oscillation ....1) open-circuited lead of 0.25-mfd. r-f cathode condenser. Replace with new lead or solder the open circuit. Also anchor bulk of condenser to tuning condenser frame

Speaker rattle ....1) dirt in speaker. Replace with new speaker and re-install set so that speaker is facing down or out and *not up*

Set locked in both the locked and unlocked key position ..1) warped cast aluminum strip, thus locking volume control in both key positions. Bend strip so as to clear set-screw in unlocked position only

WELLS-GARDNER 2CM SERIES

Excessive a-c hum ....1) inductive pickup by the type '6F6 driver lead which is located alongside the lead running between the choke and the type '80 socket in the center of the chassis. Separate these two leads as far as possible

2) unbalanced plate current condition in the output stage, employing types '6F6 tubes. In no case should their plate currents differ by more than 10-milliamperes. If they do, try substituting several different tubes until the proper balance is obtained

WELLS-GARDNER 5E

Poor tone ....1) change the grid bias on the type '19 output tubes from 6 to 4½ volts, by connecting the white lead marked "C-6" to the 4½-volt tap on the "C" battery

WELLS-GARDNER 6F

Excessive hum ....1) defective types '6B7 and '6F7 tubes. Substitute new tubes and note effect

2) insert a cardboard shim $\frac{3}{32}$-inch thick under choke *L4*

3) replace the 4-mfd. 150-volt electrolytic condenser with a 12-mfd. 300-volt unit

WELLS-GARDNER 9B

Poor tone ....1) change the grid bias on the type '19 output tubes from 6 to 4½ volts, by connecting the white lead marked "C-6" to the 4½-volt tap on the "C" battery

WELLS-GARDNER 65

Intermittent audio howl ..1) replace the double 12—12-mfd. audio electrolytic condenser with new unit

Low volume ....1) defective coupling condensers in series with volume control. Replace condensers

WELLS-GARDNER 872 SERIES

Broad tuning, Low volume ....1) poorly soldered connections at r-f or i-f coils. Re-solder all connections.

2) defective type '57 AVC tube (even though it may test O.K.). Replace

3) receiver circuits out of alignment. When re-aligning the receiver, connect a 0.05-mfd. condenser between the signal generator output and the first detector tube grid. The ground of the signal generator should connect to chassis

WESTINGHOUSE (AMERICAN) RECEIVERS

The case histories of (Canadian) Westinghouse receivers will be found after the listing for the last American set.
See also Cross-Index table on page 1B-1

WESTINGHOUSE WR-4

See also case histories listed for Radiola 48

Noisy volume control	1) bunching up of volume control wire. Replace volume control

WESTINGHOUSE WR-5 to WR-8, WR-6-R, WR-7-R

See also case histories listed for Radiola 80

Severe crackling noise	1) partially short-circuited turns in i-f transformers as a result of glue from labels pasted on them corroding the insulation of the wire

WESTINGHOUSE WR-10, WR-10A

See also case histories listed for RCA-Victor R-4

Noisy reception	1) defective volume control
	2) peeling condenser plates—burn with high voltage (all terminals disconnected)

WESTINGHOUSE WR-12

See also case histories listed for RCA-Victor R-4

Set dead	1) open-circuited first i-f transformer secondary winding. Replace transformer
	2) open-circuit or change in value of 8,000-ohm resistor in first r-f oscillator and first i-f cathode circuits. Replace

WESTINGHOUSE WR-13

Same case histories as those listed for Radiola 86

WESTINGHOUSE WR-15

Fading	1) open-circuited 5-megohm resistor
	2) leaky 0.1-mfd. AVC tube grid-return by-pass condensers
Weak, Insensitive	1) leaky 0.1-mfd. AVC tube grid-return by-pass condensers
Inoperative until AVC tube is withdrawn	1) leaky 0.1-mfd. AVC tube grid-return by-pass condensers
Distortion at low volume	1) primary-secondary "short" in push-pull input transformer
Noisy tuning, Oscillation	1) corroded condenser-gang rotor contacts
Distortion at any volume level	1) carbonized voltage divider resistors. Install wire-wound unit for screen-drop resistor

WESTINGHOUSE WR-15A

Same case histories as those listed for RCA-Victor R-10

WESTINGHOUSE WR-17

Same case histories as those listed for RCA-Victor R-4

WESTINGHOUSE WR-18

Same case histories as those listed for RCA-Victor R-8

WESTINGHOUSE WR-19

Same case histories as those listed for RCA-Victor R-71

WESTINGHOUSE WR-20

Same case histories as those listed for RCA-Victor R-74

WESTINGHOUSE WR-22

Same case histories as those listed for RCA-Victor R-73

WESTINGHOUSE WR-23

Same case histories as those listed for RCA-Victor RE-80

WESTINGHOUSE WR-24

Noisy reception ....1) loose tube sockets. Tighten with long-nosed pliers

WESTINGHOUSE WR-25

Same case histories as those listed for RCA-Victor RE-80

WESTINGHOUSE WR-26-M

Same case histories as those listed for RCA-Victor R-17-M

WESTINGHOUSE WR-27

Same case histories as those listed for RCA-Victor A-28-P

WESTINGHOUSE WR-28

Same case histories as those listed for RCA-Victor R-28

WESTINGHOUSE WR-30, WR-31

Same case histories as those listed for RCA-Victor 140, 141

WESTINGHOUSE WR-37

Same case histories as those listed for RCA-Victor 121

WESTINGHOUSE WR-45

Same case histories as those listed for RCA-Victor 143

WESTINGHOUSE WR-46

Same case histories as those listed for RCA-Victor 128

WESTINGHOUSE WR-48

Same case histories as those listed for RCA-Victor 118

WESTINGHOUSE 90

Intermittent reception ....1) intermittent short-circuiting to chassis of 0.04-mfd. condenser connected across the first filter choke to tune it. Remove this condenser

WESTINGHOUSE 90 (cont'd)

Hum ....1)	change in capacity of the 0.04-mfd. "tuning condenser connected across the choke. Replace with new unit
Fading about 15 or 20 .....1) minutes after normal operation	intermittently open-circuiting volume control resistance strip. Replace with a new unit

WESTINGHOUSE (CANADIAN) RECEIVERS

Case histories of (American) Westinghouse receivers are on the pages immediately ahead of this one. See also Cross-Index of American and Canadian Westinghouse receivers on the table on page 1B-1.

WESTINGHOUSE (CANADIAN) B103

Same case histories as those listed for Radiola 18

WESTINGHOUSE (CANADIAN) W-53

Same case histories as those listed for RCA-Victor R-28, R-28P

WESTINGHOUSE (CANADIAN) W-61

Same case histories as those listed for Radiola 48

Inoperative ....1) (negative potential on the plate of the detector tube)	short-circuited 2-mfd. filter condenser between the center tap of the filter choke and terminal *No. 6*

WESTINGHOUSE (CANADIAN) W-64

Same case histories as those listed for RCA-Victor 121

WESTINGHOUSE (CANADIAN) W-71

Same case histories as those listed for Westinghouse (Canadian) W-61

WESTINGHOUSE (CANADIAN) W-73

Same case histories as those listed for RCA-Victor 330

WESTINGHOUSE (CANADIAN) W-81

Same case histories as those listed for Westinghouse (Canadian) W-61

WESTINGHOUSE (CANADIAN) W-82

Same case histories as those listed for RCA-Victor R-71

WESTINGHOUSE (CANADIAN) W-83AW

Same case histories as those listed for RCA-Victor 140

WESTINGHOUSE (CANADIAN) W-84

Same case histories as those listed for RCA-Victor 143

WESTINGHOUSE (CANADIAN) W-89

Same case histories as those listed for Radiola 66

WESTINGHOUSE (CANADIAN) W-101

Same case histories as those listed for Radiola 80

WESTINGHOUSE (CANADIAN) W-103
Same case histories as those listed for RCA-Victor R-90

WESTINGHOUSE (CANADIAN) W-122
Same case histories as those listed for RCA-Victor R-78

WESTINGHOUSE (CANADIAN) W-155
Same case histories as those listed for RCA-Victor 117, 118

WESTINGHOUSE (CANADIAN) W-165A
Same case histories as those listed for RCA-Victor 128

WESTINGHOUSE (CANADIAN) W-165X
Same case histories as those listed for RCA-Victor 224

WESTINGHOUSE (CANADIAN) W-185X
Same case histories as those listed for RCA-Victor 143

WESTINGHOUSE (CANADIAN) W-254
Same case histories as those listed for RCA-Victor 118

WESTINGHOUSE (CANADIAN) W-801
Same case histories as those listed for RCA-Victor R-4

WESTONE 20

Inoperative on broadcast band ....1) single bolt holding chassis to cabinet touching contacts on short-wave switch, causing broadcast sections of both r-f coils to ground to chassis. Tape bolt or put fibre bushing around it

WURLITZER
See case histories listed for Lyric models

ZENITH A, B, C, D

Poor reception ....1) increase in value of bleeder resistors
2) defective 900-ohm type '45 bias resistor. Replace with a 10-watt unit

Intermittent hum ....1) replace the filter condensers

ZENETTE A, B, C, D

Erratic operation, "Squeals" ....1) replace 25,000-ohm series plate resistor with same unit in 10-watt size
2) check all high value resistors in detector plate circuit for 25% change in value, also 1-megohm resistor in first r-f grid-return circuit. If defective, replace
3) connect 0.00025-mfd. condenser from detector choke to ground
4) in radio-phono combinations, keep wire from phono switch as far away from receiver circuits as possible

ZENITH CH SERIES

No control of volume, Excessive regeneration	1) defective electrolytic condenser located in square can at far end of chassis, which by-passes choke located underneath the chassis
Loss of volume when volume control is advanced or tuning dial shifted	1) drop in value of ½-megohm plate resistor in AVC tube circuit
Weak reception, Oscillation	1) defective 0.5-mfd. condenser connected from the ground to the cathode of the second detector tube (even though it may test O.K.). Replace with new unit
Intermittent reception (tubes and voltages check O.K.) (normal operation restored when oscillator tube is tapped)	1) defective oscillator tube. Replace with new tube

ZENITH MH

Intermittent oscillator (even after coil connections are resoldered)	1) defective oscillator condensers 2) defective oscillator coil. Replace with new unit

ZENITH 10, 11

Intermittent, Noisy reception	1) corroded or loose contacts on 3-point antenna switch 2) audio coupling condenser shorting to chassis
Inoperative	1) audio coupling condenser short-circuited to chassis
Oscillation, Fading	1) open-circuiting 0.1-mfd. screen by-pass condenser 2) open-circuiting 0.1-mfd. cathode by-pass condenser
Microphonic hum	1) change type '24-A detector tube

ZENITH 11E

Intermittent reception, Inoperative	1) short-circuiting compensating condensers on condenser gang

ZENITH 12

Same case histories as those listed for Zenith 10, 11

ZENITH 14E

Same case histories as those listed for Zenith 11E

ZENITH 15-E, 15-E-P

Weak reception. Distorted reproduction	1) open-circuited 100,000-ohm detector plate resistor

ZENITH 33, 33X

Poor selectivity, Hum, Oscillation when volume control is turned toward maximum	1) open-circuited antenna primary coil located in inverted can below the first r-f tube socket under the chassis. Replace with new unit or solder a flexible lead which has a phone tip soldered to its other end to one terminal of a 0.01-mfd. condenser. Plug the end with the phone tip into the "long antenna" tip jack and ground the other end of the condenser to the chassis. Re-align circuits for maximum response
Weak reception, Audio circuits test O.K.	1) open-circuited, or omitted 2,000-ohm resistance from ground to movable antenna compensating coil under chassis. Replace with a new resistor
Tone raspy	1) substitute a '112 tube for the '71 tube
Noisy reception	1) high-resistance ground in secondary of original a-f transformer (green corrosion usually found on terminal ligs)
Intermittent reception, Noisy tuning	1) variable condenser plates blistered and peeling, causing shorts. Burn with high voltage—all leads disconnected
Inoperative	1) "open" section in voltage divider 2) "shorted" filter condenser in power pack
Intermittent reception, Fading	1) dirty or loose socket contacts 2) defective volume control 3) defective audio transformer

ZENITH 34, 34P

Same case histories as those listed for Zenith 33X

ZENITH 35, 35A, 35P, 35AP

Same case histories as those listed for Zenith 33X

ZENITH 41, 42

Oscillation, Intermittent, Noisy reception	1) loose or broken terminal lug of r-f plate circuit py-pass condenser 2) poor contacts in "local-distance" toggle switch

ZENITH 50

Excessive hum	1) inductive pickup from the filter choke by the a-f transformer between the first and final a-f stages. Remove the blocking condenser between the plate of the first a-f stage and the a-f transformer primary; shunt the transformer primary with a 0.1-megohm resistor. Connect the "low" end of this resistor through a 2-mfd. by-pass condenser to ground. Now connect in series with the "low" end of the audio transformer primary and B-plus a 0.1-megohm resistor. Disconnect the former connection of that part of the a-f transf. primary to ground

ZENITH 52, 53, 54, 55

Hum	1) defective electrolytic filter condenser. Short-circuit the terminal of each unit momentarily to chassis and note the effect—the hum might be cured. If not, replace with new units 2) connect 100,000-ohm resistor across type 27 first-audio tube grids 3) defective type '27 tube 4) defective volume control
Intermittent fading	1) defective cathode by-pass condenser
Fading, Intermittent reception	1) "cold-soldered" connections to variable condensers 2) "open" r-f coils, leads snap at lug 3) worn carbon resistance in volume control 4) break in pigtail to r-f stator vernier of first r-f tuning condenser 5) snapping of fine wire leads of r-f chokes at eyelets
Weak reception, Intermittent reception, Flickering of pilot light	1) intermittent short-circuiting of the two filament supporting stems in the pilot lamp, thus also short-circuiting the filaments of the type '45 power tubes, across which it is connected. Replace lamp
Type '80 tubes burn out	1) automatic tuner pilot light or socket shorting to metal frame
No signals on certain wavelengths	1) variable condenser plates blistered and peeling, causing short-circuits. Burn with high voltage—all leads disconnected
No reception below 650 kc	1) end rotor plates of tuning condensers shorting to stator plates
Noisy tuning, Oscillation	1) corroded copper contact and washer at end of condenser gang rotor shaft

ZENITH 70 SERIES

See also case histories listed for Zenith 52, 53, 54, 55

Fading, Weak reception	1) open- or short-circuited 0.25-mfd. dual plate by-pass condenser connected in the first and second r-f stages. Replace 2) "open" or "shorted" 0.03-mfd. audio coupling condenser. Replace with new
Noisy reception	1) defective a-f transformer

ZENITH 75-C

Motorboating	1) defective dual 0.01-mfd. condenser. Replace with new unit

ZENITH 90

Inoperative	1) defective 8-mfd. dry electrolytic filter condenser. Replace with new unit

ZENITH 91, 92

Fading, No dip action on tuning meter, Erratic operation on "local" side of local-distance switch	1) change in resistance of the two 2,800- and 3,600-ohm bleeder resistors connected in series across the d-c line. Replace with resistors of higher wattage rating
No AVC action	1) defective AVC resistor
Inoperative unless AVC tube is withdrawn	1) open-circuited section of AVC screen-cathode voltage divider
Distortion at resonance	1) AVC screen-cathode voltage divider changed in value
Local-distance switch inoperative	1) open-circuited 4.5-megohm carbon resistor

ZENITH 102, 112, 132

Same case histories as those listed for Zenith 10, 11

ZENITH 230

Distortion at low volume	1) improperly centered voice coil of either dynamic speaker
Hum, Distortion	1) capacity of electrolytic filter condensers dropped below normal
Oscillation, Weak and distorted	1) capacity of third electrolytic filter condenser dropped below normal

ZENITH 240

See also case histories listed for Zenith 230

Set does not tune to proper frequency setting of tuning dial	1) oscillator trimmer condensers out of alignment 2) celluloid dial scale requires adjustment
Distortion, Weak reception	1) back left mounting bolt screwed up too far, causing it to short-circuit to bias resistor

ZENITH 244

See also case histories listed for Zenith 230

Poor tone, Distortion at low volume	1) defective type '57 AVC tube (even though it tests O.K.). Replace with new tube
	2) improperly centered voice coil on the large speaker. Re-adjust the voice coil

ZENITH 245

Same case histories as those listed for Zenith 230

ZENITH 342, 342P, 352, 352A, 352AP, 352P, 362, 362X

Same case histories as those listed for Zenith 33X

ZENITH 410, 411, 420

Hum (present only when stations are tuned in)	1) partially short-circuited field coil, putting a greater load on the line and thereby lowering the plate voltages supplied to the tubes. Replace the field coil
Hum	1) faulty electrolytic filter condensers
Inoperative	1) open-circuited shadowgraph tuning meter
Fading after a few minutes of operation	1) replace type AVC '57 tube

ZENITH 422

Same case histories as those listed for Zenith 41, 42

ZENITH 430, 440

Same case histories as those listed for Zenith 410, 411, 420

ZENITH 474

Same case histories as those listed for Zenith 755

ZENITH 475

Same case histories as those listed for Zenith 760

ZENITH 476B

Same case histories as those listed for Zenith 770B

ZENITH 500, 501, 503, 514, 515, 516

Intermittent reception, Oscillation, Motor-boating, Station hiss	1) open-circuiting 0.5-mfd. grid filter condenser for r-f, i-f and first detector stages

ZENITH 522, 532, 542

Same case histories as those listed for Zenith 52, 53, 54, 55

ZENITH 600, 604, 606

Same case histories as those listed for Zenith 500

ZENITH 608

Intermittent reception, Volume cuts down to lower level ....1) open-circuiting r-f first detector, i-f secondary-return by-pass condensers

ZENITH 610, 616, 618

Same case histories as those listed for Zenith 500

ZENITH 701

Inoperative ....1) defective electrolytic filter condenser

Hum ....1) defective 25-5-10 mfd. electrolytic filter condenser. Replace with new unit

ZENITH 705, 706, 707, 711, 712

Broad tuning ....1) remove the 5,400-ohm resistor and 5-mfd., 20-volt condenser in the cathode of the type '2A6 tube, grounding the cathode. This removes the QAVC feature of the receiver. Realign the i-f and r-f stages, before putting the set in operation

Motorboating between stations ....1) defective 0.1-mfd. by-pass condenser in AVC circuit. Replace with new unit (part *No. 22-190*)

Oscillation, Motorboating ....1) open-circuited 0.05-mfd. cathode by-pass condensers for first detector and i-f stages
2) electrolytic filter condenser making poor contact with the metal chassis. Turn the condenser about ⅛ turn to tighten it

Intermittent reception, Oscillation, Motorboating ....1) open-circuiting 0.1-mfd. i-f secondary-return by-pass condenser

Distortion, Glowing type '59 tube grids ....1) can of electrolytic filter condenser grounding to shield
2) connecting lug of electrolytic condenser grounding to chassis

Inoperative at high frequencies ....1) intermittent oscillator plate by-pass condenser

Inoperative, type '58 i-f tube grids get red hot ....1) shorted primary-secondary windings of i-f transformer

Code interference ....1) shunt wave trap tuned to 485 kc across aerial and ground

ZENITH 715

Same case histories as those listed for Zenith 705, 755

ZENITH 750

See also case histories listed for Zenith 705, 706, etc.

Motorboating	1) type '89 tube weak on low frequencies. Reverse the i-f transformer primary terminal connections
Intermittent reception	1) defective type '59 tube (even though it may test O.K.). Replace with new tube by substitution

ZENITH 755, 756

For Zenith 755 see also case histories listed under Zenith 756

Weak reception, Distortion, Low plate voltage on type '55 tube	1) leaky first audio plate by-pass condenser
Inoperative, Very weak	1) open-circuited 15,000-ohm screen voltage dropping resistor
Oscillator inoperative below 850 kc	1) absorbed moisture in antenna coil. Replace with new unit, or dry out moisture and dope coil with a good doping compound

ZENITH 756

Noisy reception at low volume Steady popping	1) replace type '55 tube
Distortion, Poor AVC action	1) leaky r-f, or first detector secondary-return by-pass condensers
Intermittent reception, Oscillation	1) open-circuiting r-f, first detector and i-f secondary-return by-pass condensers
Hum	1) add extra filter choke between type '80 filament and speaker field and connect an 8-mfd. electrolytic condenser after filter choke to chassis
Hum on resonance	1) cathode-heater leakage of type '56 oscillator tube
Inoperative, D-C output shorted	1) type '58 r-f plate coil lead grounding to chassis

ZENITH 760, 765

Distortion, Poor AVC action	1) leaky or short-circuited secondary-return by-pass condensers
Intermittent reception, Fading, Motorboating,	1) open-circuiting r-f, first detector and i-f secondary-return by-pass condensers
Oscillation, Hum	1) add 8-mfd. electrolytic filter condenser after first speaker field to chassis 2) add additional filter choke between '80 tube filament and first speaker field, and connect 8-mfd. electrolytic filter condenser from '80 filament to chassis
Hum (after regular values of filter condensers have been installed)	1) by-pass the 0.5-mfd. by-pass condenser next to the primary of the input transformer with an 8-mfd. electrolytic condenser
Hum at resonance	1) cathode-heater leakage of type '56 oscillator tube
Distortion	1) by-pass the center tap of the volume control resistor to ground with a 0.00015-mfd. mica unit, thereby reducing the r-f load on the grid of the first a-f tube and allowing greater a-f amplification

ZENITH 767

Same case histories as those listed for Zenith 715, 755, 756

ZENITH 770, 775, 775B

Inoperative	1) open-circuited shadowgraph 2) open-circuited audio coupling condenser
Very weak, Distorted reception	1) open-circuited audio coupling condenser
No AVC action, Distortion at resonance	1) open-circuited AVC grid-coupling condenser
Motorboating between stations	1) open-circuiting r-f, first detector and i-f secondary-return by-pass condensers
Hum at resonance	1) cathode-heater leakage in type '56 oscillator tube
Intermittent reception Cutting off upon vibration	1) type '58 tube bias resistor grounding lug loose
Inoperative, Shadowgraph functions normally, Intermittent reception	1) open-circuiting audio coupling condensers 2) open-circuiting diode audio coupling condensers

(*Cont'd*)

ZENITH 770, 775, 775B (cont'd)

Intermittent reception, Fading, Oscillation, Station hiss	1) open-circuiting grid filter condensers in r-f, i-f and first detector secondary return circuits
Intermittent reception	1) leaky insulation in AVC resistor by-pass condenser lead. Slip a piece of spaghetti over this lead

ZENITH 805

Insensitive, Inoperative above 900-kc	1) short-circuited oscillator plate condenser. Replace with 0.01-mfd. unit (part *No. 22-276*)

ZENITH 835

Intermittent reception, Fading, Inoperative	1) open-circuiting 0.02-mfd. audio coupling condenser 2) rear right chassis bolt tightened too much
Oscillation, Motorboating	1) open-circuited 0.1-mfd. r-f screen by-pass condenser

ZENITH 880

See also case histories listed for Zenith 835

Distortion, AVC tube blocking	1) short-circuited 0.0004-mfd. condenser in first r-f coil can (part *No. 22-285*)

ZENITH 970, 975

Inoperative, Screen voltages on r-f, i-f and translator tubes only 20 volts, Positive indication from control grids to ground	1) Screen drop resistor short-circuiting to diode load resistor. Clear by moving
Intermittent reception, Popping noises	1) open-circuiting diode audio coupling condenser 2) intermittent short-circuiting of screen-voltage dropping resistor to diode load resistor 3) open-circuiting r-f grid filter condenser

ZENITH 5052 Chassis

Insensitive at low frequencies	1) defective second i-f transformer (even though it looks and tests O.K.). Replace with new unit

REMEDIES FOR STUBBORN CASES OF IGNITION INTERFERENCE IN VARIOUS MAKES AND MODELS OF AMERICAN CARS

Chapter XXVII of *Modern Radio Servicing** explains the general installation and servicing procedures for auto-radio receivers. While the details given are complete, and furnish all the information necessary for the satisfactory installation of auto-radio receivers in most cars, there are often cases where additional steps must be taken to eliminate entirely the interference resulting from the ignition system of the car. These stubborn cases are due to conditions peculiar to the particular model of car, or even to the particular individual car. Since the causes which may be responsible for these conditions are so varied, a great many hours may often be spent before the exact cause of the trouble, and its remedy, are found. For this reason, the information gained by a considerable amount of experience in auto-radio installation has been compiled here for the assistance of the service man—to save his time when attempting to eliminate stubborn cases of ignition system interference encountered when making auto-radio installations in various makes and models of American cars. The remedies are tabulated under the headings of the various commercial car names. These names are arranged in alphabetical order.

It is assumed that the noise persists after the standard suppressor equipment has already been installed on the car, and the receiver is securely bolted in place and connected properly. In those cases in which the use of spark-plug and distributor suppressors actually increases the noise level, the fact is stated; otherwise it is understood that the standard spark-plug and distributor suppressors are recommended to be installed.

******Modern Radio Servicing*** by Alfred A. Ghirardi—Radio & Technical Publishing Co.**

Since the necessity for by-passing differs according to the make of car, the following data specify the by-pass condensers to be used in nearly every car. When the location of the condenser is critical, the fact is stated. If all of the suggested remedies fail, then the reader is referred to Chapter XXVII of *Modern Radio Servicing* for more detailed information on the causes and remedies of car noise interference. The chart in Sec. 5 of this book should be consulted for the correct breaker and spark plug gaps recommended by the car manufacturer.

It must not be supposed that every car of the same make and model requires the same treatment in every case. For instance, as explained in Chapter XXVII of *Modern Radio Servicing*, poor bonding between the metal parts of one particular car may cause excessive noise interference in that car. Since this may be an exceptional case, it cannot be expected that all cars of that particular make and model will have the same resistance between different parts of the body and chassis, and be troubled by the same interference. For this and other similar reasons, any steps that succeed in minimizing the noise in one car cannot always be relied upon to give exactly the same results in another similar car. However, in most cases the troubles and their remedies are similar, so the information which follows should prove of great value.

All of the remedies specified here have actually been employed on hundreds of cars, and represent the findings of both the author and many other experienced service men. In the cases of those cars which are not listed, the reader is to assume that no special characteristic troubles will arise, and that the standard suppressor remedies will suffice to minimize all interference.

It is wise to try one of the suggested remedies at a time and note the effect in each case, as often a single change is all that is necessary to minimize the noise, even though there is more than one suggestion for each make of car. Wherever bonding is done, be sure to clean away all paint and grease with a scraper and emery cloth first, to insure good electrical contact between the bonding braid and the metal of the car. Otherwise, the bond will be ineffective and may even result in a source of noise itself if it should happen to make poor or intermittent contact.

AUBURN

General: On almost all Auburn cars it may be necessary to shield the high-tension lead from the ignition coil to the distributor, bonding the shield to the lock cable. It is also necessary to bond and ground all control rods entering the car from the engine compartment, and to ground all metal floor plates.

On antenna-equipped cars, it may be necessary to install a length of shielded braid over the antenna lead-in up into the roof structure; the shield should be grounded to the frame with the same screw that holds the glove box in place.

On the 1930 and 1931 models, thoroughly ground the aluminum plate which houses the distributor, on both top and bottom, with a length of braided shield fastened to one of the motor-block bolts.

By-pass condensers are required on the ignition coil, ammeter and generator. If interference still persists, connect by-pass condensers between each of the battery terminals and the instrument panel.

On the 1934 models, the ignition coil by-pass condenser should be connected to the terminal of the coil to which the *yellow* lead is attached. It is also necessary to connect a by-pass condenser at the generator. The antenna lead-in wire should be shielded as completely as possible, so that none of the lead-in wire will be exposed behind the instrument panel. It is advisable to even cover the point where the aerial wire from the receiver is spliced to the lead-in, with a piece of shielding sleeve which fits over the regular shield and which can be slid over the splice after it is made. The ends of this shielding sleeve should be tightly taped so that it makes good contact with the rest of the shielding braid from both the lead-in and the lead from the receiver. The shield should be grounded at the point where it enters the corner post. Also ground the windshield wiper pipe at the point where it passes through the dashboard, and insert a dome-light filter at the point where the dome-light lead enters the right front corner post. The filter may consist of a choke coil (about 12 to 20 turns of No. 18 wire wound on a ½″ or ¾″ form) connected in series with the dome-light lead and by-passed to ground with a 0.5-mfd. condenser.

In some cases, it may be necessary to eliminate the spark-plug suppressors and to include an additional by-pass condenser from one side of the ammeter to ground.

On the 1935 models, suppressors are necessary at the spark plugs and the distributor and by-pass condensers are required at the ignition coil, ammeter and generator. The lead-in should also be carefully shielded, as outlined above for the 1934 models.

On the 1936 models, install suppressors at the distributor and spark plugs, and by-pass condensers at the generator, ignition coil and ammeter. Install a dome-light filter as explained above for the 1934 models, grounding the filter to the bulkhead. The hood should be bonded with flexible bonding braid and grounded to the bulkhead. Connect by-pass condensers to the tail-light leads, which run across the top of the car and come down the left-hand front corner post. In some cases, removal of the distributor suppressor may actually improve reception.

BUICK

General: Ground the spark-plug cover with flexible braid to the water pump nut and to the oil lines at the rear of the motor. In some cases, it may be necessary to install a copper screen enclosure from the spark-plug cover over to the distributor, enclosing all the high-tension leads in between. Both ends of this enclosure should be bonded to the motor block.

Install a dome-light switch between the ammeter and the dome light at the left-hand side of the dash. It may sometimes be necessary to shield the dome-light wire, grounding the shield at both ends. If this does not help, use a choke coil (consisting of 12 to 20 turns of No. 18 wire wound on a ½″ or ¾″ form) in series with the dome-light lead, and by-pass the choke to ground with a 0.5-mfd. condenser. Install a strip of copper screening under the toe boards and floor boards, and ground the screen to the car frame.

By-pass condensers are required on the ammeter and generator. Spark-plug suppressors may not be required in this car;

they may actually increase the noise level. When plug suppressors must be used, they should be mounted under the cover plate of the engine.

In the 1929-30 and 1931 models, the windshield wiper tubing as well as the small metal braces on both sides of the windshield should be grounded. The lead-in wire should be shielded with copper braid and the braid grounded to the nut on the upper instrument panel bolt.

On the 1933 models, ground the dome-light filter on the right corner post and install a condenser on the dome-light switch.

On the 1934 models, the lead-in wire, which is tacked to the lower cross bar of the windshield, should be loosened and a length of shielding loom slid over it so that as much of the wire as possible is covered. The shielding loom should be grounded at the bolt on the instrument panel. At the corner post, where the lead-in passes through a plastic compound, insert a piece of tubing for shielding and slide it about an inch inside the shielding loom. Solder a pigtail from the loom to the tube.

Connect by-pass condensers to the *battery* side of the ignition coil, between the ammeter and ground, and at the generator. If interference still persists, it may be necessary to install an additional by-pass condenser from the battery side of the generator voltage regulator.

On the 1935 models, a suppressor is necessary at the distributor, and by-pass condensers are required at the ammeter and generator. Since these models usually employ running-board antennas, it is necessary to shield the lead-in completely from the antenna to the receiver and to install "grounds" or "static collectors" on the front wheels.

On the 1936 models, it is necessary to shield the antenna lead-in and install "static collectors" on the front wheels, as explained above for the 1935 models. Install a suppressor at the distributor, and a by-pass condenser at the generator. In some cases, it may also be necessary to bond the muffler to the car frame with flexible bonding braid making good electrical contact.

CADILLAC

General: Take the primary wire which connects the distributor to the ignition coil and remove it from the ignition wire duct. Shield this wire, and ground the shield at both ends. When a roof aerial is used, bond all pipes and control rods that enter the driver's compartment from the engine compartment.

Ground the shielding over the antenna lead-in which runs from the receiver to the corner post. The shield should be grounded at the point where the lead-in enters this post.

By-pass condensers are required on the *primary* side of the ignition coil, on the generator, and on the starting motor. A by-pass condenser may or may not be required on the ammeter. If so, the usual 0.5-mfd. unit is suitable; try either side of the ammeter to ground through the condenser.

On the 1934 models, connect the lead of the by-pass condenser on the starting motor to the generator terminal of the solenoid relay of the starting motor, and ground the condenser case to one of the screws of the starting motor. Spark-plug suppressors are sometimes unnecessary on these models, as they may actually increase the noise level. Shield the antenna lead-in and install a dome-light filter where the dome-light lead enters the right front corner post, in the manner explained for the 1934 Auburn cars.

On the 1935 and 1936 models, suppressors are necessary at the distributor and spark plugs. Install by-pass condensers at the "battery" side of the generator ignition coil, clock and dome light. A tubular condenser should also be installed at the ignition coil case and the condenser case grounded to the coil case with solder. The condenser lead connects to the "batt." terminal of the ignition coil. It is also necessary to install "static collectors" on the front wheels, and to bond the muffler and transmission housing to the car frame with flexible bonding braid.

CHEVROLET

General: It is sometimes necessary to ground the rain spout running around the edge of the car roof. This should be grounded to a corner post, after checking the resistance of the corner post to ground to make certain that it is well grounded to the car chassis.

Grounding the windshield frame as well as the small metal braces on both sides of the windshield will be found very effective when a roof antenna is employed.

In many cases, it will be found that reversing the ignition coil primary wires will cut down interference considerably. It may also be necessary to shield the entire ignition primary circuit wiring, bonding each shield separately to the bulkhead. If interference still persists, the same should be done with the high-tension leads. The distributor rotor should also be peened carefully in order to lengthen it, thereby reducing the length of the arc.

In severe cases of noise in 1929, 30, 31 and 32 models, it may be necessary to bond the body to the frame, or chassis, at both sides, in the front—preferably at the bulkhead. A piece of heavy bonding braid should be used, and it should be fastened to cleaned points in both the body and the frame by self-tapping screws with washers. In extremely noisy cases, the Electrolock cable and wire should be moved and the ignition should be wired up with a switch in the *hot* lead, like the later model.

On the 1930, 31, and 32 models, where a roof aerial is employed, install a dome-light switch at the dash between the ammeter and the dome-light lead. In some cases, it may also be necessary to shield the dome-light wire up into the door posts as far as possible. It is sometimes necessary to shield the high-tension lead between the ignition coil and the distributor housing. When this treatment does not help, a separate shielded primary lead must be run from the ignition switch to the battery, grounding the shielding at both ends. Disconnect and disregard the old primary lead from the switch to the coil.

The 1933 model is already equipped with a roof-antenna, but it is necessary to shield the lead-in from the receiver to a point as near the antenna as possible. This can be done by pushing a piece of braided shield over the antenna lead to the receiver. It is sometimes necessary to install a switch or choke coil in series with the dome-light circuit. The coil may consist of 12 to 20 turns of No. 18 wire wound on a ½″ or ¾″ form.

On the 1934 models, it is necessary to install a dome-light filter as explained above for the 1933 models and to shield the antenna lead as completely as possible. Also connect a condenser from the battery side of the igintion switch, grounding it to the instrument panel. If interference still persists, place a piece of screen over the toe boards and under the floor mat on the right side of the car and ground it to the bulkhead. For cases of "bucking" or missing at very high or low speeds on these models, replace the suppressors with wire-wound units.

On the 1935 models, by-pass condensers are necessary at the ammeter, generator and dome light, and a suppressor is necessary on the distributor only. Bond the muffler to the car frame and install "static collectors" on the front and rear wheels.

On the 1936 models, by-pass condensers are required at the ammeter and generator, the latter requiring a "dual" type condenser mounted on the cut-out relay. The condenser case should be mounted under the screw which holds the relay bracket. One of its leads should be connected to the generator output terminal of the cut-out relay. On the Master 6 model, the other lead should be connected to the field stud to which the field supply wire is connected; on the Standard 6 model, both leads are connected to the output terminal. It may also be necessary to connect a condenser between the spring clip located at the end of the wire which contains the fuse holder on the dash control unit and the terminal on the *discharge* side of the ammeter. The condenser should be connected to the spring clip by means of a self-threading screw, and the spring connector when compressed will easily slide on over the ammeter stud.

Coil-type "static collectors" are necessary on the front, and brush-type "static collectors" are necessary on the rear wheels. Suppressors are required at both the distributor and spark plugs. In some cases, it may also be necessary to bond the muffler to the car frame.

CHRYSLER

General: In all these models, it may be necessary to remove the *primary* wire (which connects the ignition coil to the breaker points on the distributor) from the metal high-tension wire duct. Shield this wire and bond the shield to the fire-wall or motor block. The high-tension lead from the coil to the distributor should also be shielded, and the shield grounded to the bulkhead of the car. In some cases, it may be necessary to peen the distributor rotor in order to lengthen it and thereby reduce the length of the arc.

When a roof aerial is used, install a dome-light filter or a 0.5-mfd. condenser from dome-light lead to ground; it is sometimes advisable to install a switch on the dash between the ammeter and the dome light.

It is important that the motor block and steering column be firmly bonded to the fire-wall and chassis of the car. It may sometimes be necessary to install a metal screen under the floor mat near the receiver. This screen should be well grounded to the chassis.

By-pass condensers are required on the generator, dome-light, and ignition switch in the 1934 models. The condenser case attached to the dome-light wire should be grounded to the cowl panel in front of the hood lining by drilling a 1/8″ hole where the wood overlaps, and as close to the pillar as possible. It may also be necessary to connect an additional 0.5-mfd. condenser from the ammeter to ground.

On the 1935 models, by-pass condensers are necessary at the generator, dome-light and ignition switch. It is also necessary to install suppressors at the spark plugs and the distributor.

On the 1936 models, by-pass condensers are necessary at the generator, dome-light and the ammeter or ignition switch. Ground the steering column to the dash. Ground the speedometer cable, oil line and temperature indicator tube at the points where they enter the dash. Use No. 14 stranded wire for the bonding, and a self-tapping screw for fastening the bonding wire to the dash (a 1/4″ drilled hole is provided for this screw on the dash). It is also necessary to shield the antenna lead-in wire as much as possible with braided shielding.

DE SOTO

General: The remedies for stubborn cases of noise in this car are similar to those specified for the Chrysler, Dodge and Plymouth. Refer to these cars for further details.

DODGE

General: In some cars the ignition-switch leads must be shielded, with the shield grounded at both ends. It may also be necessary to remove the primary wire connecting the ignition coil and breaker points in the distributor, from the high-tension wire duct. This lead should be shielded, and the shield grounded at both ends to the engine block. It is usually necessary to shield the high-tension lead between the ignition coil and the distributor. Both ends of the shield must be carefully grounded. Try reversing the primary leads to the ignition coil.

If a roof aerial is employed, it may be necessary to install a switch or choke coil on the dashboard between the ammeter and the dome-light wires. The latter may consist of 12 to 20 turns of No. 18 wire wound on a ½″ or ¾″ form.

By-pass condensers of about 0.5-mfd. capacity are required on the generator and the dome-light wire and should be grounded to the cowl panel in front of the hood lining by drilling a ⅛″ hole where the wood overlaps, and as close to the pillar as possible. It may also be necessary to by-pass either side of the ammeter to ground. The oil-pressure and water-temperature indicator lines on the engine side of the bulkhead should be grounded.

On some of the 1934 model cars, the use of spark-plug suppressors may actually increase the noise level. Suppressors are generally required on these models at the spark plug and distributor. By-pass condensers are required at the generator, dome-light and ignition switch.

Tire static encountered in 1935 models may be eliminated by removing the tires from the wheels and removing the tire cement (dull gray in color) which is painted inside the casing over an area about 3 inches wide and 18 inches long. It is also necessary in these models, to by-pass the dome light, generator and ignition switch and to connect suppressors at the distributor and spark plugs.

The interference-suppression remedies for the 1936 Dodge cars are essentially the same as those given for the 1936 Chrysler cars. By-pass condensers are required at the generator, dome light and ammeter or ignition switch. The steering column and control cables require bonding to the dash. Suppressors are necessary at the spark plugs and the distributor. If the car uses an insulated roof as the antenna, connect a 0.00025-mfd. condenser in series with the antenna section of the gang condenser in the receiver. In some cases, it may also be necessary to bond the hood to the bulkhead.

ESSEX

General: The receiver battery connection should be made directly to the storage battery. In the majority of these cars a by-pass condenser must be installed at the ignition switch, trying it at both sides for best results.

Good bonding is essential in these cars. The steering post should be bonded to the bulkhead, and the various rods passing through the bulkhead into the engine compartment should be grounded. The dome-light circuit should be by-passed with a 0.5-mfd. condenser to ground. The low-tension leads and the high-tension lead to the center of the distributor should be removed from the wire duct. It may be necessary to shield these leads, and ground the shields at both ends to the motor block.

FORD MODELS A AND B

The armored cable which carries the primary wire from the switch to the distributor should be grounded to the metal bulkhead, and the spark control-rod should be grounded to the motor block.

In some cases it may be necessary to install a dome-light switch on the dashboard between the ammeter and the dome-light wire and to shield the dome-light wires as far as possible.

In only a few instances will it be found necessary to shield the high-tension wire from the ignition coil to the distributor.

When this must be done, the shield should be grounded at both the ignition coil and distributor housings. The "battery" lead of the receiver should be connected directly to the storage battery.

No by-pass condenser is required on the ignition coil, though it is sometimes necessary to install a coil "suppressor" in 1933 models. This may be done by removing the coil from the bulkhead and pulling out the carbon brush and spring. Save the spring and discard the brush. Make a suppressor from a 40,000-ohm, 1-watt carbon resistor by cutting it to the same length as the original brush. Assemble this in place instead of the carbon brush, and remount the coil.

It may also be necessary to move the coil to the engine block; it may be mounted by enlarging the hole in the coil bracket. This may be done easily with a tapered reamer.

By-passing from the left terminal of the terminal block to the bulkhead, and from a low-tension coil terminal to the engine block, should also be tried in cases of extreme noise.

FORD MODEL V-8

General: Remove the primary wire from the same conduit that carries the high-tension spark-plug wires. Reroute it, or shield it with braided shielding, being careful to ground the shield well at both ends. Also shield the resistor connected in series with the high-tension coil.

The dome-light wire should be shielded at least up to the door post. If a roof-type aerial is employed, the lead-in should be brought down the left-hand door post, since the dome-light wire comes down the right-hand post in most cases. It may also be necessary to by-pass the dome-light wire.

It will be found that more perfect noise suppression will be obtained if all control rods are grounded with flexible braid, care being taken to allow sufficient slack to permit their unhampered operation.

In some instances two by-pass condensers must be installed on the generator cut-out relay, one from each terminal to ground. Very often an ordinary 8-mfd. condenser, connected directly across the battery from the fuse block to ground will aid greatly in eliminating the noise.

Because of unusual construction, the distributor suppressor must be installed in the following manner: Remove the ignition coil from the front of the motor by unscrewing the three machine screws in its base. Withdraw the carbon brush and spring from the end of the coil. Substitute a 25,000-ohm carbon resistor, removed from a standard suppressor, for the brush. Enlarge the brass bushing in the opening from which the brush and spring were removed, with a one-half inch drill so that there will be no arc from the bushing to the collector ring on the rotor shaft. Use a strip of insulating paper one-half inch wide to make a bushing to replace that portion of the brass bushing drilled away. This can be done by wrapping the insulating paper around the brush spring about twice, so that the brush is held firmly in place. The end of the brush must set squarely on the rotor shaft.

By-pass condensers connected from either low-tension coil terminal to the engine block will help reduce interference considerably. When installing these, be sure to make the connections to clean metal surfaces on the engine block. Scrape away any paint or rust that may be encountered.

In many stubborn cases, interference may be reduced by connecting a coil (consisting of about 30 turns of No. 14 enameled wire wound on a ½-inch form) in series with the low-tension lead at the spark coil next to the distributor assembly.

In 1933 models it is desirable to run the *red* lead to the distributor and the *black-and-yellow* lead to the generator in separate shields; bond the shields together every three inches and ground them to the copper gas line. Run the radio set battery lead under the floor mat to the battery; be careful that *no* leads are run on the engine side of the bulkhead.

If interference still persists after these precautions, try removing, from the high-tension cable duct, the two wires that connect to the coil and generator. Shield each separately, and ground the shields to the motor block and bulkhead. It may be necessary to connect additional by-pass condensers at the primary side of the ignition coil, at the fuse block, and at the ignition switch.

In 1934 models, the by-pass condenser to be used at the fuse block can be connected underneath the bolt which holds the loom adjacent to the fuse block. Connect the condenser lead to the terminal on either end of the fuse. It is also necessary to ground the rear edge of the hood with flexible bonding braid. In extreme cases, ground the ignition wire ducts at the hoods with short, heavy bonds, since these ducts are not sufficiently grounded through their mounting brackets. It is advisable to use a car-top type aerial only, as interference cannot be easily eliminated with a running-board type.

In the 1935 models, it is necessary to use by-pass condensers on the gas and oil gauges, as well as the fuse block, generator, ignition coil and ignition switch (see information given for their installation later for 1936 cars). Suppressors are only necessary at the spark plugs. Bond the speedometer, oil and heat indicators; also bond the door sills to the metal floor and the hood to the bulkhead. If interference still persists, change the ignition coil.

Keep the antenna lead-in as far away from the loom (under the cowling containing the ignition and lighting wires) as possible. In some cases, it may be necessary to wrap a strip of copper screen spirally around this loom where it passes through the motor compartment, spotting with solder at different points to make the shield continuous, and then grounding it.

In the 1936 models, it is necessary to by-pass all the units stated above for the 1935 models. A special coil bracket type condenser should be used on the ignition coil. In connecting the oil gauge by-pass condenser, fasten the condenser on the transmission housing underneath the starter wire clamp, and connect the lead to the terminal of the gauge on the flywheel housing, being careful that the accelerator arm does not strike the condenser or rub the condenser lead during operation. A condenser equipped with a special bracket should be installed on the gasoline gauge, which is located on top of the left side of the gasoline tank. Access may be had to it by opening the top of the trunk and removing the circular covering. In cars not having a trunk, access may be had by moving the rear seat back cushion forward. In coupes, it is necessary to lift the rear deck and then the rubber mat. Then remove the sheet metal screw and the rectangular metal cover. Fasten the dome-light condenser under the lower right mounting screw and connect the lead to the bullet connector on the dome-light wire at the pillar entrance. Mount the condenser at the fuse block behind the dash, directly to the left of the block. A hole is provided in the dash for mounting; it is only necessary to pierce the padding. Fasten the condenser in place with a No. 10, 1½-inch long sheet metal screw. Connect the lead to the left coil resistance terminal.

In models which are not equipped with an oil gauge, it is well to ground the lead which is provided for it in the harness comprising the generator and ignition wires. In that case, a grounded "shield" is also formed for the other wires in the harness as a result of grounding this lead.

It will be found that suppressors may actually increase the noise on the 1936 models.

FRANKLIN 1930, 31, 32

In these models, the conduit carrying the ignition wires must be grounded to the bulkhead on the engine side of the dash. Also, ground the ignition coil frame to the oil line in the driver's compartment. Shield the high-tension lead from the coil to the dash, and ground the shield at the dash.

Cut the dome-light wire and install a switch on the dashboard close to the door post along which the wire passes.

GRAHAM

General: Shield the wire from the ignition coil to the ignition switch located on the steering column, and ground this shield to the bulkhead. A by-pass condenser must be connected from one terminal of the fuse block located on the bulkhead, to ground. Another by-pass condenser may be required from the ignition switch terminal nearest the left side of the car (behind the instrument panel) to ground. This ground should be made securely to the top of the cowl bar immediately behind the instrument panel.

In the 1934 models, filtering is necessary for the dome light and the cigar lighter and clock light which are located in the header plate. Bond the ignition manifold with short bonds to the motor block at several places, making sure that both sections are bonded. Shield the antenna lead, as explained for the 1934 Auburn model.

In the 1935 and 1936 models, suppressors are necessary at the spark plugs and the distributor. By-pass condensers are required at the ignition switch in the 1935 models, and at both the generator and ignition switch in the 1936 models.

HUDSON AND TERRAPLANE

In 1931 models, take the primary lead which connects from the ignition coil to the distributor and remove it from the high-tension wire duct. Shield this lead, bonding the ends of the shield to both the ignition coil and to the distributor housings.

In 1933 models, it may be necessary to by-pass the ammeter to ground and to bond the steering column and motor block to the bulkhead.

In 1934 models, by-pass condensers are required on the ignition coil, generator, dome-light, gasoline gauge and water-level gauge. Connect the lead of the by-pass condenser in the gasoline gauge circuit to the battery terminal of the tank unit, and ground the condenser case to the tank. Connect the lead of the water-level gauge by-pass condenser to the terminal in the center of the radiator unit, and ground the condenser to one of the six screws at the rim of the radiator unit. The antenna lead-in should also be shielded as completely as possible and the shield properly grounded.

In the 1935 models, by-pass condensers are required at the dome light, ignition coil, and gasoline and water gauges. Suppressors are also necessary at the spark plugs and at the distributor. The manner in which the gasoline and water gauge by-pass condensers should be connected is described above for the 1934 models.

In the 1936 models, by-pass condensers are required at the gasoline and water gauges and at the generator. In attaching to the gasoline gauge, attach the condenser case with one of the gauge mounting screws and connect the lead to the gauge terminal. Installing at the water gauge, attach the condenser to the upper rear cap screw of the water manifold of the engine, and attach the condenser lead to the terminal of the water temperature gauge element. On Terraplane models, this condenser is not required.

Also install under the floor mat, three grounding contact springs to the front, rear and left of the floor-board opening, so that the spring fingers will make contact with the transmission control housing. Be sure to clean the paint from the floor panel and transmission tower to insure good electrical contact. Place spacers under the ground clamps and secure them to the floor-board with sheet metal screws and tapping plates. Also install a ground strap from the front muffler bracket to the frame, being sure here, again, to scrape away the paint in order to insure good electrical contact.

In some cases, it may be necessary to install a dome-light filter or by-pass condenser. It may also be necessary in extreme cases, to bond the motor block, the hood and the headlights.

HUPMOBILE

General: The antenna lead-in on these models should be well shielded. The shielding should be pushed over the lead-in and extended up into the right-hand pillar for a few inches. Ground the shield by drilling a hole in the cowl in front of the hood lacing, and connect the shield pigtail terminal to it with an 8-32 bolt and nut.

By-pass the generator by mounting a condenser under the generator relay mounting leg, and connect the condenser lead to the "battery" side of the relay. Also connect a by-pass condenser in the dome-light lead by drilling a 1/8" hole on the left side of the cowl in front of the hood lacing, fastening the condenser under the cowl with an 8-32 nut and bolt.

In the 1935 and 1936 models, by-pass condensers are necessary at the generator, dome light and starting motor. Suppressors are also necessary at the spark plugs and at the distributor.

LAFAYETTE

The ignition troubles and remedies for these cars are the same as those presented here for the Nash 400 model. Refer to the Nash ignition interference suppression information for complete details.

LA SALLE

General: In these cars, the *primary* lead from the distributor to the ignition coil passes through the high-tension wire duct. This wire must be removed from the duct, and, in some instances, should be shielded, the shield being grounded at both ends.

In some of the more recent custom-built models, the installation of two dome-light filters is necessary, especially when a roof aerial is employed. These filters must be connected underneath the car, at the junction boxes, to their respective circuits.

In 1932 models the ignition coil is located on the bulkhead on the driver's side, above the clutch pedal. It is sometimes necessary to move the ignition coil to some other location to prevent interference from being radiated by the body of the operator of the car.

In 1934 models, by-pass condensers are required on the ignition coil, generator and starting motor, and often in the ammeter circuit. Connect the lead of the by-pass condenser in the starting motor circuit to the generator terminal of the solenoid relay on the starting motor, and ground the condenser case to one of the screws holding the solenoid relay to the starting motor.

The high-tension wire between the coil and dash should be shielded and the shield grounded to the dash. In some cases, the body of the driver or a passenger in the front seat may reradiate interference to the antenna. In such cases, it is necessary to move the ignition coil to some other location, or to shield the ignition coil by installing a metal plate under it and grounding this plate securely to the instrument panel.

On the 1935 models, it is necessary to install suppressors on the spark plugs and at the distributor. By-pass condensers should be connected at the ignition coil, generator and starting motor.

On the 1936 models, by-pass condensers are necessary at the generator, ignition coil, clock and dome light. Suppressors are also necessary at the spark plugs and distributor. A tubular condenser must also be installed at the ignition coil case, grounding the grounding terminals to the coil case with solder. "Static collectors" are also necessary at the rear wheels.

LINCOLN

General: In these cars there are two ignition coils which are mounted on the dash in the driver's compartment. The high-tension leads pass through the dash in metal conduits to the distributor which is located on the motor. The leads from the ignition coils should be well shielded and the shields carefully bonded to the fire-wall. It may be necessary to remove the coils and place them in the motor compartment (under the gear-case nuts).

Because of the complex dome-light wiring, shielding is usually necessary to eliminate interference from this point. A choke coil should be installed in series with the dome-light lead and by-passed to ground by a 0.5-mfd. condenser which is well grounded.

In some instances, it may also be necessary to by-pass the dome-light feeder (at the terminal box located in back of the rear seat cushion) to the body of the car with a 0.5-mfd. condenser.

By-pass the battery terminal of each coil to the coil-mounting plate, and by-pass either terminal of the ammeter to the instrument board. A suppressor should be used at the high-tension terminal of the coil as well as at the distributor.

In the event that noise still persists, add a by-pass condenser from the brush side of the generator cut-out to ground, reverse the primary leads to one coil, and bond all rods and metal parts passing through the bulkhead to the motor block and the bulkhead.

In the 1934 models, the antenna lead-in should be shielded as completely as possible. It is sometimes necessary to let the antenna shield float free, so that it grounds at the radio set only.

In the 1935 models, it is necessary to connect by-pass condensers at the ignition coil and at the generator relay. The manufacturer recommends the use of special radio spark plugs in order to eliminate the use of external suppressors and disturbance of the ignition system in general.

LINCOLN-ZEPHYR

On the 1936 models, the lead-in is located at the base of the left center door pillar. Carefully carry the shielded lead-in over the propeller shaft housing, and ground the shield to the floor of the car at the base of the pillar.

By-pass condensers are necessary at the generator, both ignition coils, the oil gauge, the gasoline gauge, the water thermometer and the relay. In installing the generator condenser, remove the generator cutout relay mounting screw and fasten the condenser bracket on the cutout relay mounting lug. Connect the condenser lead to the *battery* terminal of the cutout. In installing the by-pass condensers on the distributor, use the units specially designed for this installation. The oil gauge condenser should be installed on the transmission housing underneath the starter wire clamp. The condenser lead should be connected to the terminal on the oil gauge. The water gauge by-pass condenser should be fastened underneath the top radiator shell to the body bracket bolt at the top of the radiator. Connect the condenser lead to the water gauge terminal. The coil resistor condenser should be installed under the left cutout mounting strip and bolted to the dash. The lead should be connected to the *battery* terminal of the relay.

For severe cases of stubborn interference, try bonding the exhaust pipe to the car frame.

NASH

1934 Nash cars require by-passing at the generator and at the ammeter. If radiation into the antenna is strong, shield the bulkhead with copper sheet or screen, and bond the shielding on both sides to the engine block. It is also well to bond the instrument panel to the bulkhead.

In the 1936 models, it is necessary to install by-pass condensers at the generator, dome light and ignition coil. In the Ambassador 6 and 8 models, fasten the condenser under the generator cutout relay mounting screw, and connect its lead to the "battery" terminal of the relay. Install another condenser under the right door instrument board flange, and connect its lead to the dome-light wire—as close as possible to the corner post. (Note: this connection should be in the form of a splice, and must be soldered and taped). Another condenser should be fastened under the outside ignition coil bracket, and its terminal connected to the "ammeter" side of the ignition coil.

In the Nash 400 model, fasten a condenser under the generator cutout relay mounting screw and connect its lead to the battery terminal of the relay. Mount another condenser on the instrument board flange, and connect its lead to the *discharge* side of the ammeter.

OAKLAND

General: The "battery" lead of the receiver must be run directly to the car storage battery and must be completely shielded; the shield should be grounded at both ends.

In some instances, shielding of the spark-plug lead to the No. 8 spark plug is absolutely essential. The shield, of course, must be grounded.

Dome-light filters should be installed on all sedan models. A by-pass condenser may have to be installed from the starting motor terminal to the fire-wall. The lead from the coil to the fire-wall must be shielded, and the shield grounded to the fire-wall.

By-pass either terminal of the ammeter to the instrument board. The high-tension wire from the coil to the distributor should be shielded, and the shield grounded to the bulkhead. The low-tension lead from the coil to the breaker should also be shielded, and the shield grounded.

If interference still persists, it may be necessary to house the distributor in a copper-screen shield and ground the shield to the engine block.

In the 1930 models, shield the antenna lead-in all the way to the antenna, and bond this shield to the corner post as near to the antenna as possible. Also bond the car body to the chassis frame with flexible bonding braid. If interference still persists, cover the entire floor board with copper screen, bonding the screen to the car frame. Also install all the customary by-pass condensers.

OLDSMOBILE

In the 1929 and 1930 cars, intermittent ignition interference (usually due to poor grounds) may be eliminated by shielding the antenna lead-in wire to a point within about 5 or 6 inches from the car aerial and grounding this shield to the steel body brace at the right or left top corner of the car. Also connect a bond between the header bar mounting bracket and one of the tabs holding the body sheet metal to the upper front door sill of the car. Return these bonds to the point where the lead-in is grounded. Do the same in the opposite front corner. If necessary, a conductor of 3/8" shielded braid should be extended from the common ground of these three points to the instrument panel, where it should be grounded and then extended to the dash or bulkhead. In extreme cases, bond the car body to the chassis.

On 1934 Oldsmobiles, the antenna lead-in should be shielded for as long a length up the corner post as possible, but do not ground the pigtail of the shield until the set is installed. After installation, turn on the set and tune between stations with full volume. Start the engine and let it run just above idling speed. Note the noise level first with the shield ungrounded, then with the shield grounded to the nearest instrument panel bracket bolt, and finally with the shield grounded to the windshield wiper tube. If least noise is obtained with the shield ungrounded, then clip the pigtail close to the shield and tape the end to prevent its grounding. On the other hand, if the shield must be grounded, do so to the point where least noise was obtained.

Spark-plug suppressors should not be used as they may actually increase the noise level. Connect the lead of the generator by-pass condenser to the generator terminal of the cut-out relay, and by-pass the ammeter to ground.

The high-tension lead from the coil, and the coil itself, should be shielded and the shields grounded with short, heavy bonding braid. Extreme care must be taken in shielding the coil, as the battery terminal of the coil is "hot." Disconnect the ignition system wire from the starter relay terminal before mounting the shield.

A shielded low-tension wire should replace the original lead from the ignition coil to the distributor. After the connections are made, a pigtail should be soldered to the shield braid at a point where the wire enters the engine compartment, as near to the grommet as possible. This pigtail should then be grounded to the dash at the nearest point, preferably by soldering.

A piece of 3/8″ wide flexible copper braid 10½″ to 11″ long should be secured for bonding. Cut off one piece about 3½″ long and bond the steering column to the dash at the point where it passes through the dash on the engine side. This bonding strip should be cut and soldered in place and cut as short as possible except for a small loop to allow for some movement between the bonded parts. The remaining length of braid should be used as a bond between the support bracket on the exhaust side of the engine immediately below the dash.

It is recommended that two 3/8″ holes be punched in the ends of the piece of braid and then the entire end of the braid soldered over to make a good, hard terminal. This binding strip is then to be mounted under the top bolt which mounts the exhaust pipe bracket, and the other end is secured under the top bolt securing the engine support bracket. When these bolts are removed to attach the bonding strip, care should be taken to see that all the paint is removed from the under side of the bolt head and from the area under the bolt which will be covered by the bonding strip.

If interference still persists, the dome-light circuits should be by-passed or filtered. This is one of the few cars in which by-passing and bonding should be used in preference to suppressors. Only one suppressor, in the distributor lead, is usually necessary.

In some cases, the body of the driver or passengers in the front seat may re-radiate interference to the antenna. In such cases, it is necessary to move the ignition coil to a different location, or to install a metal plate about 5″ x 10″ under the coil, fastening it to the instrument panel securely so as to shield the bottom of the coil.

In the 1935 models, by-pass condensers are necessary at the ammeter, generator and dome light. A suppressor is also necessary at the distributor. Also connect by-pass condensers to either, or both, terminals of the stop-light switch. If interference still persists, bond the last cylinder-head to the fire wall and the aluminum stops on the door sills. Also bond the relay core and base to the bulkhead.

In the 1936 models a by-pass condenser is necessary only at the generator, and a suppressor is necessary at the distributor. Connect the condenser lead on the generator to terminal *A*.

Connect a ground strap to the left chassis cross-member by means of a 5/16″ bolt, nut, shakeproof lock-washer and 5/16″ × ¾″ plain washer. A hole is provided in the cross-member for this purpose. In making the connection, be sure that the surfaces are clean, and that good contact is made. The other end of the strap should be fastened under the head of one of the transmission case bolts, inserting a plain washer between the strap and the head of the bolt. Another similar ground strap should be fastened between one of the cylinder head bolts and the bolt at the top of the starting pedal bracket on the dash. Static collectors should also be installed on the front wheels, making sure that the connections are clean and that there is no grease at the contact surfaces (unless the grease has graphite mixed with it).

PACKARD

General: Take the primary wire which connects the ignition coil to the breaker in the distributor housing, and remove it from the high-tension wire duct. Shield it, and ground this shield to the bulkhead or engine block. If the noise still persists, it may be necessary to move the ignition coil to the front of the engine compartment.

Since the ignition switch mechanism is located at the base of the ignition coil, it will be necessary to remove this mechanism from the base, so that it can be used again; or, a new ignition switch may be installed on the dash.

In the first instance, the switch mechanism may be removed from the base of the coil. Solder the switch wires in the coil together, and cover with a fiber disc. A metal disc may then be cut and soldered in the base of the coil. Mount the coil in a horizontal position at the top of the radiator brace under the hood. Then reassemble the switch and make the connections from ammeter to switch and from switch to coil. Remount the switch and shield the wire from the switch to the coil, grounding the shield to the bulkhead.

In some cases, additional by-pass condensers must be connected from either side of the ammeter to the instrument panel. By-pass condensers are also required at the generator, ignition switch, and, perhaps, from one terminal of the ignition coil primary to ground.

The low-tension lead between the coil and the breaker arm should be shielded and the shield grounded to the bulkhead.

In all cases, the spark-plug gap should be increased from 0.025″ to 0.03″.

In all the 1935 models, by-pass condensers are necessary at the ignition coil and generator. Suppressors are necessary at the spark plugs and distributor.

In the 1936 Packard 8 and Packard Super 8 models, connect a by-pass condenser at the *ammeter* side of the ignition switch, grounding it under the lower instrument light housing screw. Mount another condenser under the outside generator relay mounting screw and connect its lead to the relay *battery* terminal. The spark-plug gap should be increased from 0.025″ to 0.03″.

In the 1936 Packard 12 models, mount a condenser on the coil bracket, fastening it with the right-front coil mounting screw. Pass the condenser lead through the hole provided in the coil bracket, and connect it to the lower side of the coil, to which a brass strip is fastened. In replacing the unit, make sure that the enamel is cleaned away so the condenser case is well grounded. Fasten another condenser under the outside generator relay mounting screw, and connect its lead to the relay "battery" terminal. Resistors may or may not be necessary in the coil wires. The spark-plug gap should be increased from 0.025″ to 0.030″.

In the 1936 Packard 120 model, solder the end of a braided grounding strap with an eyelet provided at the other end for grounding to the oil pressure gauge tubing and wind the strap tightly around each of the tubes and cables coming through the dash at this point. Before winding the strap, make sure that all the points which the strap touches on the various cables around which it is wound are clean and make good electrical contact with the strap. After winding, solder the strap to the pressure gauge tubing again and ground the eyelet in the braided strap to the dash. In some cases, it may also be necessary to bond the steering column to the dash with a short lead.

Install a condenser on the generator under the outside relay mounting screw, and connect the lead to the "battery" terminal of the relay.

PIERCE-ARROW

In the 1936 models 8 and 12, two by-pass condensers are necessary at the generator and one at the ammeter. Fasten one of the condensers under the inside generator relay leg and connect its lead to the *battery* side of the relay. The second condenser is mounted under the current-limiting relay mounting screw, and its lead should be fastened to the same terminal to which the "A" lead is connected. The ammeter by-pass condenser should be fastened to the instrument board flange, and its lead connected to the ammeter. A suppressor is also necessary at the distributor.

PLYMOUTH

General: The lead from the ignition coil should be shielded up to the metal fire-wall, and then grounded to the oil line. The oil line, in turn, should be grounded, on the motor side, to the fire-wall. It is also essential on these models to remove the primary lead between the ignition coil and the distributor from the high-tension duct. This lead should be shielded, and the shield bonded to the engine and fire-wall.

Because of the use of the rubber "floating power" engine mounting in these cars (which insulates the motor block from the frame) it is absolutely essential that the motor block be carefully grounded to the car frame by means of stout, flexible copper braid, leaving sufficient slack so as not to interfere with the normal "rocking" of the motor.

By-passing is required at the dome light, generator and ignition switch in nearly all cases. It may also be necessary to by-pass either side of the ammeter to the instrument board.

A dome-light switch or filter should be installed close to the left-hand side of the dash when a roof antenna is employed.

Interference is sometimes caused by a sticking brush in the distributor. Remove the top of the distributor housing and drop some thin oil on the brush in order to loosen it. This may eliminate a considerable amount of noise. In some cases, bonding the speedometer cable to the chassis will eliminate a considerable amount of interference.

In the 1935 models, interference caused by tire static may be eliminated by removing the tires from the wheels and removing the strip of cement (dull grey in color) about 3″ wide and 18″ long which is painted inside the casing. Remove with a wire buffer and benzine.

In the 1936 models, the interference suppression remedies are essentially the same as those presented here for the 1936 Chrysler models. By-pass condensers are required at the generator, dome light, ammeter or ignition switch. Suppressors are necessary at the distributor and spark plugs.

PONTIAC

General: Shield the high-tension lead from the ignition coil to the fire-wall, and ground the shield to the fire-wall. Shield the lead-in as described for Buick cars.

Remove the low-tension lead (which connects the coil to the distributor) from the high-tension wire-duct. Rearrange this lead behind the conduit alongside the motor block.

If a roof aerial is employed, a dome-light filter is necessary to eliminate pick-up from the dome light and leads. This filter should consist of an r-f choke and by-pass condenser.

Ground the generator and radiator shell to the same point on the motor block.

It is necessary that the ammeter, dome light, and generator be by-passed in these cars. The lead of the generator by-pass condenser should connect to the generator terminal of the cut-out relay, and the ammeter by-pass condenser should be connected to the registering terminal. In order to prevent excessive noise pickup, it may also be necessary to carry the antenna lead-in wire under the floor boards, rather than under the dash. Spark-plug suppressors should not be used as they may actually increase interference noise.

In the 1936 models, a by-pass condenser is required at the generator, and a suppressor is required at the distributor. The generator by-pass condenser case should be mounted on the armature terminal, making sure that all paint and dirt are scraped away, so that good contact is made. Connect the condenser lead to the cover screw of the generator bearing. Do *not* connect it to the field terminal, as damage to the voltage regulator will result.

Bond the torque tube to the chassis frame, fastening the bonding strap to the web of one of the K members.

Install "static collectors" in the dust caps on the front wheels. See that the rounded contact button at the center of the helical spring is centered in the center hole of the axle shaft. File away all burrs at this hole to prevent wear at the contact point. Remove any grease from the end of the axle shaft and bend the cotter pin back against the flat of the nut to avoid interference with the collector spring.

Static collectors are also necessary on the rear wheels, but the type to be used depends upon the particular type of flange on the wheels. If the flange is square, use a "pencil type" collector. If the flange is round, use a "static collector" which is made of sheet brass and carries a carbon contact brush.

REO

In the 1936 models, by-pass condensers are necessary at the generator and dome light. Suppressors are necessary at the distributor and spark plugs. Fasten the generator by-pass condenser case under the screw that holds the generator cutout, and connect the condenser lead to the cutout terminal. Connect the dome-light wire condenser at the point where it enters the right windshield pillar, grounding it to the lower instrument board fastening screw. In some cases, it may be necessary to bond and ground all the metal controls that come through the large grommet in the center of the dash.

ROCKNE

General: Shield the high-tension cable between the ignition coil and the distributor, and ground the shield to the oil line. Ground the oil line on the motor side of the fire-wall.

The dome-light wire should be disconnected and a switch installed. In some cases, the dome-light wire must be shielded from the switch to the cowl and up into the door post as far as possible. Ground the shield.

STUDEBAKER

Shield the high-tension lead between the ignition coil and the distributor, and ground the shield at both ends. By-passing is necessary in the ammeter, generator, and dome-light circuits. It may also be necessary to by-pass the switch wire of the coil to the coil bracket.

The metal eavestrough around the top of the car is usually a source of interference radiation, and should be bonded to the chassis frame.

In the 1934 Studebaker models, the remaining interference-elimination remedies are essentially the same as those already presented here for Dodge cars, and should be carried out.

In the 1936 Dictator models, it is necessary to by-pass the generator and ammeter, and to apply a suppressor to the distributor. Mount the case of the generator by-pass condenser under the relay mounting screw and connect the condenser lead to the "battery" terminal on the relay. The ammeter by-pass condenser should be mounted on the back of the speedometer, and the lead connected to one of the ammeter terminals.

In the 1936 President models, by-pass condensers are necessary at the generator, ignition coil and ammeter. A suppressor is necessary in the distributor. The by-pass condensers should be connected in the same way as outlined above for the Dictator models. The ignition coil by-pass condenser should be mounted on the bottom edge of the instrument board and the lead connected to the ignition coil switch terminal. The front end of the muffler should be bonded to the car frame.

—4—

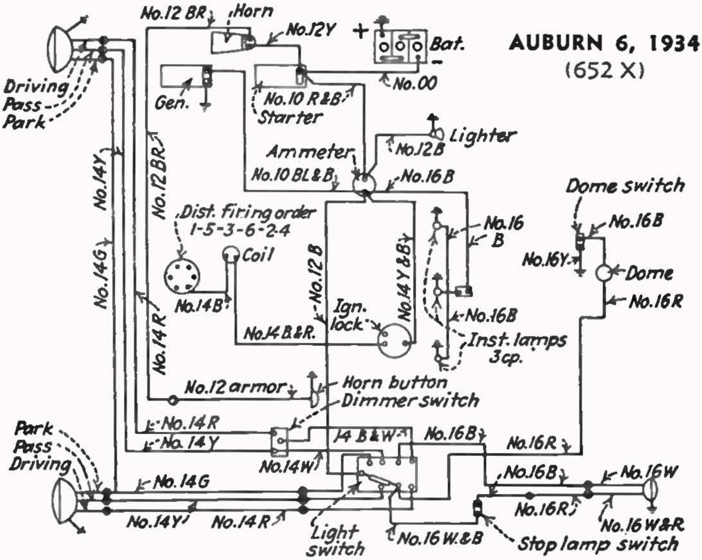
ELECTRICAL WIRING DIAGRAMS OF AUTOMOBILES

Since a knowledge of the electrical systems of automobiles is very important in auto-radio service work, there are shown in the following pages the diagrams of the electrical wiring systems of eighty American cars. As pointed out in Chapter XXVII of *Modern Radio Servicing,* and in Section 3 of this book, it is sometimes necessary to place suitable filters in lighting leads or in some of the switching circuits to prevent interference. While the proper location of such filters may be determined by cut-and-try methods, it is very desirable to know the relative position of the filter with respect to other electrical apparatus in the car. It is the purpose of these diagrams to show these positions.

There are other uses for these diagrams. Certain pieces of electrical equipment are at ground potential and others are not; certain cars have their switches in the negative lead and others have them in the positive lead; some cars use a two-wire system and others, like the Chevrolet, use a single-wire system; some switches are in the ground side of the line and others are in the "live" lead, regardless of the polarity of the grounded terminal of the battery. By means of the diagrams shown here, these peculiarities may be ascertained for the particular car in question.

In instances where the original wiring of the car has not been changed since it left the factory, the color coding shown in the diagrams may be used to advantage, especially in those cars whose wiring systems are somewhat complicated. The leads are usually cabled, and the individual wires in the cable may be checked and selected either by means of the color code (when it is used) or by means of an ohmmeter when necessary. Diagrams of this kind will be found very helpful in the work of installing, servicing, and eliminating electrical interference in auto-radio receivers. These diagrams are reproduced here by courtesy of *Radio Retailing* and *Automobile Digest* magazines.

AUBURN 6, 1934 (652 X)



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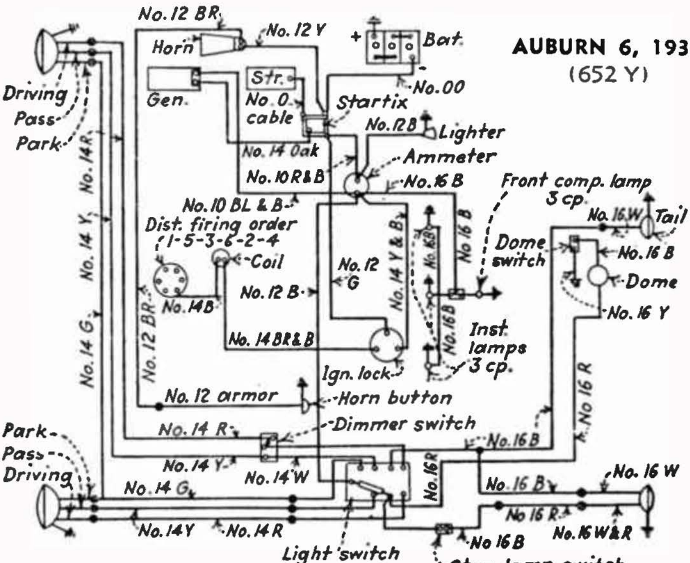

Courtesy "Radio Retailing"

AUBURN 8, 1934
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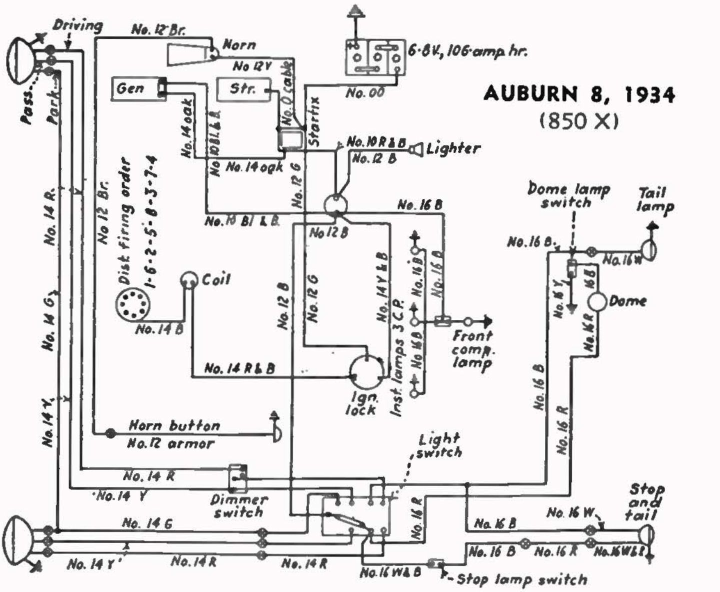

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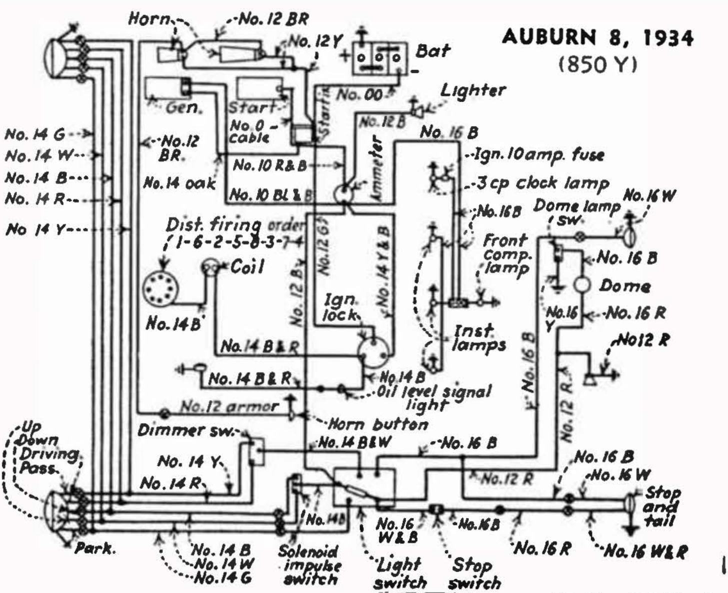

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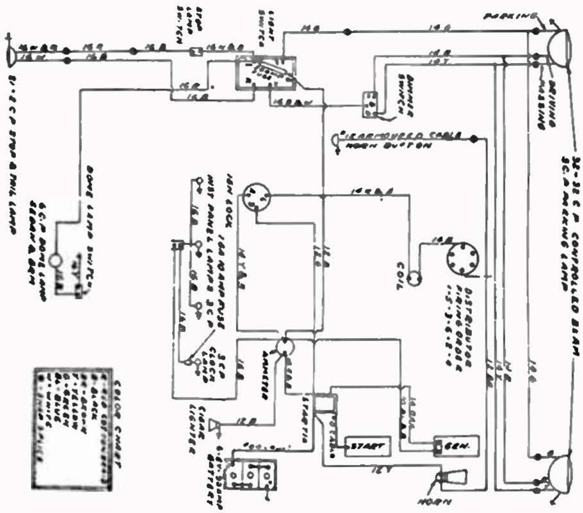

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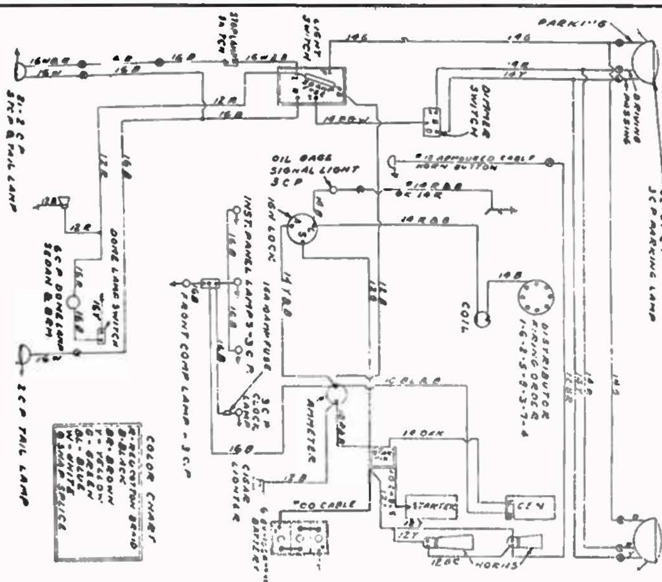

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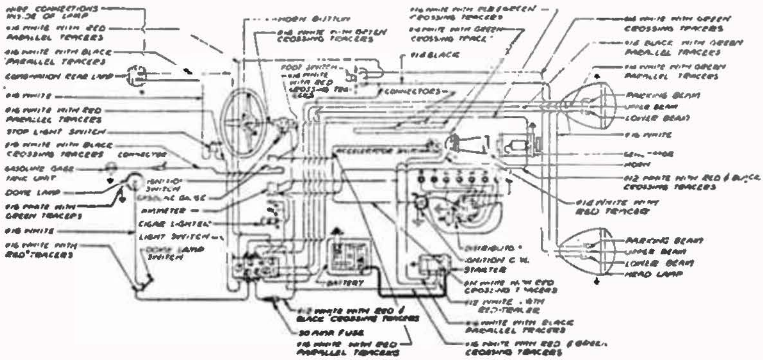
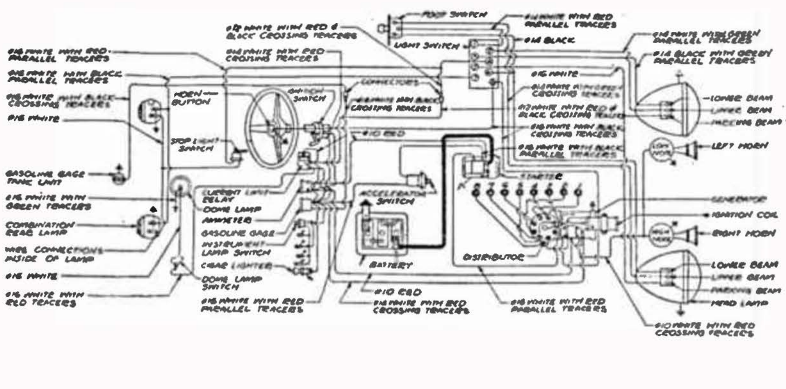
Courtesy "Automobile Digest"

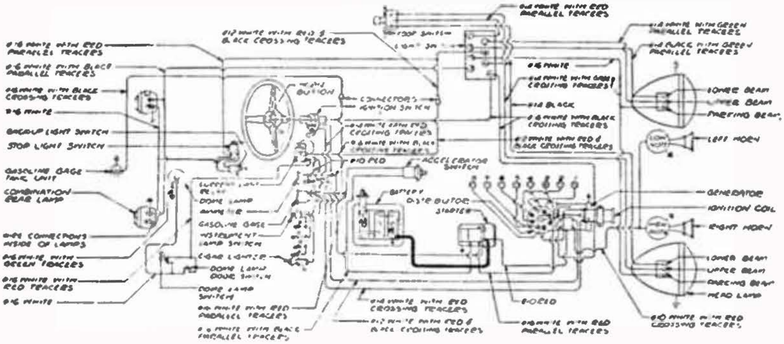


BUICK 40, 1935

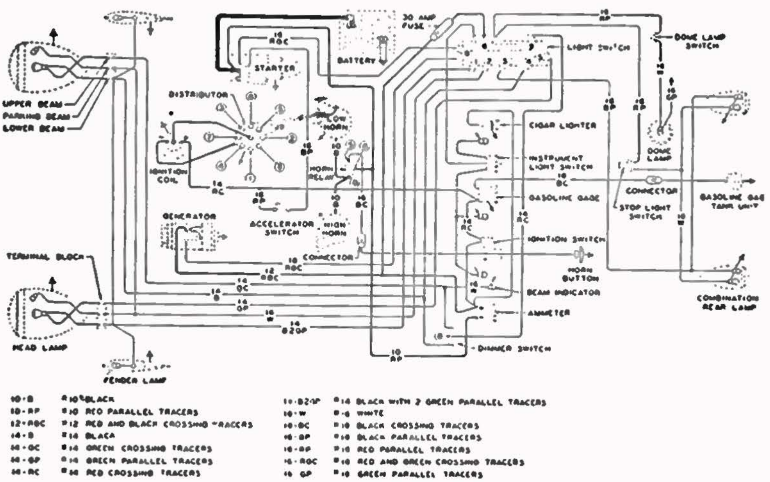


BUICK 50, 1935

Courtesy "Automobile Digest"

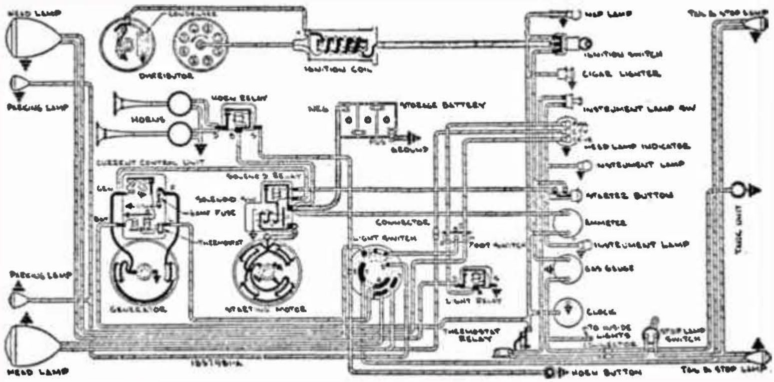


BUICK 60, 1935

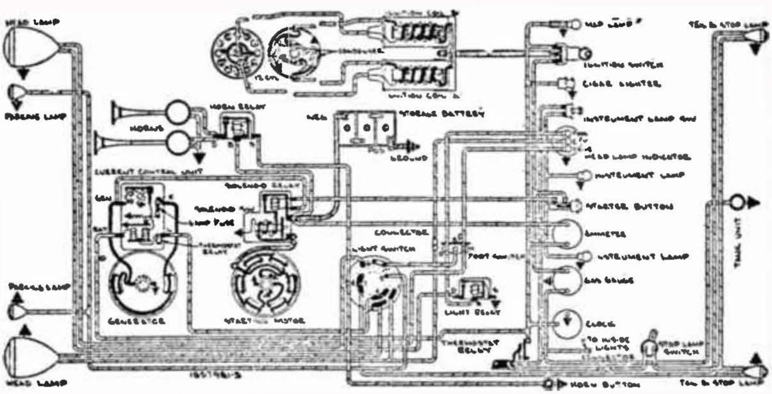


BUICK 40 "Special", 1936

Courtesy "Automobile Digest"

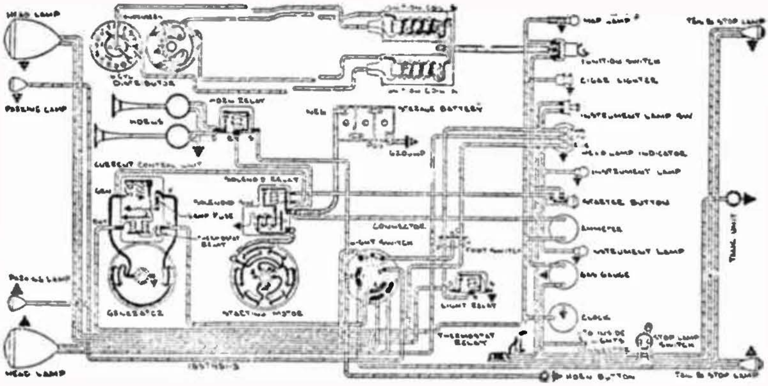


CADILLAC V-8, 1935
(Series 10, 20 and 30)

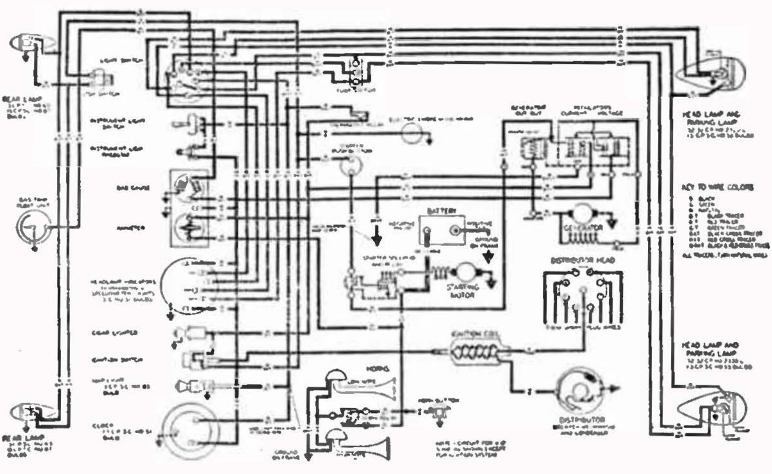


CADILLAC V-12, 1935
(Series 40)

Courtesy "Automobile Digest"

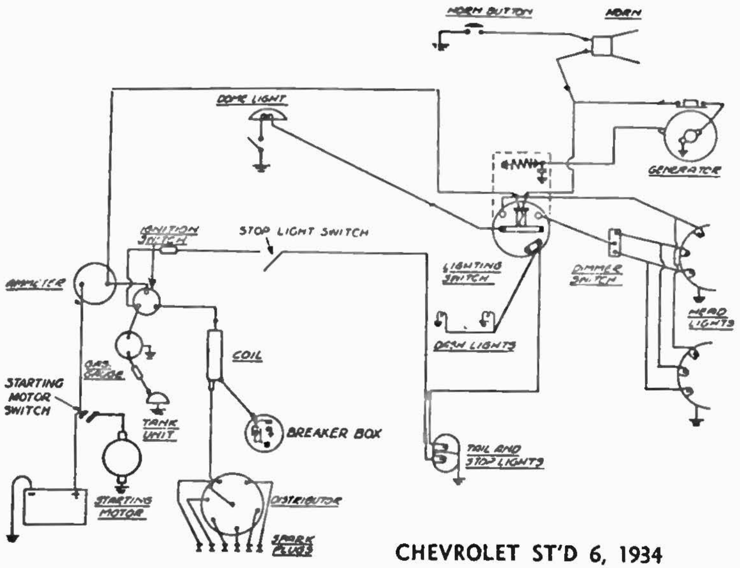


CADILLAC V-16, 1935
(Series 60)

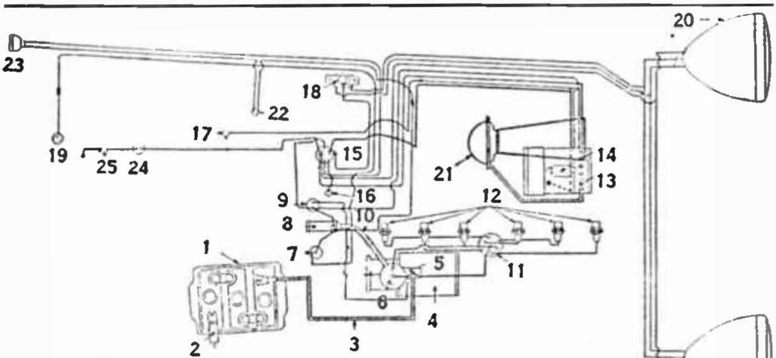


CADILLAC V-8, 1936
(Series 60, 70, 75)

Courtesy "Automobile Digest"



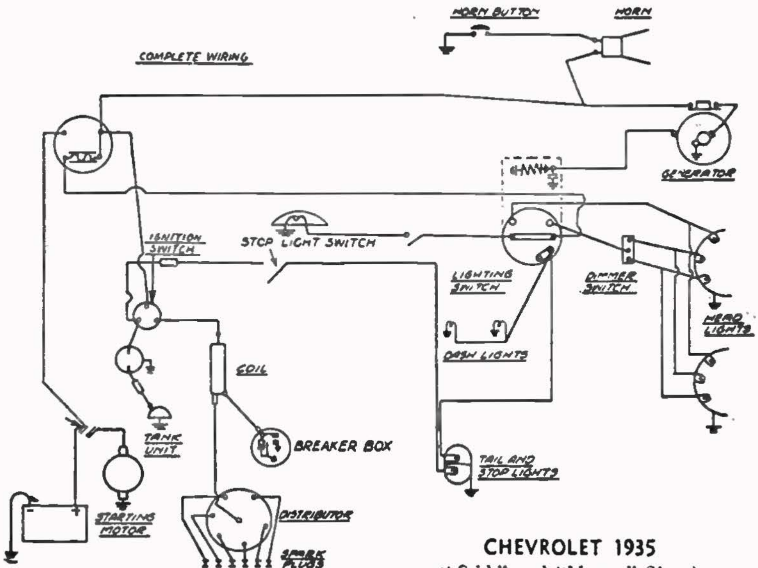
CHEVROLET ST'D 6, 1934



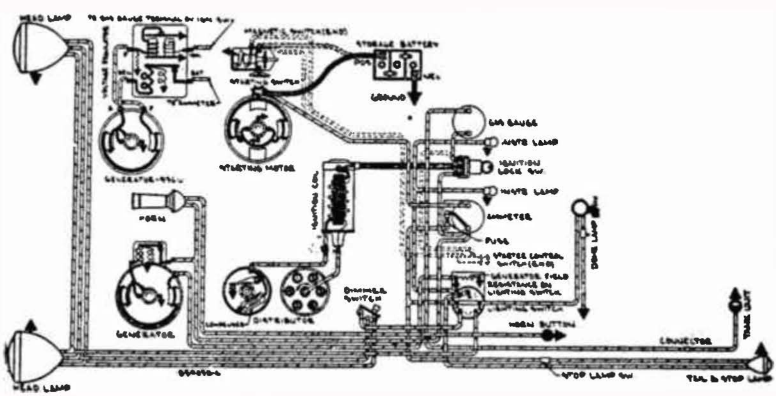
LEGEND
1—BATTERY
2—BATTERY GROUND STRAP
3—STARTING MOTOR CABLE
4—STARTING MOTOR
5—STARTING MOTOR SWITCH
6—IGNITION COIL
7—GASOLINE GAUGE—DASH UNIT
8—ELECTROLOCK
9—AMMETER
10—ELECTROLOCK CABLE
11—DISTRIBUTOR
12—SPARK PLUGS
13—GENERATOR
14—CIRCUIT BREAKER
15—LIGHTING SWITCH
16—INSTRUMENT PANEL LIGHT
17—HORN BUTTON
18—HEADLIGHT CONTROL SWITCH
19—GASOLINE GAUGE—TANK UNIT
20—HEADLAMP
21—HORN
22—STOP LAMP SWITCH
23—TAIL AND STOP LAMP
24—DOME LAMP
25—DOME LAMP SWITCH

CHEVROLET MASTER 6, 1934

Courtesy "Automobile Digest"

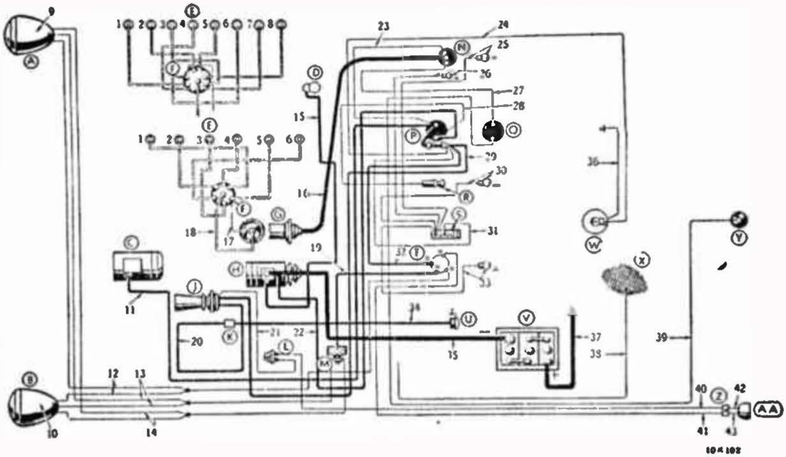


CHEVROLET 1935
("St'd." and "Master" Sixes)

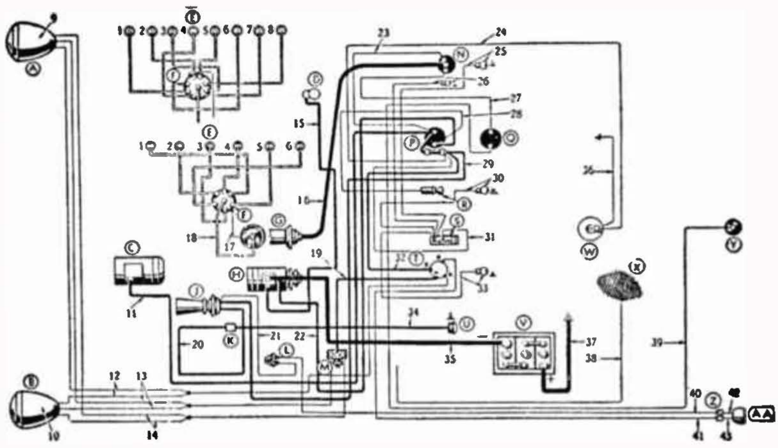


CHEVROLET 1936
("St'd." and "Master" Sixes)

Courtesy "Automobile Digest"

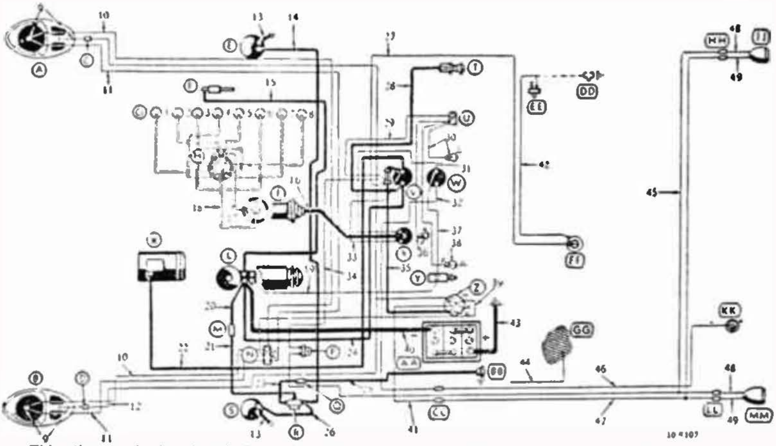


CHRYSLER 6, 1935
(Models C6 & CZ-8)



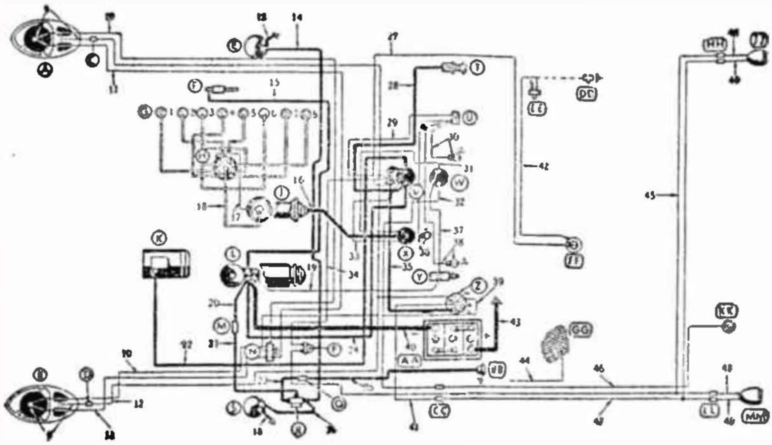
CHRYSLER "AIRSTREAM 8", 1935
(Model CZ)

Courtesy "Automobile Digest"



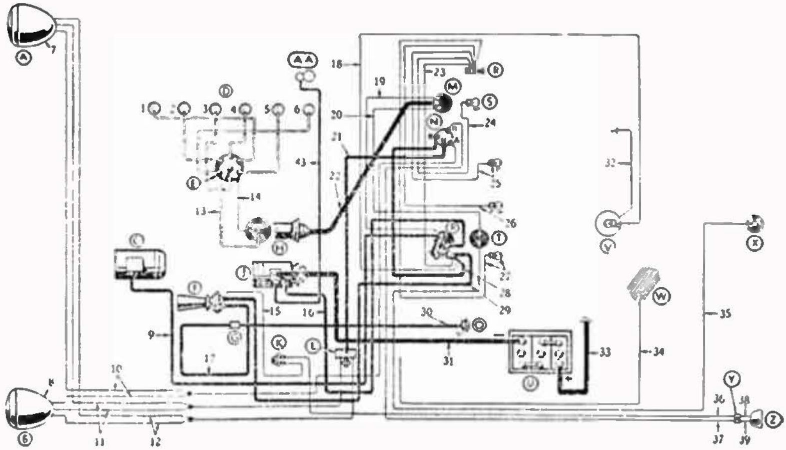
This diagram is for Model C-1 only. The other two models are similar, but additional equipment means additional wiring.

CHRYSLER "AIRFLOW 8", 1935
(Model C-1, Imperial 8 Model C-2, & Imperial Custom 8 Model C-3)

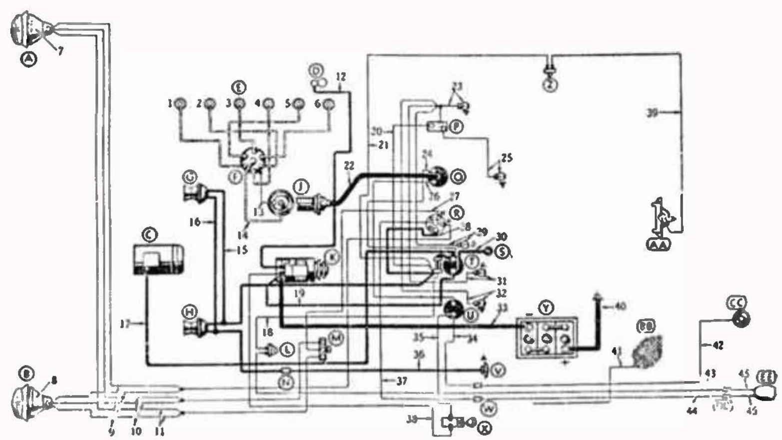


CHRYSLER "AIRFLOW 8", 1935
(Model CW)

Courtesy "Automobile Digest"

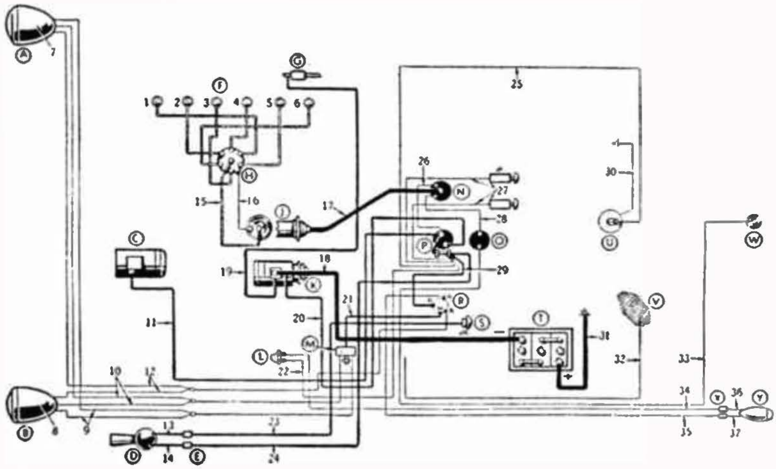


DE SOTO "AIRSTREAM", 1935
(Model SF)

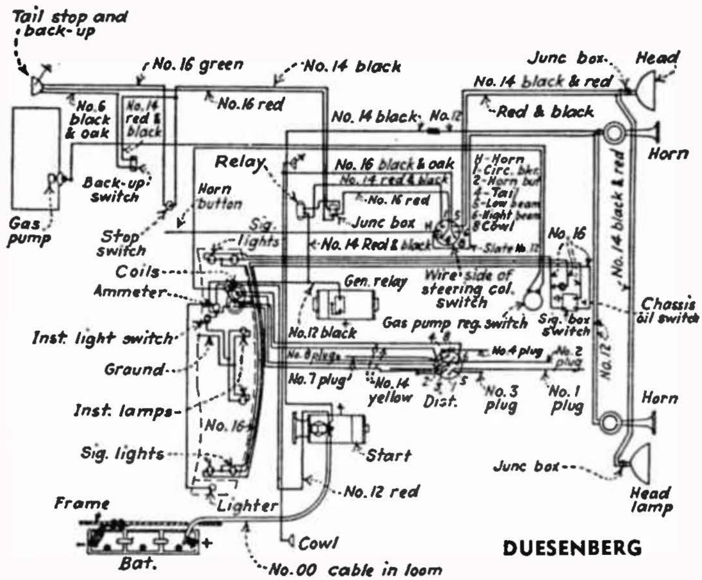


DE SOTO "AIRFLOW", 1935
(Model SG)

Courtesy "Automobile Digest"

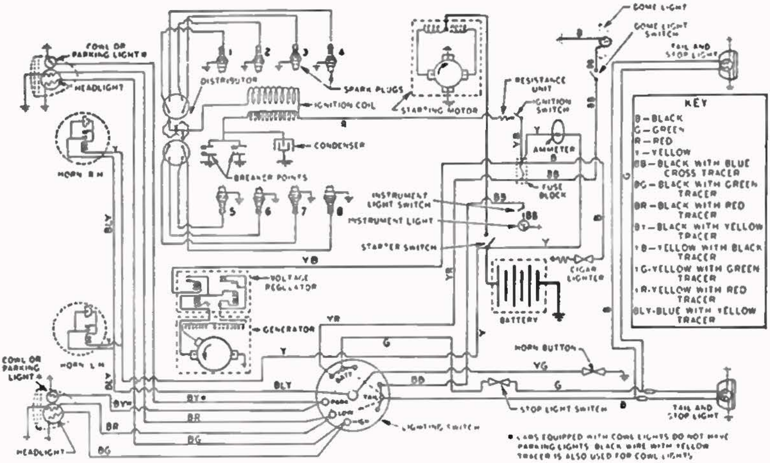


DODGE 6, 1935
(Model DU)

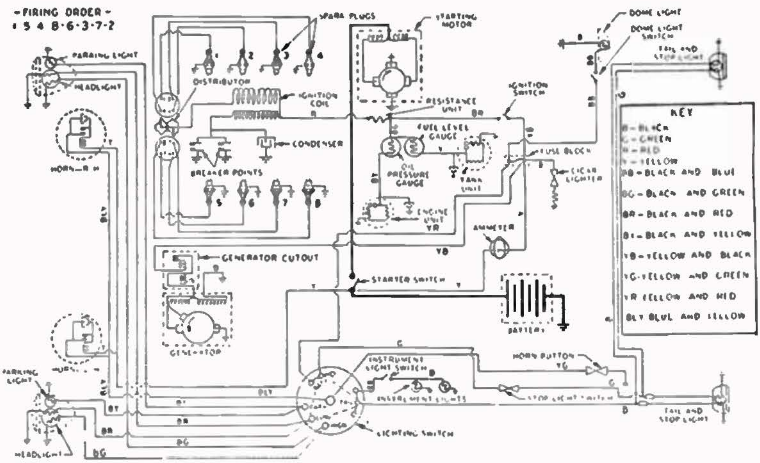


DUESENBERG

Courtesy "Radio Retailing"

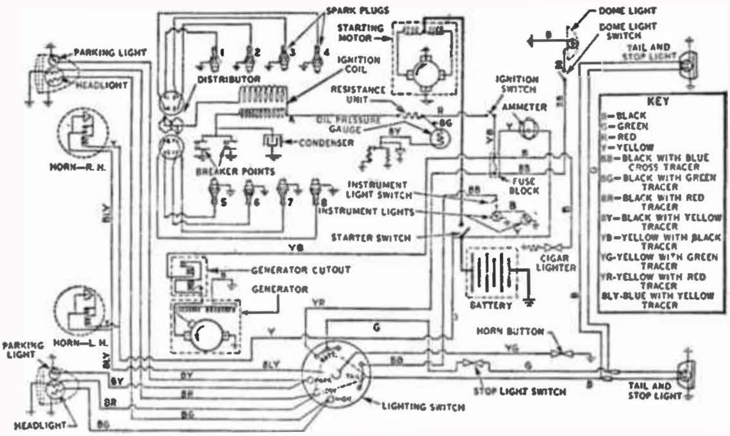


FORD V-8, 1933

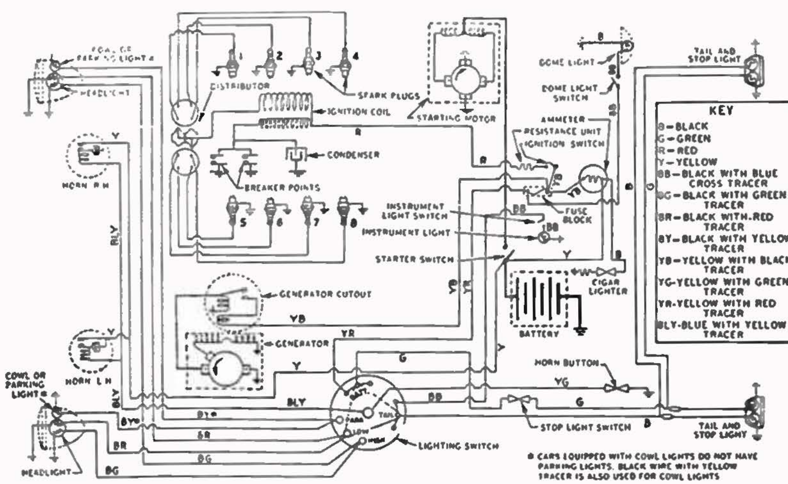


FORD V-8, 1934

Courtesy "Automobile Digest"

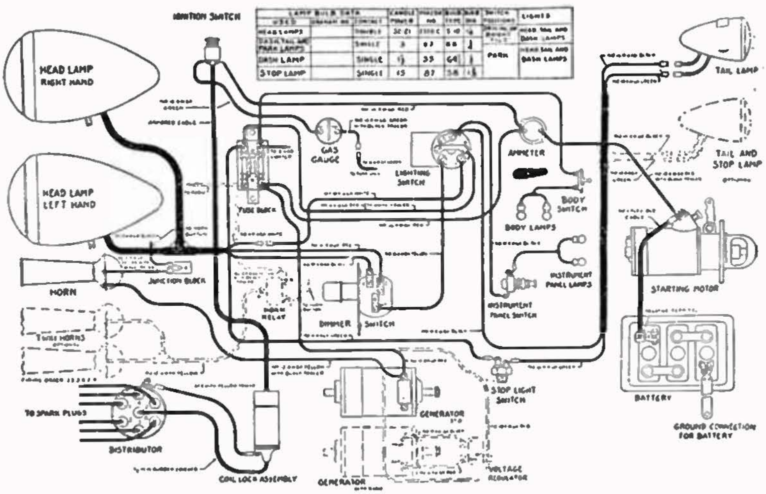


FORD V-8, 1935

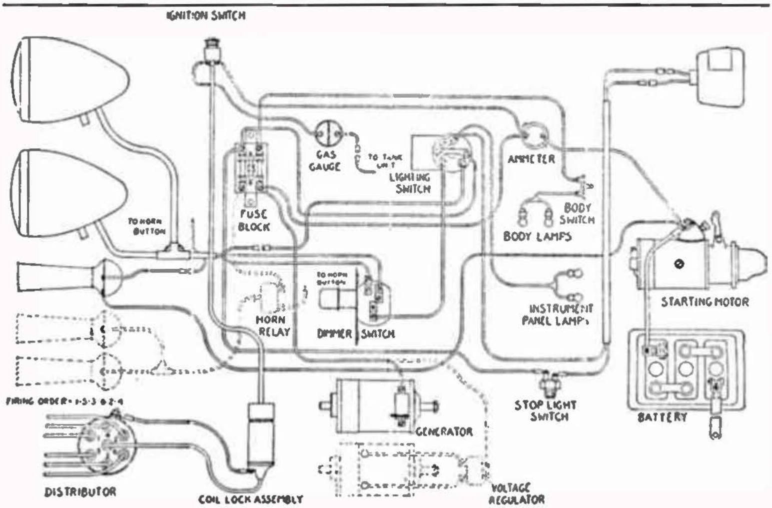


FORD V-8, 1936

Courtesy "Automobile Digest"

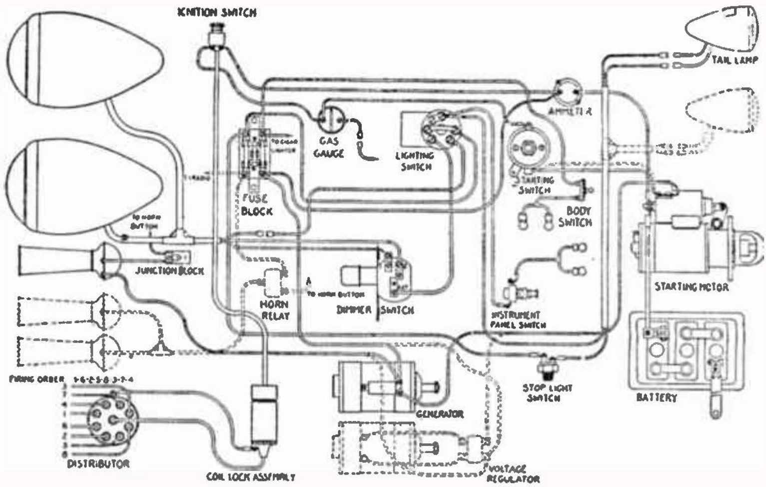


GRAHAM SPECIAL 6, 1935
(Model 73)

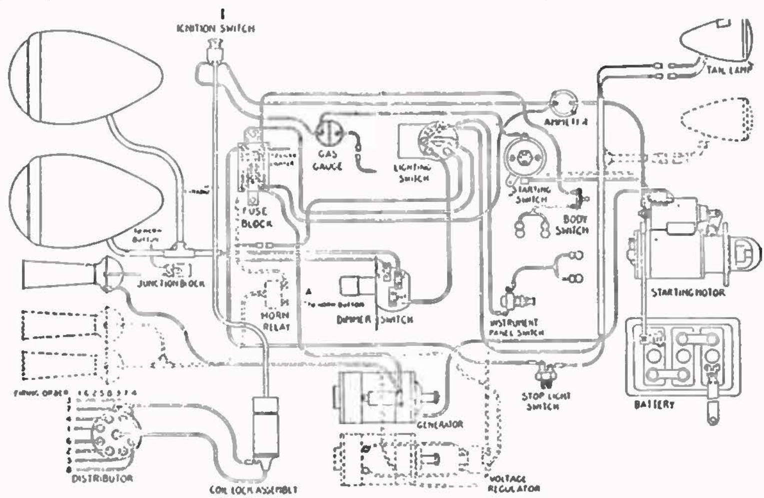


GRAHAM 6, 1935
(Model 74)

Courtesy "Automobile Digest"

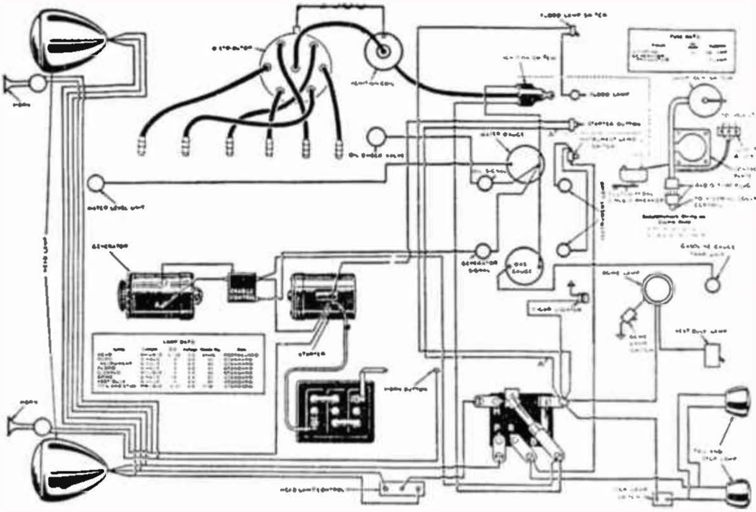


GRAHAM 8, 1935
(Model 72)

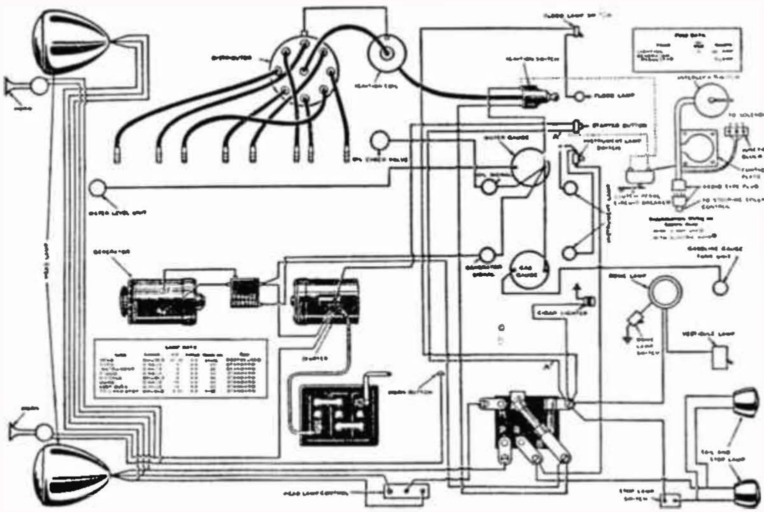


GRAHAM "SUPERCH'GD 8", 1935
(Model 75)

Courtesy "Automobile Digest"

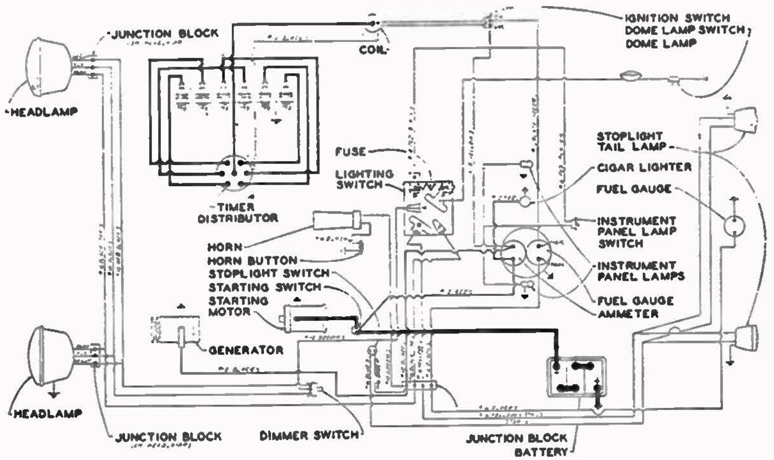


HUDSON 6, 1935
(Model "GH" 6)

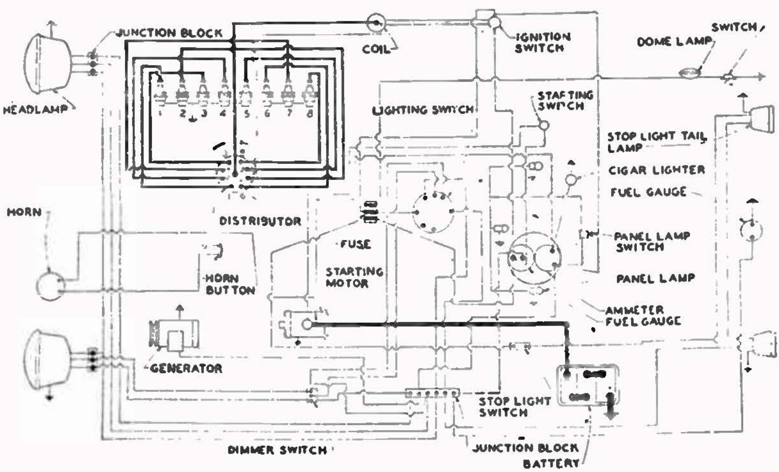


HUDSON 8, 1935

Courtesy "Automobile Digest"

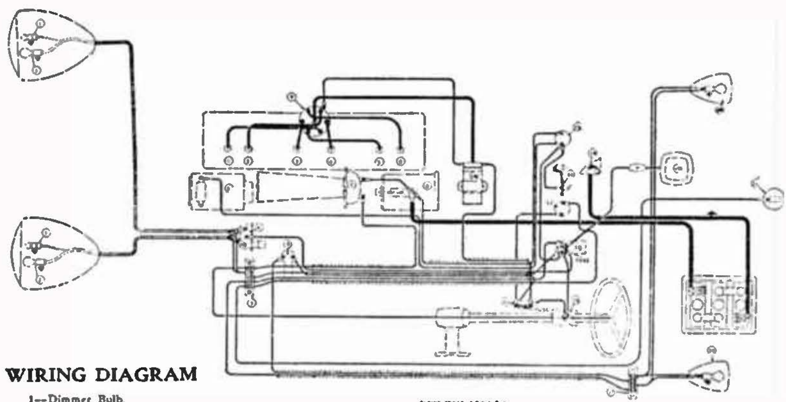


HUPMOBILE 6, 1935
(Series 518-D)



HUPMOBILE 8, 1935
(Series 521-O)

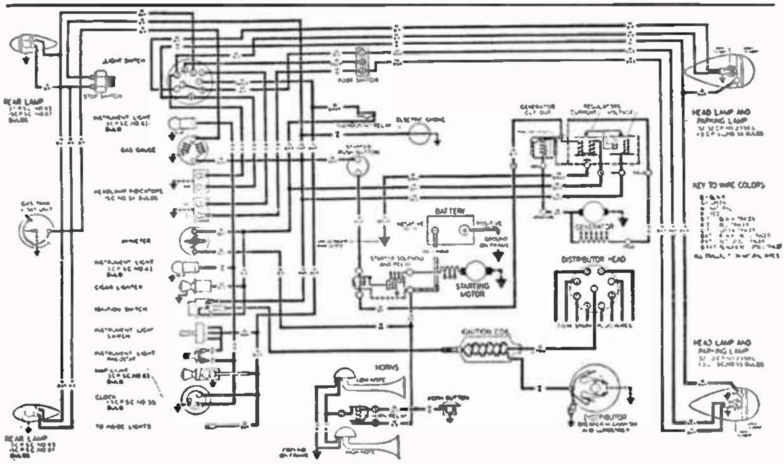
Courtesy "Automobile Digest"



WIRING DIAGRAM

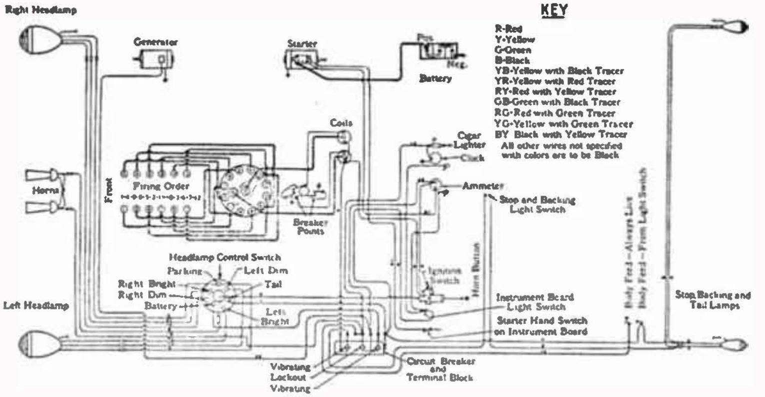
1—Dimmer Bulb.
2—Bright Bulb.
3—Junction Block.
4—Dimmer Switch.
5—Generator.
6—Stoplight Switch.
7—Horn.
8—Starter
9—Distributor
10—Coil.
11—Fuse for Horn, etc.
12—Fuse for Lights-on Switch.
13—Fuel Gauge.
14—Dash Light.
15—Ammeter.
16—Ignition Switch.
17—Junction Block.
18—Battery Ground.
19—Dome Light.
20—Rear Lights.
21—Fuel Gauge at Tank.

LAFAYETTE, 1935
(Series 3510)

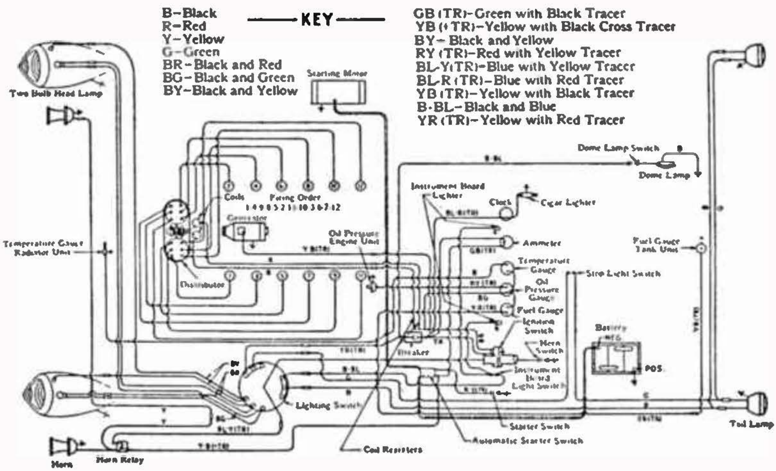


LA SALLE, 1935, 1936
(Series 35-50, 1935 and Series 36-50, 1936

Courtesy "Automobile Digest"

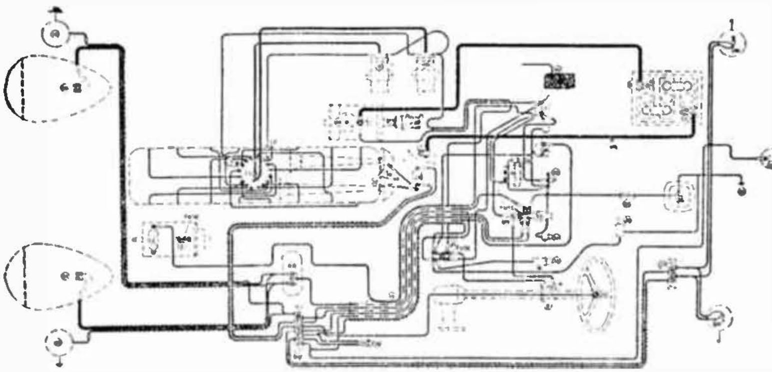


LINCOLN V-12, 1935

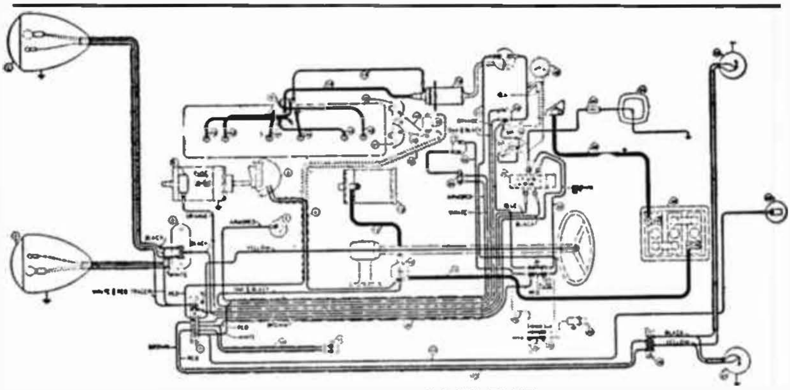


LINCOLN-ZEPHYR, 1936

Courtesy "Automobile Digest"



NASH 6 & 8, 1935
(3520 "Six" and 3580 "Eight")

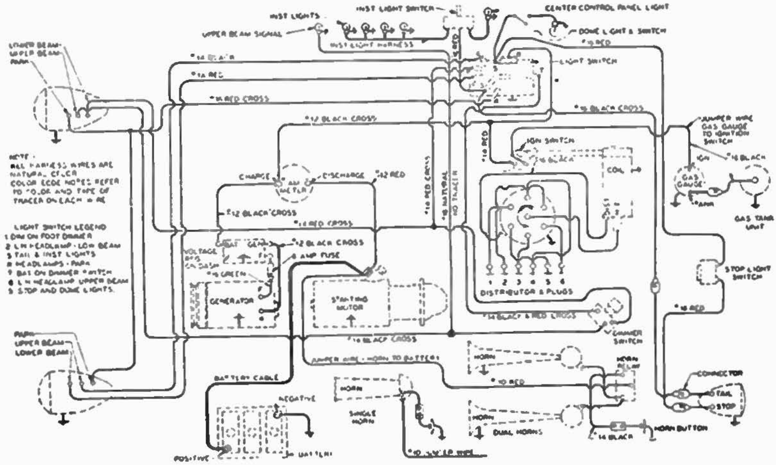


WIRING DIAGRAM AND WIRING CHART

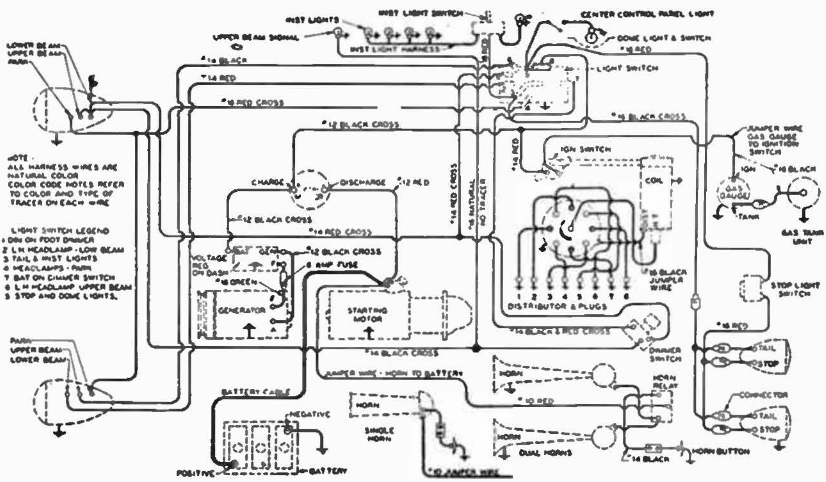
1—Head Lamp R. H
2—Head Lamp L. H
3—Horn
4—Horn Wire Harness
5—Generator and Relay
6—Head Lamp Foot Switch
7—Junction Block
8—Distributor
9—Oil Pan Oil Gauge
10—Stop Light Switch Wire Harness
11—Stop Light Switch
12—Starting Switch to Start Motor Cable
13—Starting Motor
14—Starter Switch
15—Neg Bat to Starting Motor Cable
16—Coil to Distributor—High Ten. Wire
17—Coil to Distributor—Low Ten Wire
18—Ignition Coil
19—Gasoline Gauge
20—Gas & Oil Gauge Selector Switch
21—Ignition Switch to Fuse Block Wire
22—Ammeter
23—Ammeter to Ignition Switch Wire
24—Instrument Panel Light
25—Light Switch
26—Fuse
27—Fuse Block
28—Battery
29—Battery to Ground Cable
30—Main Wiring Harness
31—Tail & Stop Light L H
32—Tail & Stop Light R H
33—Gasoline Gauge Tank Unit
34—Dome Light
35—Dome Light Switch
36—Junction Block—Tail Light Wire
37—Tail and Stop Light Wire
38—Cigar Lighter—Special Equip
39—Fuse Block—Special Equip
40—Light Switch to Fuse Block —Special Equip
41—Fuse Block to Gas Gauge Dash Unit
42—No 1 & 6 Cylinder Wire
43—No 2 & 5 Cylinder Wire
44—No 3 & 4 Cylinder Wire
45—Clock—Special Equip
46—Horn—Short—Special Equip
47—Horn—Long—Special Equip
48—Wire—Horn Relay to Horn—Special Equip
49—Horn Relay—Special Equip
50—Horn Wire Harness
51—Ammeter to Fuse Block
52—Junction to Gas Gauge Tank Unit Wire
53—Instrument Lamp Switch
54—Ammeter to Instrument Lamp Switch
55—Light Switch to Fuse Block

NASH "400" 6, 1936
(Series 3640A)

Courtesy "Automobile Digest"

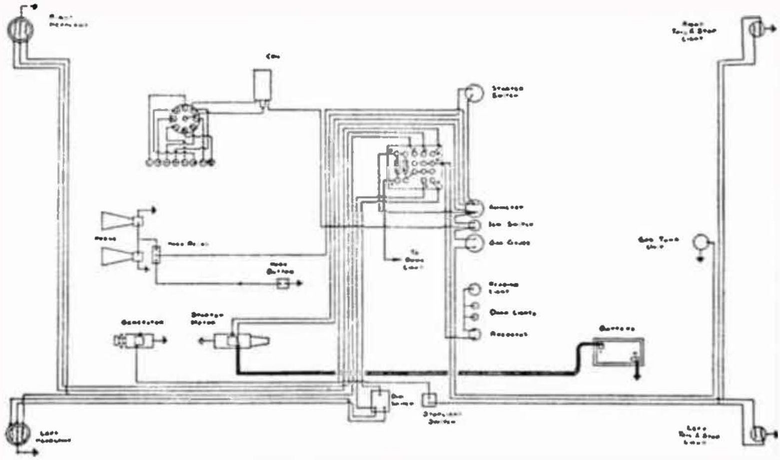


OLDSMOBILE 6, 1935

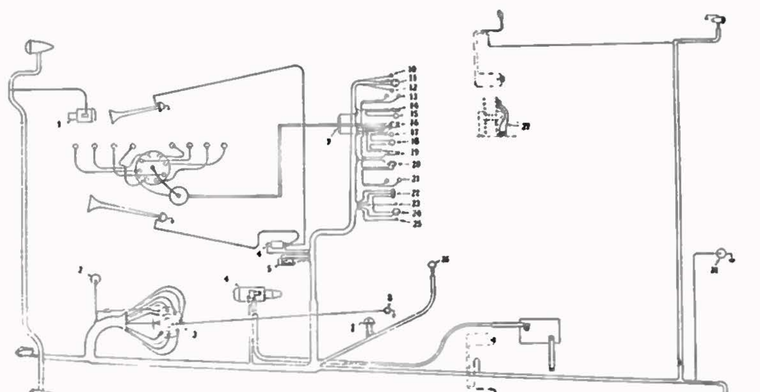


OLDSMOBILE 8, 1935

Courtesy "Automobile Digest"



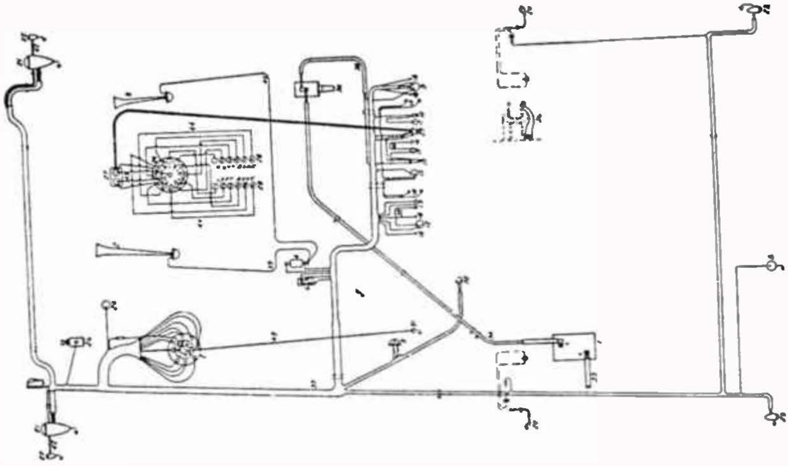
PACKARD 120, 1935



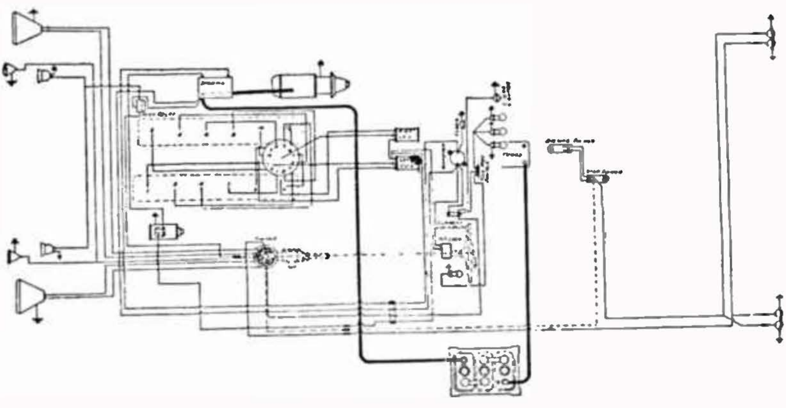
1—Generator.
2—Crankcase oil gauge
3—Light switch
4—Horn relay
5—Fuse block
6—Starting motor
7—Stop light switch
8—Horn button
9—Stop light fuse
10—City light signal
11—Ammeter.
12—Parking light signal
13—Panel lights
14—Cigar lighter
15—Clock
16—Ignition switch.
17—Reading light.
18—Reading light switch
19—Starter switch.
20—Panel light rheostat.
21—Panel light.
22—Selector switch.
23—Pass light signal.
24—Gas and oil gauge
25—Drive light signal.
26—Backing light switch.
27—Motor ground.
28—Gasoline gauge.

PACKARD 8, 1935
Twelfth Series
(Models 1200, 1201, 1202)

Courtesy "Automobile Digest"

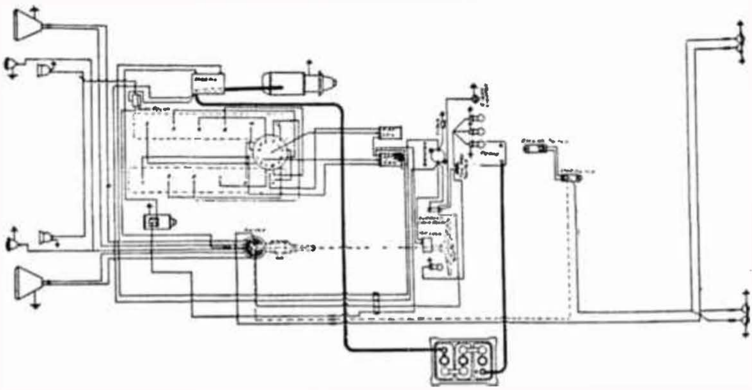


PACKARD 12, 1934-5
(Models 1207, 1208)

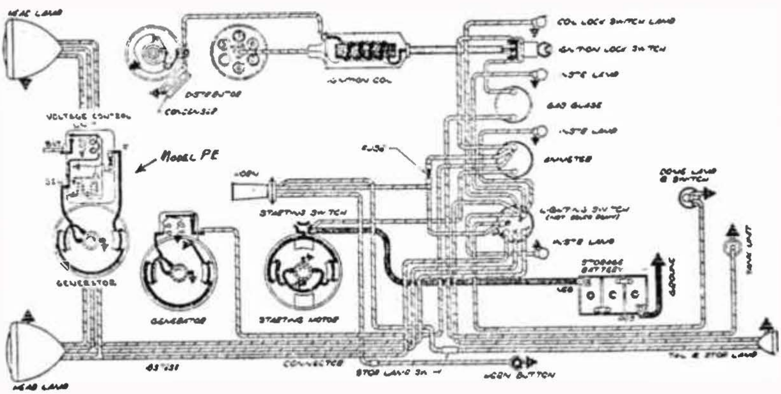


PIERCE-ARROW 8, 1935
(Model 845)

Courtesy "Automobile Digest"

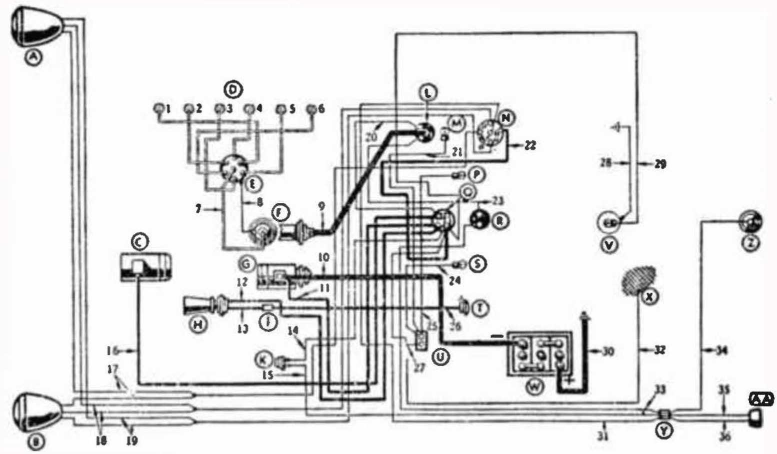


PIERCE-ARROW 1240-A, 1248-A
(Car Models 338—341—647)

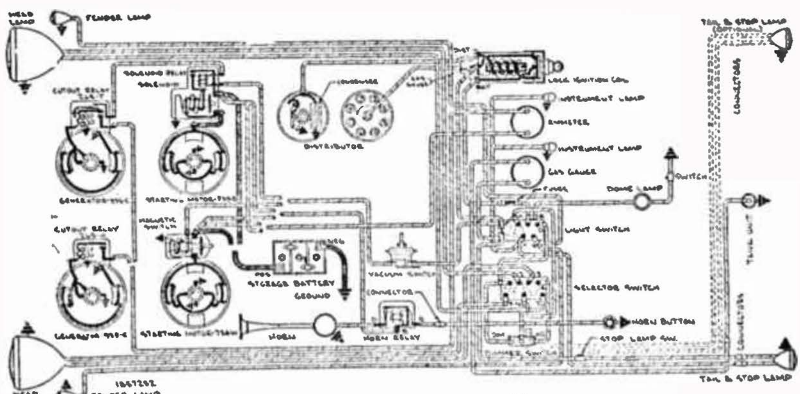


PLYMOUTH 6, 1934
(Model PF)

Courtesy "Automobile Digest"



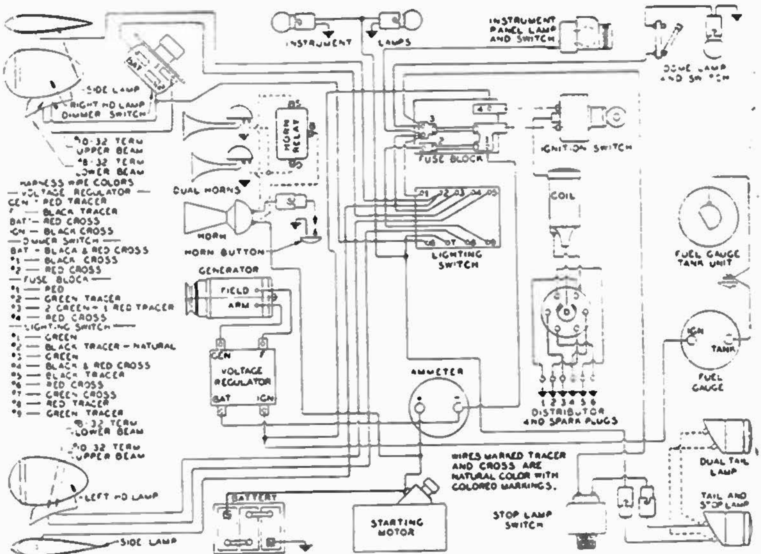
PLYMOUTH 6, 1936
(Series P1)



Note: 931-R Generator has Model 5540 Voltage Control Unit mounted on Generator Field Frame.

PONTIAC 8, 1934

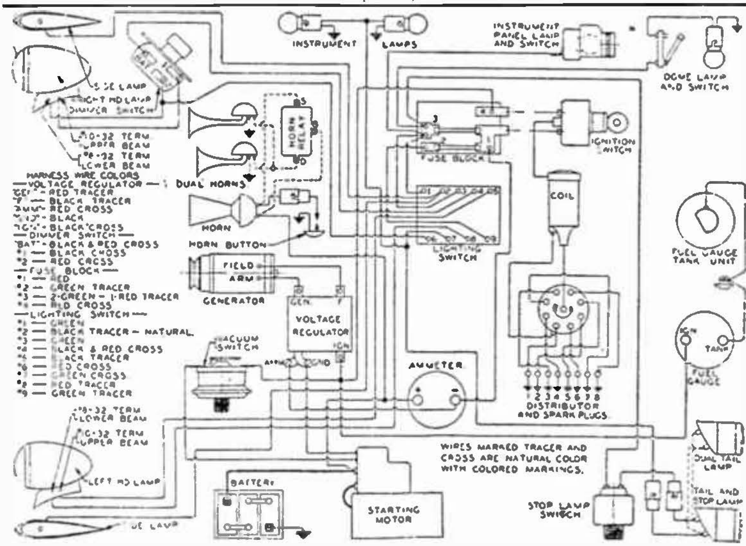
Courtesy "Automobile Digest"



PONTIAC 6, 1935

"Standard" & "De Luxe"

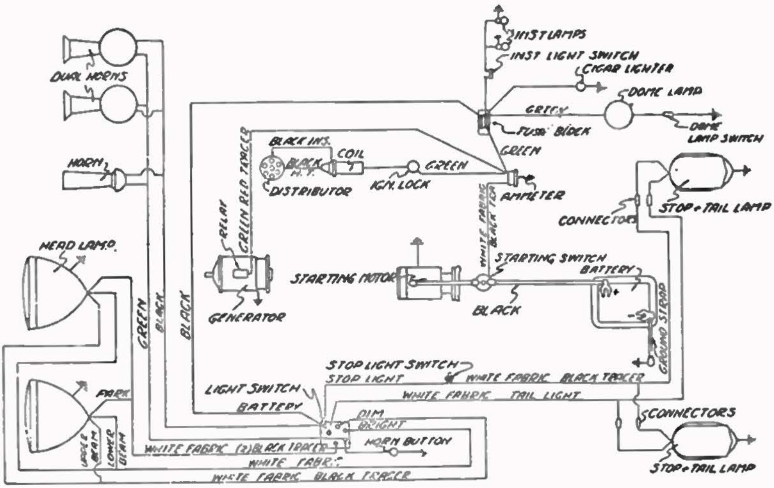
(1701)



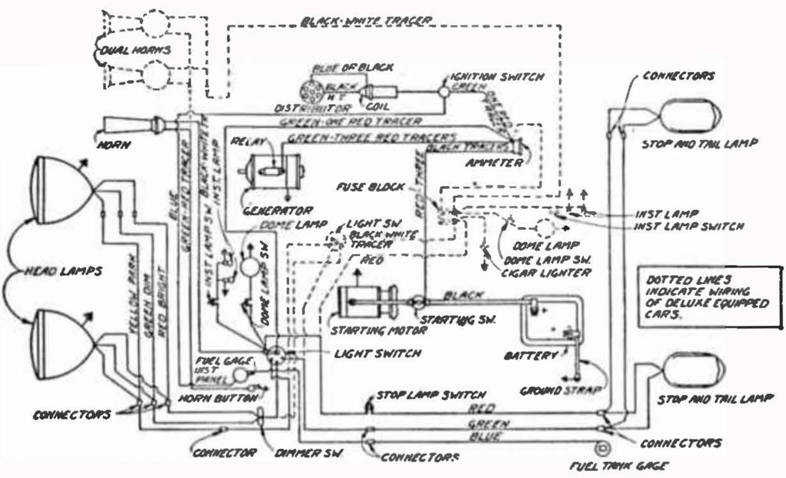
PONTIAC 8, 1935

(605)

Courtesy "Automobile Digest"

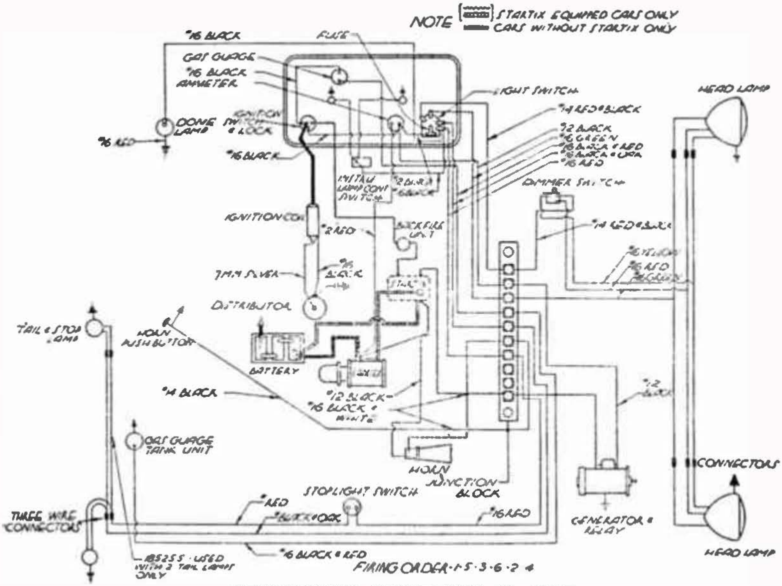


REO ROYALLE SIX, 1935

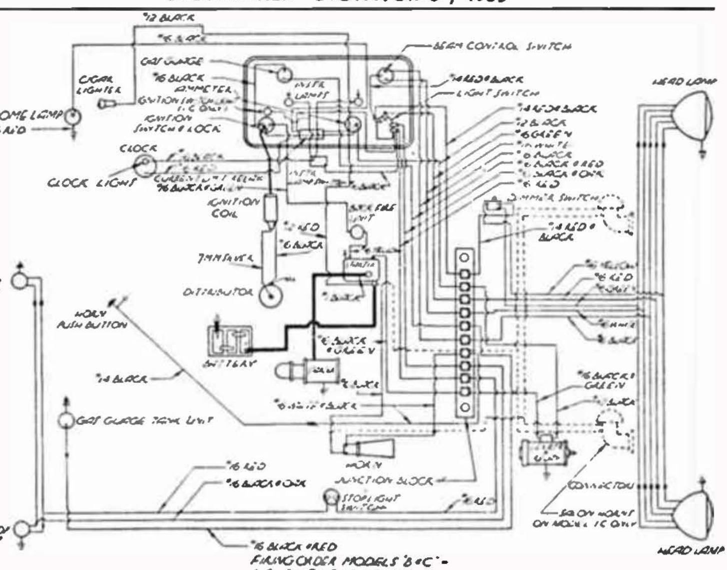


REO FLYING CLOUD, 1935

Courtesy "Automobile Digest"

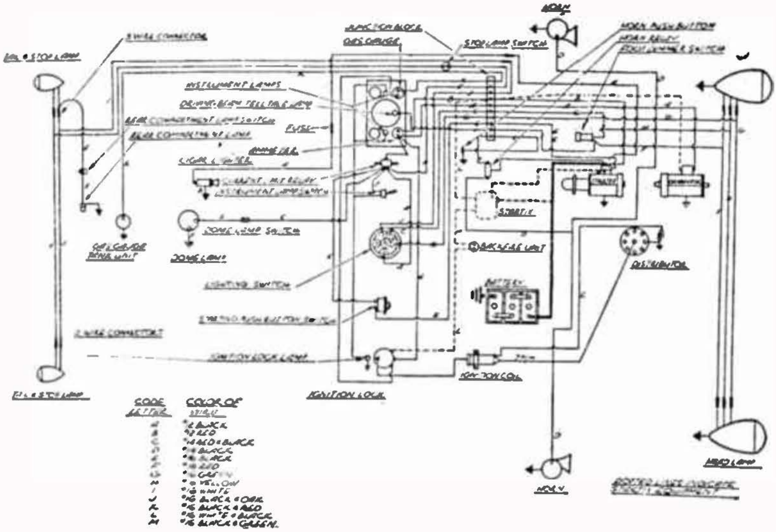


STUDEBAKER "DICTATOR-6", 1935

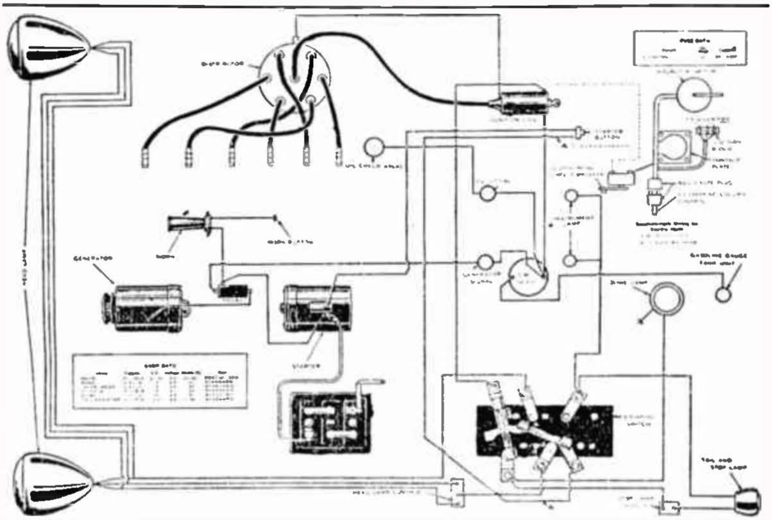


STUDEBAKER "COMMANDER-8", 1935
—and "PRESIDENT-8" 1935

Courtesy
"Automobile Digest"



STUDEBAKER "PRESIDENT-8", 1936



TERRAPLANE 6, 1935
("Special" and "De Luxe")

Courtesy "Automobile Digest"

CAR BATTERY POLARITIES, BREAKER-POINT AND SPARK-PLUG GAPS. GENERATOR "CHARGING" RATES, AND AUTO-RADIO INSTALLATION INSTRUCTIONS FOR AMERICAN CARS

A wealth of reference data which servicemen will find very helpful when installing and servicing auto-radio receivers in American cars has been compiled and presented in the following chart in a form which makes quick reference possible.

The *Make* and *Model* numbers of all the various automobiles of American manufacture have been arranged alphabetically according to name, and numerically by year (1932 to 1937). The various vertical columns tell, in turn, which terminal of the car storage battery is grounded, the correct breaker gap, the correct spark plug gap, the maximum normal charging rate it is safe to set the generator for, where suppressor resistors should be installed, where by-pass condensers should be installed, what parts of the car should be "grounded" (by copper bonding braid or other appropriate means), whether the car comes from the factory with a built-in antenna or not, where the lead-in wire will be found (when an antenna has been provided). All of this data is presented for American car models from 1932 to 1937. It has been checked carefully.

(*See Chart on following pages*)

CAR BATTERY POLARITIES, BREAKER-POINT AND SPARK-PLUG GAPS GENERATOR "CHARGING" RATES AND AUTO-RADIO INSTALLATION INSTRUCTIONS FOR AMERICAN CARS

(Revised Sept. 1937)

Make & Model of Car	*Year*	*Batt. Term. Grounded*	*Correct Breaker Gap (Inches)*	*Correct Spark Plug Gap (Inches)*	*Generator max. normal charging rate*			*Install a Suppressor at:*	*Install a By-Pass Condenser at:*	*Ground the:*	*Auto-Radio Antenna built-in**	*Antenna Lead-in Location*
					Amps.	*Volts*	*Car Speed*					
Auburn (none mfd.)	1937	—	—	—	—	—	—	—	—	—	—	—
Auburn 654	1936	P	.018	.025	16	8.0	....	Dist.,S.P.	Gen.,I.C.,Amm.	....	Yes	Right
Auburn 852	1936	P	.018	.025	16	8.0	....	Dist.,S.P.	Gen.,I.C.,Amm.	....	Yes	Right
Auburn 653	1935	P	.018	.025				Dist.,S.P.	Gen.,I.C.,Amm.	....	Yes	Right
Auburn 851	1935	P	.018	.025				Dist.,S.P.	Gen.,I.C.,Amm.	....	Yes	Right
Auburn Std. 6-52	1934	P	.018	.026							Yes	
Auburn Cust. 6-52	1934	P	.018	.026							Yes	
Auburn Cust. 8-50	1934	P	.018	.026							Yes	
Auburn Std. 8-50	1934	P	.018	.026							Yes	
Auburn 12-165	1934	P	.018	.025							Yes	
Auburn 8-101	1933	P	.018	.026							No	....
Auburn 8-105	1933	P	.018	.026							Yes	
Auburn 12-161	1933	P	.018	.025							No	....
Auburn 12-165	1933	P	.018	.025							Yes	....
Auburn 8-100	1932	P	.018	.026							No	....
Auburn 12-160	1932	P	.018	.025							No	....
Buick 40	1937	N	.017	.025	28	8.0	41	Dist.	Gen.,I.C.	F.W.	Yes (Insul.R)	....
Buick 60	1937	N	.017	.025	28	8.0	47	Dist.	Gen.,I.C.	F.W.	Yes (Insul.R)	....
Buick 80	1937	N	.017	.027	28	8.0	45	Dist.	Gen.,I.C.	F.W.	Yes (Insul.R)	....
Buick 90	1937	N	.017	.025	28	8.0	42	Dist.	Gen.,I.C.	F.W.	Yes (Insul.R)	....

*Note: Key to types of aerials: *R-"Running Board"* type; *SS-"Steel Screen"* type in roof; *W-"Wire"* type in roof.

†Note: These cars have "Turret" or "steel" tops and require an antenna mounted on the outside of the car.

Key to Symbols: "Amm."-*Ammeter*; "C"-*Coil*; "Dist."-*Distributor*; "D.L."-*Dome Light*; "E.C."-*Electric Clock*; "F.B."-*Fuse Block*; "F.W."-*Front Wheels*; "Gen."-*Generator*; "G.G."-*Gasoline Gauge*; "I.C."-*Ignition Coil*; "I.S."-*Ignition Switch*; "Muff."-*Muffler*; "O.G."-*Oil Gauge*; "Reg."-*Regulator*; "Rel."-*Relay*; "R.S." *Rear Springs*; "R.W."-*Rear Wheels*; "S.C."-*Steering Column*: "S.M."-*Starting Motor*; "S.P."-*Spark Plugs*; "Transm."-*Transmission*; "T.T."-*Torque Tube*; "W.T."-*Water Thermometer*. *(Con't over)*

(Continued from preceding page)

Make & Model of Car	*Year*	*Batt. Term. Grounded*	*Breaker Gap (Inches)*	*Correct Spark Plug Gap (Inches)*	*Generator max. normal charging rate* Amps.	Volts	Car Speed	*Install a Suppressor at:*	*Install a By-Pass Condenser at:*	*Ground the:*	*Auto-Radio Antenna built-in**	*Antenna Lead-in Location*
Buick 40	1936	N	.013	.022				Dist.	Gen.	F.W.	Not	...
Buick 60	1936	N	.013	.022				Dist.	Gen.	F.W.	Not	...
Buick 80	1936	N	.013	.022				Dist.	Gen.	F.W.	Not	...
Buick 90	1936	N	.013	.022				Dist.	Gen.	F.W.	Not	...
Buick 40	1935	N	.013	.020				Dist.	Gen., Amm.		Yes	Left
Buick 50	1935	N	.013	.020				Dist.	Gen., Amm.		Yes	Left
Buick 60	1935	N	.013	.020				Dist.	Gen., Amm.		Yes	Left
Buick 90	1935	N	.013	.020				Dist.	Gen., Amm.		Yes	Left
Buick 34-50	1934	N	.013	.020							Yes	
Buick 34-60	1934	N	.013	.020							Yes	
Buick 34-90	1934	N	.013	.020							Yes	
Buick 33-50	1933	N	.015	.020							Yes	
Buick 33-60	1933	N	.015	.020							Yes	
Buick 33-80, 90	1933	N	.015	.020							Yes	
Buick 32-50	1932	N	.020	.025							No	....
Buick 32-60	1932	N	.020	.025							No	....
Buick 32-80, 90	1932	N	.020	.025							No	....
Cadillac V8, 60	1937	P	.013	.025	30	8.0	51	Dist., S.P.	Gen. I.C., E.C.	F.W.	Not	....
Cadillac V8, 65, 70	1937	P	.013	.025	26	8.0	20	Dist., S.P.	Gen. I.C., E.C.		Not	....
Cadillac V8, 75	1937	P	.013	.025	26	8.0	20	Dist., S.P.	Gen. I.C., E.C.		Not	....
Cadillac V12	1937	P	.018	.025	26	8.0	20	Dist., S.P.	Gen. I.C., E.C.		Not	....
Cadillac V16	1937	P	.014	.025	26	8.0	20	Dist., S.P.	Gen. I.C., E.C.		Not	..
Cadillac V8, 60	1936	P	.013	.025				Dist., S.P.	Gen, I.C., E.C., D.L.		Not	....
Cadillac V8, 70, 75	1936	P	.013	.025				Dist., S.P.	Gen, I.C., E.C., D.L.	F.W.	Not	....
Cadillac V12	1936	P	.018	.025				Dist., S.P.	Gen, I.C., E.C., D.L.	F.W.	Not	....
Cadillac V16	1936	P	.014	.025				Dist., S.P.	Gen, I.C., E.C., D.L.	F.W.	Not	..
Cadillac V8, 65	1935	P	.013	.025				Dist., S.P.	Gen., I.C., S.M.	F.W.	Yes	Left

*Note: Key to types of aerials: *R-"Running Board"* type; *SS-"Steel Screen"* type in roof; *W-"Wire"* type in roof.
†Note: These cars have "Turret" or "steel" tops and require an antenna mounted on the outside of the car.
Key to Symbols: "Amm."-*Ammeter;* "C"-*Coil;* "Dist."-*Distributor;* "D.L."-*Dome Light;* "E.C."-*Electric Clock;* "F.B."-*Fuse Block;* "F.W."-*Front Wheels;* "Gen."-*Generator;* "G.G."-*Gasoline Gauge;* "I.C."-*Ignition Coil;* "I.S."-*Ignition Switch;* "Muff."-*Muffler;* "O.G."-*Oil Gauge;* "Reg."-*Regulator;* "Rel."-*Relay;* "R.S." *Rear Springs;* "R.W."-*Rear Wheels;* "S.C."-*Steering Column;* "S.M."-*Starting Motor;* "S.P."-*Spark Plugs;* "Transm."-*Transmission;* "T.T."-*Torque Tube;* "W.T."-*Water Thermometer.* (Con't over)

(Continued from preceding page)

Make & Model of Car	*Year*	*Batt. Term. Grounded*	*Correct Breaker Gap (Inches)*	*Correct Spark Plug Gap (Inches)*	*Generator max. normal charging rate*			*Install a Suppressor at:*	*Install a By-Pass Condenser at:*	*Ground the:*	*Auto-Radio Antenna built-in**	*Antenna Lead-in Location*
					Amps.	*Volts*	*Car Speed*					
Cadillac V12	1935	P	.018	.025				Dist.,S.P.	Gen.,I.C.,S.M.		Yes	Left
Cadillac V16	1935	P	.014	.025				Dist.,S.P.	Gen.,I.C.,S.M.		Yes	Left
Cadillac V8	1934	P	.013	.025							Yes	
Cadillac V12	1934	P	.018	.025							Yes	
Cadillac V16	1934	P	.014	.028							Yes	
Cadillac V8	1933	P	.018	.025							Yes	
Cadillac V12	1933	P	.018	.025							Yes	
Cadillac V16	1933	P	.014	.028							Yes	
Cadillac V8	1932	P	.018	.025							No	----
Cadillac V12	1932	P	.018	.025							No	----
Cadillac V16	1932	P	.014	.028							No	----
Chevrolet Master 6	1937	N	.018	.040	18	8.2	33	Dist.	Gen.,Amm.	Wheels,Muff.	No†	----
Chevrolet De Luxe 6	1937	N	.018	.040	18	8.2	29	Dist.	Gen.,Amm.	Wheels,Muff.	No†	----
Chevrolet Std. 6	1936	N	.018	.032				Dist.	Gen.,Amm.	FW.,RW.	No†	----
Chevrolet Mast. 6	1936	N	.018	.032				Dist.	Gen.,Amm.	FW.,RW.	No†	----
Chevrolet Std. 6	1935	N	.021	.032				Dist.	Gen.,Amm.,D.L.		Yes	Left
Chevrolet Mast. 6	1935	N	.021	.032				Dist.	Gen.,Amm.,D.L.		Yes	Left
Chevrolet Std. 6, 33	1934	N	.018	.032							No	----
Chevrolet Mast. 6	1934	N	.018	.032							Yes	
Chevrolet	1933	N	.018	.032							Yes	
Chevrolet	1932	N	.018	.025							No	----
Chrysler Royal 6	1937	P	.020	.025	22	8.0	17	Dist.	Gen.,Amm.orI.S.	Controls	No	----
Chrysler Imperial 8	1937	P	.018	.025	28	8.0	16	Dist.	Gen.,Amm.orI.S.	Controls	No	----
Chrysler Cust. Imp. 8	1937	P	.018	.025	28	8.0	16	Dist.	Gen.,Amm.orI.S.	Controls	No	----
Chrysler Airflow 8	1937	P	.018	.025	28	8.0	16	Dist.	Gen.,D.L.,Amm.orI.S.	Controls,S.C.	Yes	Left
Chrysler 6	1936	P	.020	.025				Dist.,S.P.	Gen.,D.L.,Amm.orI.S.	Controls,S.C.	Yes(SS)	Left

***Note:** Key to types of aerials: *R*-"*Running Board*" type; *SS*-"*Steel Screen*" type in roof; *W*-"*Wire*" type in roof.
†Note: These cars have "Turret" or "steel" tops and require an antenna mounted on the outside of the car.
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(Continued from preceding page)

Make & Model of Car	*Year*	*Batt. Term. Grounded*	*Correct Breaker Gap (Inches)*	*Correct Spark Plug Gap (Inches)*	*Generator max. normal charging rate*			*Install a Suppressor at:*	*Install a By-Pass Condenser at:*	*Ground the:*	*Auto-Radio Antenna built-in**	*Antenna Lead-in Location*
					Amps.	*Volts*	*Car Speed*					
Chrysler DL. 8	1936	P	.018	.025				Dist.,S.P.	Gen.,D.L.,Amm.	S.C.,Controls	Yes(SS)	Left
Chrysler AF. 8	1936	P	.018	.025				Dist.,S.P.	Gen.,D.L.,Amm.	S.C.,Controls	Yes(SS)	Left
Chrysler Imp. 8	1936	P	.018	.025				Dist.,S.P.	Gen.,D.L.,Amm.	S.C.,Controls	Yes(SS)	Left
Chrysler 6AS	1935	P	.020	.025				Dist.,S.P.	Gen.,D.L.,I.S.		Yes	Right
Chrysler 8AS	1935	P	.018	.025				Dist.,S.P.	Gen.,D.L.,I.S.		Yes	Right
Chrysler 8AF	1935	P	.018	.025				Dist.,S.P.	Gen.,D.L.,I.S.		Yes	Right
Chrysler Imp. 8AF	1935	P	.018	.025				Dist.,S.P.	Gen.,D.L.,I.S.		Yes	Right
Chrysler IC8AF-137	1935	P	.018	.025				Dist.,S.P.	Gen.,D.L.,I.S.		Yes	Right
Chrysler IC8AF-146	1935	P	.018	.025				Dist.,S.P.	Gen.,D.L.,I.S.		Yes	Right
Chrysler 6	1934	P	.020	.025							Yes	
Chrysler 8	1934	P	.018	.025							Yes	
Chrysler Imp. 8	1934	P	.018	.025							Yes	
Chrysler Imp. Cust. 8	1934	P	.018	.025							Yes	
Chrysler 6	1933	P	.020	.025							Yes	
Chrysler Royal 8	1933	P	.018	.025							Yes	
Chrysler Imp. 8	1933	P	.018	.025							Yes	
Chrysler Imp. Cust. 8	1933	P	.018	.025							Yes	
Chrysler 6	1932	P	.020	.025							No	...
Chrysler 8	1932	P	.020	.025							No	...
Chrysler Imp. Cst. 8	1932	P	.020	.025							No	...
Cord 8	1937	P	.013	.025	28	8.8	31	Dist.	Gen.,I.C.	Exh.pipe	No	...
Cord 8	1936	P	.018	.025							Yes	
Cord	1933	P	.018	.025							No	
Cord 8	1932	P	.018	.025							No	...
Cunningham	1933	N	.018	.031							No	...
Cunningham	1932	N	.018	.031							No	...

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(Continued from preceding page)

Make & Model of Car	Year	Batt. Term. Grounded	Correct Breaker Gap (Inches)	Correct Spark Plug Gap (Inches)	Generator max. normal charging rate: Amps.	Volts	Car Speed	Install a Suppressor at:	Install a By-Pass Condenser at:	Ground the:	Auto-Radio Antenna built-in*	Antenna Lead-in Location
DeSoto 6	1937	P	.020	.025	22	8.0	17	Dist.	Gen.,Amm.orI.S.	Controls	No	
DeSoto AS6	1936	P	0.20	.025				Dist.,S.P.	Gen.,D.L.,Amm.	S.C.,Controls	Yes(SS)	Left
DeSoto AF. 6	1936	P	0.20	.025				Dist.,S.P.	Gen.,D.L.,Amm.	S.C.,Controls	Yes(SS)	Left
DeSoto 6AS	1935	P	0.20	.025				Dist.,S.P.	Gen.,D.L.,I.S.		Yes	Right
DeSoto 6AF	1935	P	0.20	.025				Dist.,S.P.	Gen.,D.L.,I.S.		Yes	Right
DeSoto 6	1934	P	.018	.025							Yes	
DeSoto 6	1933	P	0.20	.025							Yes	
DeSoto 6	1932	P	0.20	.025							No	----
Dodge 6	1937	P	.020	.025	22	8.0	17	Dist.	Gen.,Amm.orI.S.	Controls	No	----
Dodge 6	1936	P	.020	.025				Dist.,S.P.	Gen.,D.L.,Amm.	S.C.,Controls	Yes(SS)	Left
Dodge 6	1935	P	.020	.025				Dist.,S.P.	Gen.,D.L.,I.S.		Yes	Right
Dodge 6	1934	P	.018	.025							Yes	
Dodge 6	1933	P	.020	.025							Yes	
Dodge 8	1933	P	.020	.025							Yes	
Dodge 6	1932	P	.020	.025							No	----
Dodge 8	1932	P	.020	.025							No	----
Duesenberg 8	1937	N	.018	.025	11	7.5	----	----	-------	----	----	----
Duesenberg 8	1936	N	.018	.025							No	----
Duesenberg 8	ALL	N	.018	.025							No	----
Essex, Terraplane 6	1933	N	.020	.022							No	----
Essex, Terraplane 8	1933	N	.020	.022							No	----
Essex	1932	N	.020	.025							No	----
Ford V8, 60	1937	P	.014					None	Gen.,G.G.,O.G.,I.S.	----	No	----
Ford V8, 85	1937	P	.014	.025	12	6.2	25	None	Gen.,G.G.,O.G.,I.S.	----	No	----

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(Continued from preceding page)

Make & Model of Car	*Year*	*Batt. Term. Grounded*	*Correct Breaker Gap (Inches)*	*Correct Spark Plug Gap (Inches)*	*Generator max. normal charging rate* Amps.	Volts	Car Speed	*Install a Suppressor at:*	*Install a By-Pass Condenser at:*	*Ground the:*	*Auto-Radio Antenna built-in**	*Antenna Lead-in Location*
Ford V8	1936	P	.012	.025				None	Gen.,D.L.,GG,I.C.,O.G.,F.B.	....	Yes(SS)	Left
Ford V8	1935	P	.012	.025				S.P.	Gen.,I.C.,F.B.,I.S.		Yes	Left
Ford V8	1934	P	.015	.025							Yes	
Ford B	1933	P	.018	.027							No	
Ford V8	1933	P	.015	.025							No	....
Ford A	1932	P	.018	.025							No	....
Franklin Olympic 6	1935	P	.020	.025							Yes	
Franklin Airman 6	1935	P	.020	.025							Yes	
Franklin V12	1935	P	.020	.025							Yes	
Graham 6, 85	1937	P	.018	.025	15	8.0	36	Dist.	Gen.,I.S.	Muff.,R.S.	No	....
Graham 6, 95	1937	P	.018	.025	18	8.3	45	Dist.	Gen.,O.G.,Reg.,W.T.,I.S.	....	Yes(SS)	Left
Graham 6, 116	1937	P	.018	.025	22	8.3	47	Dist.	Gen.,O.G.,Reg.,W.T.,I.S.	....	Yes(SS)	Left
Graham 6, 120	1937	P	.018	.025	22	8.3	48	Dist.	Gen.,O.G.,Reg.,W.T.,I.S.	....	Yes(SS)	Left
Graham 6, 80, 80A	1936	P	.018	.025				Dist.,S.P.	Gen.,I.S.	....	No	....
Graham 6, 90, 90A	1936	P	.018	.025				Dist.,S.P.	Gen.,I.S.	....	No	....
Graham 6, 110	1936	P	.018	.025				Dist.,S.P.	Gen.,I.S.	....	No	....
Graham 6	1935	P	.018	.025				Dist.,S.P.	I.S.		Yes	Left
Graham Spc. 6	1935	P	.018	.025				Dist.,S.P.	I.S.		Yes	Left
Graham 8	1935	P	.018	.025				Dist.,S.P.	I.S.		Yes	Left
Graham Super C8	1935	P	.018	.025				Dist.,S.P.	I.S.		Yes	Left
Graham 6, 8	1934	P	.020	.025							Yes	
Graham Cust. 8	1934	P	.020	.025							Yes	
Graham Std. 6	1933	P	.020	.025							No	....
Graham Std. Cust. 8	1933	P	.020	.025							No	....
Graham 6	1933	P	.020	.025							No	....
Graham 8	1932	P	.020	.025							No	....

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(Continued from preceding page)

Make & Model of Car	Year	Batt. Term. Grounded	Correct Breaker Gap (Inches)	Correct Spark Plug Gap (Inches)	Generator max. normal charging rate			Install a Suppressor at:	Install a By-Pass Condenser at:	Ground the:	Auto-Radio Antenna built-in*	Antenna Lead-in Location
					Amps.	Volts	Car Speed					
Hudson 6, 73	1937	P	.020	.022	22	8.0	30	Dist.	Gen.,G.G.,W.T.	Transm.,Muff.	No	----
Hudson 8, 74, 75	1937	P	.017	.022	22	8.0	30	Dist.	Gen.,G.G.,W.T.	Transm.,Muff.	No	----
Hudson 6	1936	P	.020	.022				Dist.	Gen.,G.G.,W.T.	Transm.,Muff.	No†	----
Hudson 8	1936	P	.020	.022				Dist.	Gen.,G.G.,W.T.	Transm.,Muff.	No†	----
Hudson 6	1935	P	.020	.022				Dist.,S.P.	Gen.,I.C.,D.L.,GG,W.G.		Yes	Left
Hudson 8	1935	P	.020	.022				Dist.,S.P.	Gen.,I.C.,D.L.,GG,W.G.		Yes	Left
Hudson 8	1934	P	.020	.022							Yes	
Hudson Super 6	1933	N	.020	.022							No	----
Hudson 8	1933	N	.020	.022							No	----
Hudson 8	1932	N	.020	.025							No	----
Hupmobile 618	1936	P	.018	.028				Dist.,S.P.	Gen.,D.L.	----	Yes(SS)	Right
Hupmobile 621	1936	P	.015	.028				Dist.,S.P.	Gen.,D.L.	----	Yes(SS)	Right
Hupmobile 518	1935	P	.018	.028				Dist.,S.P.	Gen.,D.L.,S.M.	----	Yes	Right
Hupmobile 521	1935	P	.015	.028				Dist.,S.P.	Gen.,D.L.,S.M.	----		
Hupmobile 527	1935	P	.020	.028				Dist.,S.P.	Gen.,D.L.,S.M.	----		
Hupmobile 417	1934	P	.015	.025							Yes	Left
Hupmobile 421A	1934	P	.015	.028							Yes	Right
Hupmobile 421J	1934	P	.015	.025							Yes	Right
Hupmobile 422	1934	P	.020	.028							Yes	
Hupmobile 426	1934	P	.020	.028							Yes	
Hupmobile 427	1934	P	.020	.028							Yes	
Hupmobile 321	1933	P	.015	.028							Yes	
Hupmobile 322, 326	1933	P	.020	.028							Yes	
Hupmobile 214, 216	1932	P	.015	.025							No	----
Hupmobile 218	1932	P	.020	.028							No	----
Hupmobile 221, 222	1932	P	.020	.028							No	----
Hupmobile 255, 237	1932	P	.020	.048							No	----

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(Continued from preceding page)

Make & Model of Car	Year	Batt. Term. Grounded	Correct Breaker Gap (Inches)	Correct Spark Plug Gap (Inches)	Generator max. normal charging rate: Amps.	Volts	Car Speed	Install a Suppressor at:	Install a By-Pass Condenser at:	Ground the:	Auto-Radio Antenna built-in*	Antenna Lead-in Location
LaFayette 6	1936	P	.020	.025				Dist.	Gen.,Amm.	....	No†	....
LaFayette 6	1935	P	.020	.018				Dist.,S.P.	Gen.,Amm.	....	Yes	Left
LaFayette	1934	P	.020	.018							Yes	
LaSalle V8	1937	P	.013	.025	28	....	48	Dist.,S.P.	Gen.,I.C.,E.C.	F.W.	No	....
LaSalle 8	1936	P	.013	.025				Dist.,S.P.	Gen.,I.C.,E.C.,D.L.	F.W.	No†	....
LaSalle 8	1935	P	.018	.025				Dist.,S.P.	Gen.,I.C.,S.M.		Yes	
LaSalle 8	1934	P	.018	.025							Yes	
LaSalle	1933	P	.018	.025							Yes	
LaSalle	1932	P	.018	.025							No	
Lincoln Zephyr	1937	P	.014	.028	15	7.0	10	None	Gen.,I.C.(2),O.G.,G.G.,R.W.T.	....	Yes	Left
Lincoln V12	1937	N	.020	.025	22	8.0	20	Dist.(2)	Gen.,I.S.,D.L.,W.T.,O.G.,G.G.	....	Yes	Rear Seat
Lincoln Zephyr	1936	P	.014	.025				None	Gen.,I.C.(2),O.G.,G.G.,WT,R	....	Yes	Left
Lincoln V12	1936	N	.020	.025				Dist.(2)	Gen.,I.C.	....	Yes	Left
Lincoln V12	1935	N	.020	.025				Dist.(2)		....	Yes	
Lincoln V12-136	1934	N	.020	.025							Yes	
Lincoln V12-145	1933	N	.020	.025							Yes	
Lincoln 12	1932	N	.020	.025							Yes	
Marmon 16	1933	P‡	.018	.022							No	....
Marmon 8-125	1932	P‡	.022	.025							No	....
Marmon 16	1932	P‡	.015	.022							No	....
Nash LaFayette 400	1937	P	.020	.025	18	8.0	24	Dist.	Gen.Cutout	Mff.,Br.Cble.	No	....
Nash Amb. 6	1937	P	.020	.025	18	8.0	24	Dist.	Gen.	Muffler	No	....
Nash Amb. 8	1937	P	.020	.025	28	8.0	24	Dist.(2)	Gen.			
Nash 400	1936	P‡	.020	.025						Muffler	Yes(P)	

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(Continued from preceding page)

Make & Model of Car	Year	Batt. Term. Grounded	Correct Breaker Gap (Inches)	Correct Spark Plug Gap (Inches)	Generator max. normal charging rate: Amps.	Volts	Car Speed	Install a Suppressor at:	Install a By-Pass Condenser at:	Ground the:	Auto-Radio Antenna built-in*	Antenna Lead-in Location
Nash Amb. 6	1936	P‡	.020	.025				Dist. (2)	Gen., D.L., I.C.	----	Yes (P)	Left
Nash Amb. 8	1936	P‡	.020	.025				Dist. (2)	Gen., D.L., I.C.	----	Yes (P)	Left
Nash Adv. 6	1935	P‡	.020	.022				Dist., S.P.	Gen., Amm.		Yes	Left
Nash Adv. Amb. 8	1935	P‡	.020	.022				Dist., S.P.	Gen., Amm.		Yes	Left
Nash Big 6	1934	P‡	.020	.020							Yes	
Nash Adv. 8	1934	P‡	.020	.020							Yes	
Nash Amb. 8	1934	P‡	.020	.020							Yes	
Nash Big 6	1933	N	.020	.018							Yes	
Nash Std. 8	1933	N	.020	.018							Yes	
Nash Spec. 8	1933	N	.020	.018							Yes	
Nash Adv. 8	1933	P	.025	.020							Yes	
Nash Amb. 8	1933	P	.025	.019							Yes	
Nash 960	1932	N	.020	.018							No	
Nash 970	1932	N	.020	.018							No	—
Nash 980	1932	P	.025	.015							No	—
Nash 990	1932	P	.021	.019							No	—
Oldsmobile 6	1937	N	.020	.040	20	8.6	36	Dist.	Gen.	Eng.,F.W.,Tr.	Yes (Insul. R)	—
Oldsmobile 8	1937	N	.015	.030	20	8.6	42	Dist.	Gen.	same	Yes (Insul. R)	—
Oldsmobile 6	1936	N	.020	.030				Dist.	Gen.	F.W.,Tr.,E.	No†	—
Oldsmobile 8	1936	N	.015	.030				Dist.	Gen.	F.W.,Tr.,E.	No†	—
Oldsmobile 6	1935	N	.018	.025				Dist.	Gen., Amm., D.L.		No	—
Oldsmobile 8	1935	N	.018	.025				Dist.	Gen., Amm., D.L.		No	—
Oldsmobile 6	1934	N	.018	.025							Yes	Left
Oldsmobile 8	1934	N	.018	.025							Yes	Left
Oldsmobile 6	1933	N	.018	.025							Yes	
Oldsmobile 8	1933	N	.018	.025							Yes	
Oldsmobile 6, 8	1932	N	.018	.025							No	—

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(Continued from preceding page)

Make & Model of Car	Year	Batt. Term. Grounded	Correct Breaker Gap (Inches)	Correct Spark Plug Gap (Inches)	Generator max. normal charging rate: Amps.	Volts	Car Speed	Install a Suppressor at:	Install a By-Pass Condenser at:	Ground the:	Auto-Radio Antenna built-in*	Antenna Lead-in Location
Packard 6	1937	P	.018	.028	18	8.0	....	Dist.	Gen.,I.S.,E.C.	Controls,S.C.	Yes	Left
Packard 120	1937	P	.013	.028	20	8.0	....	Dist.	Gen.,I.S.,E.C.	Controls,S.C.	Yes	Left
Packard Super 8	1937	P	.013	.028	26	8.0	....	Dist.	Gen.,Reg.,D.L.	....	Yes	Right
Packard 12	1937	P	.018	.028	30	8.0	....	Dist.	Gen.,Reg.,D.L.	....	Yes	Right
Packard 120	1936	P	.018	.029				Dist.	Gen.,E.C.	....	Yes	Left
Packard 8	1936	P	.018	.029				Dist.,S.P.	Gen.,I.S.	....	Yes	Right
Packard Super 8	1936	P	.018	.029				Dist.,S.P.	Gen.,I.S.	....	Yes	Right
Packard 12	1936	P	.018	.029				Dist.,S.P.	Gen.,I. C.	....	Yes	Right
Packard 120	1935	P	.018	.025				Dist.,S.P.	Gen.,I.S.		Yes	Right
Packard 8	1935	P	.018	.025				Dist.,S.P.	Gen.,I.S.		Yes	Right
Packard Super 8	1935	P	.018	.025				Dist.,S.P.	Gen.,I.S.		Yes	Right
Packard 12	1935	P	.018	.025				Dist.,S.P.	Gen.,I. C.		Yes	Right
Packard 8	1934	P	.018	.025							Yes	
Packard Super 8	1934	P	.018	.025							Yes	
Packard 12	1934	P	.018	.025							Yes	
Packard 8	1933	P	.018	.025							Yes	
Packard Super 8	1933	P	.018	.025							Yes	
Packard 12	1933	P	.018	.025							Yes	
Packard 901, 902	1932	P	.015	.025							No	....
Packard 903, 904	1932	P	.015	.025							No	....
Pierce Arrow 8	1937	P	.018	.022	28	8.0	....	Dist.	Gen.(2),Amm.	....	Yes(W)	Right
Pierce Arrow 12	1937	P	.018	.022	28	8.0	....	Dist.	Gen.(2),Amm.	....	Yes(W)	Right
Pierce Arrow 8	1936	P	.018	.022				Dist.	Gen.(2),Amm.	....	Yes(W)	Left
Pierce Arrow 1602	1936	P	.018	.022				Dist.	Gen.(2),Amm.	....	Yes(W)	Left
Pierce Arrow 1603	1936	P	.018	.022				Dist.	Gen.(2),Amm.	....	Yes(W)	Left
Pierce Arrow 845	1935	P	.018	.022							Yes	
Pierce Arrow 1245	1935	P	.018	.022							Yes	

*Note: Key to types of aerials: R-"*Running Board*" type; SS-"*Steel Screen*" type in roof; W-"*Wire*" type in roof.
†Note: These cars have "Turret" or "steel" tops and require an antenna mounted on the outside of the car.
Key to Symbols: "Amm."-*Ammeter*; "C"-*Coil*; "Dist."-*Distributor*; "D.L."-*Dome Light*; "E.C."-*Electric Clock*; "F.B."-*Fuse Block*; "F.W."-*Front Wheels*; "Gen."-*Generator*; "G.G."-*Gasoline Gauge*; "I.C."-*Ignition Coil*; "I.S."-*Ignition Switch*; "Muff."-*Muffler*; "O.G."-*Oil Gauge*; "Reg."-*Regulator*; "Rel."-*Relay*; "R.S." *Rear Springs*; "R.W."-*Rear Wheels*; "S.C."-*Steering Column*; "S.M."-*Starting Motor*; "S.P."-*Spark Plugs*; "Transm."-*Transmission*; "T.T."-*Torque Tube*; "W.T."-*Water Thermometer*. (*Con't over*)

(Continued from preceding page)

Make & Model of Car	Year	Batt. Term. Grounded	Correct Breaker Gap (Inches)	Correct Spark Plug Gap (Inches)	Generator max. normal charging rate: Amps.	Volts	Car Speed	Install a Suppressor at:	Install a By-Pass Condenser at:	Ground the:	Auto-Radio Antenna built-in*	Antenna Lead-in Location
Pierce Arrow 1255	1935	P	.018	.022							Yes	
Pierce Arrow 840A	1934	P	.018	.022							Yes	
Pierce Arrow 1240A	1934	P	.018	.022							Yes	
Pierce Arrow 1248A	1934	P	.018	.022							Yes	
Pierce Arrow 836	1933	P	.018	.022							Yes	
Pierce Arrow 1236	1933	P	.018	.022							Yes	
Pierce Arrow 1242, 47	1933	P	.018	.022							Yes	
Pierce Arrow 54	1932	P	.018	.025							Yes	
Pierce Arrow 53	1932	P	.018	.022							Yes	
Pierce Arrow 52, 51	1932	P	.018	.022							Yes	
Plymouth 6, P3	1937	P	.020	.025	15	8.0	18	Dist.	Gen.,Amm.or.I.S.	Controls	No	----
Plymouth 6, P4	1937	P	.020	.025	22	7.8	18	Dist.	Gen.,Amm.or.I.S.	Controls	No	----
Plymouth 6	1936	P	.020	.025				Dist.,S.P.	Gen.,Amm.,D.L.	----	Yes(SS)	Left
Plymouth 6	1935	P	.020	.025				Dist.,S.P.	Gen.,D.L.,I.S.		Yes	Right
Plymouth 6	1934	P	.020	.025							Yes	
Plymouth 6	1933	P	.020	.025							Yes	
Plymouth	1932	P	.020	.020							No	
Pontiac 6	1937	N	.020	.025	18	8.0	40	Dist.	Gen.	CylHd.,F.W.	No†	----
Pontiac 8	1937	N	.015	.025	18	8.0	40	Dist.	Gen.	CylHd.,F.W.	No†	----
Pontiac Master 6	1936	N	.020	.025				Dist.	Gen.	FW,RW,TT.	No†	----
Pontiac DL. 6	1936	N	.020	.025				Dist.	Gen.	FW,RW,TT.	No†	----
Pontiac DL. 8	1936	N	.018	.025				Dist.	Gen.	FW,RW,TT.	No†	----
Pontiac 6	1935	N	.020	.025				Dist.,S.P.	Gen.,Amm.,D.L.		No	----
Pontiac 8	1935	N	.018	.025				Dist.,S.P.	Gen.,Amm.,D.L.		No	----
Pontiac 8	1934	N	.013	.022							Yes	Left
Pontiac 8	1933	N	.013	.018							Yes	Left

*Note: Key to types of aerials: R-"*Running Board*" type; SS-"*Steel Screen*" type in roof; W-"*Wire*" type in roof.
†Note: These cars have "Turret" or "steel" tops and require an antenna mounted on the outside of the car.
Key to Symbols: "Amm."-*Ammeter*; "C"-*Coil*; "Dist."-*Distributor*; "D.L."-*Dome Light*; "E.C."-*Electric Clock*; "F.B."-*Fuse Block*; "F.W."-*Front Wheels*; "Gen."-*Generator*; "G.G."-*Gasoline Gauge*; "I.C."-*Ignition Coil*; "I.S."-*Ignition Switch*; "Muff."-*Muffler*; "O.G."-*Oil Gauge*; "Reg."-*Regulator*; "Rel."-*Relay*; "R.S." *Rear Springs*; "R.W."-*Rear Wheels*; "S.C."-*Steering Column*; "S.M."-*Starting Motor*; "S.P."-*Spark Plugs*; "Transm."-*Transmission*; "T.T."-*Torque Tube*; "W.T."-*Water Thermometer*. (Con't over)

(Continued from preceding page)

Make & Model of Car	*Year*	*Batt. Term. Grounded*	*Correct Breaker Gap (Inches)*	*Correct Spark Plug Gap (Inches)*	*Generator max. normal charging rate* — *Amps.*	*Volts*	*Car Speed*	*Install a Suppressor at:*	*Install a By-Pass Condenser at:*	*Ground the:*	*Auto-Radio Antenna built-in**	*Antenna Lead-in Location*
Reo Flying Cloud 6	1936	N	.018	.025				Dist.,S.P.	Gen.,D.L.	Controls	Yes(SS)	Left
Reo Flying Cloud	1936	N	.020					Dist.,S.P.	Gen.,D.L.	Controls	Yes	
Reo Royale	1936	N	.020					Dist.,S.P.	Gen.,D.L.	Controls	Yes	
Reo 6A	1935	N	.020	.025				Dist.	Gen.,Amm.,D.L.		Yes	Right
Reo S	1935	N	.020	.025				Dist.	Gen.,Amm.,D.L.		Yes	Right
Reo S6	1934	N	.020	.025							No	----
Reo Royale 8	1934	N	.020	.025							No	----
Reo S	1933	N	.020	.025							Yes	
Reo Royale	1933	N	.020	.025							Yes	
Reo 6-21	1932	N	.020	.025							No	----
Reo 8-21, 2	1932	N	.018	.025							No	----
Reo 31, 35	1932	N	.022	.025							No	----
Studebaker Dict. 6	1937	P	.020	.022	18	7.8	26	Dist.	Gen.	----	No	----
Studebaker Pres. 8	1937	P	.020	.022	26	8.0	25	Dist.	Gen.	Engine	No	----
Studebaker Dict. 6	1936	P	.025	.023				Dist.	Gen.,Amm.	----	No	----
Studebaker Pres. 8	1936	P	.025	.023				Dist.	Gen.,Amm.,I.C.	Muffler	No	----
Studebaker Dict. 6	1935	P	.020	.023				Dist.S.P.	Gen.,Amm.,D.L.		Yes	Left
Studebaker Com. 8	1935	P	.020	.023				Dist.S.P.	Gen.,Amm.,D.L.		Yes	Left
Studebaker Pres. 8	1935	P	.020	.023				Dist.S.P.	Gen.,Amm.,D.L.		Yes	Left
Studebaker Dict. 6	1934	P	.020	.023							Yes	
Studebaker Com. 8	1934	P	.020	.023							Yes	
Studebaker Pres. 8	1934	P	.020	.023							Yes	
Studebaker 6	1933	P	.020	.025							Yes	
Studebaker Com. 8	1933	P	.020	.025							Yes	
Studebaker Pres. 8	1933	P	.020	.025							Yes	
Studebaker Pres. 8	1933	P	.020	.025							Yes	

*Note: Kev to types of aerials: *R*-"*Running Board*" type; *SS*-"*Steel Screen*" type in roof; *W*-"*Wire*" type in roof.
†Note: These cars have "Turret" or "steel" tops and require an antenna mounted on the outside of the car.
Key to Symbols: "Amm."-*Ammeter;* "C"-*Coil;* "Dist."-*Distributor;* "D.L."-*Dome Light;* "E.C."-*Electric Clock;* "F.B."-*Fuse Block;* "F.W."-*Front Wheels;* "Gen."-*Generator;* "G.G."-*Gasoline Gauge;* "I.C."-*Ignition Coil;* "I.S."-*Ignition Switch;* "Muff."-*Muffler;* "O.G."-*Oil Gauge;* "Reg."-*Regulator;* "Rel."-*Relay;* "R.S." *Rear Springs;* "R.W."-*Rear Wheels;* "S.C."-*Steering Column;* "S.M."-*Starting Motor;* "S.P."-*Spark Plugs;* "Transm."-*Transmission;* "T.T."-*Torque Tube;* "W.T."-*Water Thermometer.* (Con't over)

(Continued from preceding page)

Make & Model of Car	Year	Batt. Term. Grounded	Correct Breaker Gap (Inches)	Correct Spark Plug Gap (Inches)	Generator max. normal charging rate: Amps.	Volts	Car Speed	Install a Suppressor at:	Install a By-Pass Condenser at:	Ground the:	Auto-Radio Antenna built-in*	Antenna Lead-in Location
Studebaker 6	1932	P	.020	.025							Yes	
Studebaker Dict. 8	1932	P	.020	.025							Yes	
Studebaker Com. 8	1932	P	.020	.025							Yes	
Studebaker Pres. 8	1932	P	.020	.025							Yes	
Stutz SV16	1935	N	.017	.025							No	----
Stutz DV32	1935	N	.020	.022							No	----
Stutz SV16	1934	N	.017	.025							No	----
Stutz DV32	1934	N	.020	.022							No	----
Terraplane 6, 71	1937	P	.020	.022	15	8.0	27	Dist.	Gen.,W.T.,G.G.		No	----
Terraplane 6, 72	1937	P	.020	.025	22	8.0	30	Dist.	Gen.,W.T.,G.G.	Muff.Transm.	No	
Terraplane 6	1936	P	.020	.022				Dist.	Gen.,W.T.,G.G.	Muff.Transm.	No†	
Terraplane 6	1934	P	.020	.022						Muff.Transm.	Yes	Left
Terraplane 6	1933	N	.020	.022							Yes	
Willys 37	1937	N	.020	.025	13	8.0	22	Dist.	G.G.,O.G.,Gen.,Amm.	....	No	----
Willys 77	1936	N	.018	.024							No	----
Willys 77	1935	N	.018	.024							No	----

*Note: Key to types of aerials: R-"*Running Board*" type; *SS*-"*Steel Screen*" type in roof; *W*-"*Wire*" type in roof.
†Note: These cars have "Turret" or "steel" tops and require an antenna mounted on the outside of the car.
Key to Symbols: "Amm."-*Ammeter;* "C"-*Coil;* "Dist."-*Distributor;* "D.L."-*Dome Light;* "E.C."-*Electric Clock;* "F.B."-*Fuse Block;* "F.W."-*Front Wheels;* "Gen."-*Generator;* "G.G."-*Gasoline Gauge;* "I.C."-*Ignition Coil;* "I.S."-*Ignition Switch;* "Muff."-*Muffler;* "O.G."-*Oil Gauge;* "Reg."-*Regulator;* "Rel."-*Relay;* "R.S." *Rear Springs;* "R.W."-*Rear Wheels;* "S.C."-*Steering Column;* "S.M."-*Starting Motor;* "S.P."-*Spark Plugs;* "Transm."-*Transmission;* "T.T."-*Torque Tube;* "W.T."-*Water Thermometer.* (*Con't over*)

TROUBLE-SHOOTING CHART FOR COMMON RECEIVER TROUBLES

It is apparent that there are a great many causes for inoperation or poor operation of a radio receiver; in fact, it is the distinct purpose of the text book *Modern Radio Servicing* to discuss the servicing of modern radio receivers in detail. The chart shown on the following pages has been compiled with the idea of presenting a short outline of the salient causes of some of the more common trouble-symptoms in both battery-operated and line-operated receivers of all types.

It must not be inferred that this chart is intended to be a complete servicing guide in itself. It was really compiled to act as a convenient *reminder* or trouble outline to which the radio service man can refer when he is "trouble-shooting" a receiver, so he can make sure that he has not overlooked some possible cause for the trouble symptom which the receiver is exhibiting. This makes it unnecessary for him to remember each of the 275 possible receiver troubles and trouble sources which the chart lists. After he has checked over the receiver in the usual way he can refer to this trouble-shooting chart to see if he has overlooked some possible cause for the trouble.

Examination of this chart will show that for each of the six common receiver trouble symptoms specified, several possible sources or causes of trouble are listed for each main part of the receiver. Thus, for the symptom of Weak Reception, *five* likely causes of trouble in the tubes of the receiver are listed, *eight* likely causes of trouble in the power supply unit are mentioned, etc. Of course, each of these possible troubles would have to be checked by making suitable tests on the proper components of the receiver in order to definitely locate the trouble in any case. Therefore, this chart serves best as a *trouble reminder.*

TROUBLE-SHOOTING CHART FOR COMMON RECEIVER TROUBLES

POSSIBLE TROUBLE SOURCES	SYMPTOMS OF TROUBLE					
	HUM	*WEAK*	*NOISY*	*INOPERATIVE* (*no signals*)	*INTERMITTENT RECEPTION, FADING*	*OSCILLATION, DISTORTION*
TUBES	1. "Gassy" power tubes. 2. Unmatched power tubes. 3. Cathode-heater leakage. 4. Center-tap connection open. 5. Weak tubes.	1. Low emission tubes. 2. Wrong type tubes. 3. Loose elements. 4. Gassy tubes. 5. Control-grid cap not soldered.	1. Loose elements in tubes. 2. Shorting elements. 3. Corroded tube pin terminals. 4. Weak tubes. 5. Poor oscilator tube —"flat."	1. Tube burned out. 2. Tube short-circuited or paralyzed. 3. "Flat" oscillator tube. 4. Faulty tube prong contacts. 5. Series-connected pilot lamp burned out, so other tubes in set do not light.	1. Imperfect prong contacts. 2. Loose elements in tubes. 3. Shorting tube elements. 4. Gassy screen grid tubes. 5. Cathode-heater leakage in indirect-heater type tubes.	1. Gassy, high emission tubes. 2. Wrong type tubes. 3. Cathode-heater leakage. 4. Weak power tubes. 5. Gassy tubes.
POWER UNIT	1. Open-circuited filter condenser. 2. Loose laminations of power transformer. 3. Short-circuited filter choke. 4. Loose laminations of filter choke. 5. Short-circuited filter choke by-pass condenser. 6. Open-circuited filter choke by-pass condenser. 7. Electrolytic filter or by-pass condenser "dried up." 8. Open-circuited line-voltage supply buffer condensers.	1. Weak or gaseous rectifier tubes (filament type). 2. Weak or exhausted rectifier tube (gas type). 3. Line voltage too low. 4. Open voltage-divider section. 5. Carbonized voltage-divider system. 6. Transformer winding partially short-circuited. 7. Leaky or short-circuited by-pass condenser. 8. Voltage divider changed value.	1. Sparking, porous voltage-divider. 2. Punctured filter or by-pass condenser "sparking over." 3. Noisy carbon resistors. 4. High-voltage winding of power transformer sparking over to shield. 5. Loose or corroded line switch or fuse contacts. 6. Carbonized rectifier socket. 7. Leaky line-buffer condensers. 8. Leaky or open-circuited high-voltage winding buffer condensers.	1. Not connected to power supply. 2. Fuse blown. 3. Rectifier inoperative. 4. Line plug reversed (d-c). 5. Filter choke open-circuited. 6. Open-circuited voltage-divider section. 7. Open-circuited bias resistor. 8. Short-circuited filter condenser or by-pass condenser. 9. Rectifier tube socket fused. 10. Loose connection. 11. Fuses blow. Short-circuited buffer condenser, filter condenser, or power transformer winding. 12. Open-circuited high-voltage winding, or section of power transformer.	1. Fluctuating line voltage. 2. Poor contact in line switch. 3. Poor contact at fuse block. 4. Corroded line switch terminals or contacts. 5. Corroded fuse clip contacts. 6. Open-circuiting voltage-divider section. 7. Open-circuiting filter choke. 8. Leaky filter or by-pass condenser.	1. Carbonized voltage-divider system. 2. Open-circuited filter condenser. 3. Short-circuited bias resistor. 4. Short-circuited bias resistor by-pass condenser. 5. Weak rectifier tube. 6. Voltage-divider changed value.

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"B" BATTERY (if used)	1. Exhausted battery.	1. Battery exhausted. 2. Battery terminals ("intermediate" and "high") reversed.	1. Exhausted battery. 2. Poor internal connection. 3. Dead cell. 4. Noisy cell.	1. Battery exhausted. 2. Battery terminals reversed.	1. Defective cell. 2. Loose connection. 3. Battery exhausted.	1. Exhausted battery. 2. Defective cell.
"A" BATTERY (if used)	1. Charger operating while receiver is in operation.	1. Battery exhausted. 2. Corroded battery terminals. 3. Charger not functioning. 4. Dead cell.	1. Battery sulphated. 2. Terminals corroded. 3. Charger operating while receiver is in operation.	1. Battery exhausted. 2. No water in storage battery. 3. Corroded battery terminals. 4. Dead cell.	1. Loose connection to battery. 2. Battery run down. 3. Renew acid.	1. Exhausted battery. 2. Whistle due to depleted battery.
RECEIVER CIRCUITS PROPER	1. Open-circuited center tapped resistor or hum control. 2. Hum control or balancer out of adjustment. 3. Push-pull input transformer secondary unbalanced. 4. Open-circuited A.F. secondary winding or grid resistor. 5. Open-circuited or leaky line supply by-pass condenser. 6. Short-circuited bias resistor or by-pass condenser. 7. Open-circuited screen or cathode by-pass condenser.	1. Tuned stages out of alignment. 2. Open-circuited R.F. coil. 3. Open-circuited A.F. transformer. 4. Open-circuited plate or grid resistor or suppressor. 5. Open-circuited or leaky by-pass condenser. 6. Open-circuited, leaky or short-circuited coupling or isolating condenser. 7. Antenna binding post grounded. 8. Voltage divider carbonized, or open-circuited section. 9. Short-circuited by-pass condenser. 10. Open-circuited bias resistor.	1. Noisy carbon resistor. 2. Sparking wire-wound resistor. 3. Noisy A. F. transformer primary. 4. Noisy volume control resistance element or contacts. 5. Condenser gang plates peeling. 6. Burrs on condenser gang plates. 7. Dirty or corroded condenser gang rotor wiping contacts. 8. High-resistance or poorly soldered connections especially in R-F circuits, chassis soldered grounds and grid connections. 9. Leaky or noisy by-pass condenser. 10. Corroded tube socket contacts or prongs. 11. Inadequate shielding of receiver.	1. Open-circuited R.F. coil. (primary or secondary). 2. Open-circuited audio transformer. (primary or secondary). 3. Open-circuited plate or grid resistor. 4. Open-circuited voltage-divider section. 5. Short-circuited by-pass condenser. 6. Open-circuited or short-circuited coupling or isolating condenser. 7. Short-circuited tuning condenser, compensating or neutralizing condenser. 8. Line switch open-circuited.	1. Open-circuited or open-circuiting by-pass condenser. 2. Leaky by-pass condenser. 3. Open-circuiting leaky or short-circuiting coupling or isolating condenser. 4. Poor insulation on trimmer or compensator condensers. 5. Tuning condenser plates peeling. 6. Dirty or corroded condenser rotor-wiping contacts. 7. Open-circuiting resistor. 8. Leads short-circuiting. 9. Resistors short-circuiting to one another. 10. Terminal rivets on wire-wound resistor or loose, or resistor or element warped and shorting to chassis. 11. High-resistance leaks. 12. Poorly soldered connections especially in r-f circuits, chassis soldered grounds, and grid connections.	1. Short-circuited bias resistor. 2. Short-circuited bias resistor by-pass condenser. 3. Leaky or open-circuited coupling or isolating condenser. 4. Carbonized voltage-divider system. 5. Open-circuited A.F. transformer secondary. 6. Tuned circuits adjusted too sharply. 7. Plate or screen voltage too high. 8. Bias voltage too high or too low. 9. Push-pull input transformer secondary unbalanced. 10. Open-circuited plate, screen or cathode by-pass condenser. 11. Pilot light socket or wiring shorting against chassis. 12. Dirty wiping contact on gang-condenser rotor. 13. Loose or dusty coil or tube shields.

(Continued on next page)

Reproducer	1. Unfiltered field coil supply. 2. Open-circuited filter condenser. 3. Voice coil rubbing. 4. Rectifier worn. 5. Loose output transformer laminations. 6. Short-circuited hum-bucking coil. 7. Short-circuited field coil.	1. Speaker out of adjustment. 2. Spider on cone worn. 3. Voice coil or speaker winding partially short-circuited. 4. Field coil short-circuited. 5. No field coil voltage supply. 6. Field coil open-circuited. 7. Worn rectifier for speaker field supply. 8. High-resistance connection.	1. Speaker out of adjustment. 2. Snapped spider. 3. Scraping voice coil. 4. Poorly soldered connection. 5. Unfiltered field supply. 6. Loose connection. 7. Loose apex. 8. Torn or worn cone. 9. Loose armature. 10. Loose mounting nuts or bolts.	1. Speaker disconnected. 2. Voice coil open-circuited. 3. Voice coil short-circuited. 4. Speaker windings open or short-circuited. 5. Open or short-circuited output transformer secondary. 6. Open or short-circuited output condenser. 7. Open-circuited output choke. 8. Open-circuited hum-bucking coil.	1. Loose connection to voice coil, speaker winding or field coil. 2. Open-circuiting or short-circuiting field coil or voice coil. 3. Voice coil rubbing against pole piece. 4. Armature sticks. 5. Loose apex.	1. Speaker out of adjustment. 2. Spider on cone snapped. 3. Voice coil rubbing on pole piece. 4. Armature not centered. 5. Cone out of round or warped. 6. Cone too soft or too stiff. 7. Speaker overloaded or not matched to output. 8. Insufficient field coil energizing voltage. 9. Worn rectifier in field coil supply.
Antenna Ground	1. Antenna too close to power lines. 2. Antenna too near that of an oscillating receiver. 3. No ground wire. 4. Remove ground wire. 5. Antenna lead too close, or parallel to, line-supply cord.	1. Antenna or ground disconnected. 2. High resistance leaks or grounds. 3. Antenna too short. 4. Antenna too close to grounded object. 5. Short-circuited lightning arrester. 6. No ground wire.	1. Antenna too long. 2. Antenna too short. (noise within building) 3. Loose or corroded connections. 4. Antenna or lead-in too close to power lines or line-supply cord. 5. Antenna or lead-in near electrical devices. 6. Antenna grounding to nearby antenna or grounded object. 7. Corroded lead-in strip. 8. Break somewhere in antenna circuit. 9. Defective lightning arrester.	1. Antenna disconnected. 2. Antenna grounded. 3. Defective short-circuited lightning arrester.	1. Loose connections in antenna or ground system. 2. Loose and "swinging" antenna. 3. Antenna grounding or short-circuiting to nearby aerial on grounded object. 4. Loose lead-in strip or ground clamp. 5. Lead-in wire snapped in middle. 6. Corroded connections.	1. Antenna too long. 2. Insufficient antenna. 3. No ground wire.
General	1. Poor modulation of station. 2. Electrical apparatus operating nearby.	1. Sensitivity of receiver inadequate. 2. "Dead-Spot" reception. 3. Line voltage too low.	1. Natural static. 2. Man-made static due to electrical devices. 3. Nearby regenerative receiver. 4. Loose lamp fixtures. 5. Loose wiring in building. 6. Loose line fuses or lamps.	1. Receiver incorrectly wired. 2. Receiver incorrectly connected. 3. S.O.S. on the air. 4. Receiver not turned on. 5. Station not broadcasting. 6. No power supply.	1. Fault of broadcasting station. 2. Natural fading (atmospheric causes or conditions). 3. Interrupted line supply.	1. Improper tuning. 2. Weather conditions unsatisfactory. 3. Two stations broadcasting at or near same frequency. 4. Nearby oscillating receiver. 5. Poor modulation of broadcasting station.

RMA TUBE "TYPE NUMBER" DESIGNATION SYSTEM FOR STANDARD-"GLASS" TUBES, OCTAL-BASED "GLASS" TUBES ("G" TUBES), AND OCTAL-BASED "ALL-METAL" TUBES

The RMA sstem (standardized in 1933) which is employed for designating the type numbers of both the "glass" and "all-metal" type American tubes is interesting and should be understood by every radio service man. With this system, only three symbols are required (in most cases) to give a tube an identifying type number: a *numeral*, a *letter* and *another numeral* (see column 1 in the *Tube Characteristic Data Chart* of Section 11).

The *first numeral* indicates the *filament* or *heater* voltage. Thus, the numeral 1 is used for 2-volt tubes (like the 1A6), the numeral 2 is used for 2.5-volt tubes (like the 2A3), the numeral 5 is used for the 5-volt tubes (like the 5Z3), the numeral 6 is used for the 6.3-volt tubes (like the 6A6), the numeral 12 is used for the 12.6-volt tubes (like the 12A5), etc.

The *letter* following the first numeral is supposed to distinguish one tube type from another which may happen to have the same numerals. Thus, the *letter* in the "type number" is the only thing which distinguishes between the identifying type numbers of the 1A6 and 1C6 tubes, etc. These letters are assigned in alphabetical sequence, starting with A, for all tubes except rectifiers. In the case of rectifiers, a separate assignment is made, starting with Z and working backward. The number of tube types manufactured has now become so large that *two* letters are employed in the type numbers of some tubes. This departure from the conventional system is made in cases where it is found that the type number which would ordinarily be assigned to a new tube if *one* letter were to be used, has already been assigned previously to some existing tube being manufactured. In such cases *two* letters are used in the type number of the newer tube to distinguish it from the other one. Examples of this are furnished by the 6Z5 and 6ZY5G tubes, the 6B5 and 6AB5 tubes, etc.

The *last numeral* indicates the number of *useful* elements which are brought out to the terminals. Thus, the 2A5 has *five* such "useful" elements: a heater, a cathode, two grids and a plate. In this particular tube, the suppressor is not brought out to an external terminal (it is connected to the cathode *inside* of the tube) so it is not counted.

In the case of "G" tubes (octal-based "glass" tubes) the letter "G" follows the last numeral. This immediately signifies that the tube is of the "glass" type but has an octal base. Examples of this are furnished by such type numbers as 6A5G, 6B8G, etc.

If the RMA tube type-numbering system is kept in mind, it is usually possible to figure out the main information about a tube from a study of its type number. For instance, the 2A3 tube must have *three* "useful" elements brought out to terminals. The tube is certainly not a rectifier because it has the letter "A". It must therefore be a *triode*. Also, the last number does not allow for a heater in addition to the other three "useful" elements. Therefore it must be a *"direct-heater"* or a *"filament"* type tube. Considering these deductions together with the first numeral, we find that the tube must be a *2.5-volt filament-type triode.* Information concerning many types of tubes cannot be deduced as easily as this from the type numbering system, but in all cases, the first number will at least supply definitely the filament or heater voltage. A study of the type numbers and specifications of some of the tubes listed in the chart in Section 11 will aid in understanding this system.

RMA SOCKET & TUBE BASE PIN DESIGNATION AND NUMBERING SYSTEM FOR STANDARD-"GLASS" TUBES

Socket and Tube base pin numbering system for standard-"glass" tubes: Modern tube development has led to an increased number of internal element arrangements and their external connections. The result is that many different tube base (and socket) terminal arrangements are now used. Fortunately, the entire method of designating socket and tube base terminals has also been systematized and standardized by the Radio Manufacturers Association (Nov. 1934). The numerical numbering system which has been standardized for standard-"glass" tubes has the advantage of establishing a basic method of referring to these terminals.

The fifth column from the left in the *Tube Characteristic Chart* in Section 11 lists the socket connection figure number corresponding to the tubes listed in column 1. The R.M.A. Standard socket terminal arrangements for the various tube bases have been reproduced in the Tube Socket Connection Charts which follow the Tube Characteristics Chart (in Section 11). The connections have been drawn as they appear when looking *up at the socket from the bottom.* Examination of any of the socket connection illustrations shown in these charts will show that the two large prongs, commonly known as the *heater* prongs, are toward the bottom of the chart. The left-hand heater or filament hole is always No. 1, and, going in a *clockwise* direction, the one immediately adjacent to it is always No. 2; this process of numbering continues until the right-hand heater or filament prong is reached. Thus, the right-hand filament or heater terminal now bears a number representative of the total number of pins on the tube base. It should be noted that the system of terminal numbering pertains to the number of tube prongs (and hence the number of socket holes) only, and not to the structure of the tube directly.

When the socket is looked down upon from the top, the opposite is the case, i.e., the right-hand heater or filament terminal is always No. 1, and, going in a *counter-clockwise* direction, the terminal immediately adjacent to it is always No. 2; the numbers continuing in numerical order until the remaining filament or heater terminal is reached.

This method of designation is particularly convenient for the service man. Thus, *plate voltage* (from plate to cathode) may be designated as that between socket terminals *2* and *5* in a type '55 tube, between terminals *2* and *6* in a 6A7, between terminals *2* and *4* in a '56, etc. In practice, the *filament* or *heater* terminal numbers are always the first and last terminal numbers for the socket. The *plate* is almost always terminal No. *2*. This system is also a great convenience in the point-to-point analysis of radio receivers, since, through its use, simple voltage and resistance charts may be compiled without the necessity of referring continually to the various tube elements. All that need be specified in these charts are the socket terminal numerals between which voltage or resistance must be measured (regardless of the tube types involved), and the readings which should be obtained if the circuits and components are O.K.

RMA SOCKET & TUBE BASE PIN DESIGNATION AND NUMBERING SYSTEM FOR "ALL-METAL" AND "OCTAL"-BASED "GLASS" TUBES ("G" TUBES)

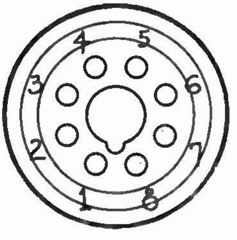
The socket-connection figure number for each of the all-metal and octal-based glass ("G" tubes) is shown in the fifth column from the left in the *Tube Characteristic Data Chart* in Section 11.

The "octal" base provided on all-metal, and glass "G" tubes has provisions for *eight* pins uniformly spaced 45-degrees apart. Where fewer than 8 pins are required, the unnecessary ones are omitted *and the spacing of the remaining pins is unchanged.* These tube bases fit into a universal 8-hole "octal" socket.

The numbering of the pins is in accordance with the RMA standard base pin numbering system, in which numbers are assigned to each of the *eight* possible pin positions. Numbering starts at the *shell* pin, which is always the first pin to the *left* of the locating lug when the tube base is viewed *from the bottom* (with the lug toward the observer). The numbering is *clockwise* on the basis of possible pin positions (see the octal tube base illustrated later). Thus, the numbers of the pins used in a particular 6-pin octal tube base might be: No. 1 (shell), 2, 3, 5, 7, and 8 (normal cathode).

The table following shows the pin positions, pin numbers, and terminal arrangements for the octal-based all-metal tubes, and base terminal arrangements for the octal-based all-metal tubes and the "Intermediate" or "G" type tubes. The "G" tubes have standard-size glass bulbs, and octal bases.

The octal-based glass tubes ("G" tubes) include counterparts for all of the all-metal tubes, and in addition many types which are identical to "standard" glass tubes except for the base. In general, metal tubes can be replaced by "G" tubes of corresponding type, but such replacement should be followed by a realignment of all trimmer condensers connected to any tuned circuits which could be affected by capacity differences existing between the "G" tubes and the corresponding metal types. Tube capacities are shown in the *Tube Characteristic Data Chart* (see Section 11) so that by looking up the tube capacities of both the *original* and the *replacement* tubes in this chart, the probable required retuning can be figured in advance. For r-f use, the "G" tubes must be shielded. Metal "glove" type shields with a special grounding clip which fits over the No. 1 or "shield" prong on the octal base can be had. This special shield is required when metal tubes are replaced with the "G" type since grounding "fingers" or collars have not been provided on the receiver chassis for metal tubes.



An 8-pin "Octal"-type tube base (*viewed from the bottom*) showing the eight pins, their numbers, and the guiding lug at the center.

A chart listing the base *Pin Positions* and *Pin Numbers* for both octal-based glass tubes ("G" tubes) and all-metal tubes, as well as the "type numbers" of the particular "glass" tubes which are *equivalent* to octal-based "all-metal" and "G" tubes, will be found in Section 10.

C

2.5 VOLT AC DETECTOR AND AMPLIFIER TUBES

24A	DETECTOR AMPLIFIER	TETRODE	HEATER	5E MED. 5 PIN	5 1/32	1 13/16	1.75	0.007 MAX.	5.0	10.5	DETECTOR	250	45	5						0.25 MΩ		24A
											R.F. AMPLIFIER	250	25	1	0.5	1000	2.0 MΩ	500		0.1 MΩ		
											R.F. AMPLIFIER	180	90	3	4.0	400	0.4 MΩ	1000			15	
												250	90	3	4.0	630	0.6 MΩ	1050			15	
26	AMPLIFIER	TRIODE	1.5V AC FIL.	4D MED. 4 PIN	4 11/16	1 9/16	1.5V 1.05A	8.1	3.5	2.2	AMPLIFIER	135		10	5.5	8.3	7600	1100	0.08	8800		26
												180		14.5	6.2	8.3	7300	1150	0.18	10500		
27	DETECTOR AMPLIFIER	TRIODE	HEATER	5A SM. 5 PIN	4 1/4	1 9/16	1.75	3.3	3.5	3.0	BIAS DETECTOR	250		30								27
											AMPLIFIER	135		9	4.5	9	9000	1000	0.08	13000		
												180		13.5	5.0	9	9000	1000	0.165	19000		
												250		21	5.2	9	9250	975	0.30	34000		
35/51	DETECTOR AMPLIFIER	REMOTE CUT-OFF TETRODE	HEATER	5E MED. 5 PIN	5 1/32	1 13/16	1.75	0.007 MAX.	5.0	10.5	1ST. DETECTOR	250	90	7								35/51
											AMPLIFIER	180	90	3	6.3	305	0.3 MΩ	1020			50	
												250	90	3	6.5	420	0.4 MΩ	1050			50	
45	POWER AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	4 11/16	1 13/16	1.50				SINGLE AMPLIFIER	180		31.5	31	3.5	1650	2125	0.82	2700		45
												275		56	36	3.5	1700	2050	2.0	4600		
											PUSH PULL (AVG. 2 TUBES)	300		70	44 TO 70				10	9000		
46	POWER AMPLIFIER	DOUBLE GRID TRIODE	FIL.	5C MED. 5 PIN	5 3/8	2 1/16	1.75				CLASS A	250		33	22	5.6	2400	2350	1.25	6400		46
											CL. B (AVG. 2 TUBES)	300		0	8 TO 70				16	5000 min		
												400		0	12 TO 75				20	5500 min		
47	POWER AMPLIFIER	PENTODE	FIL.	5B MED. 5 PIN	5 3/8	2 1/16	1.75				AMPLIFIER	250	250	16.5	31	150	60000	2500	2.7	7000		47
53	POWER AMPLIFIER	TWIN TRIODE	HEATER	7B MED. 7 PIN 1.6 PIN CIRCLE	4 11/16	1 13/16	2.0				CL. A (PARALLEL CONN.)	294		6	7	35	11000	3200	0.37	35000		53
											COMPLETE CLASS B	250		0	28 TO 50				8	8000		
											(BOTH SECTIONS)	300		0	35 TO 50				10	10000		
55	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	6G SM. 6 PIN	4 7/32	1 9/16	1.0	2.0	2.0	4.0	DIODE DETECTOR	180		13.5	6	8.3	8500	975	0.16	20000		55
											TRIODE AMPLIFIER	250		20	8	8.3	7500	1100	0.35	20000		
56	DETECTOR AMPLIFIER	TRIODE	HEATER	5A SM. 5 PIN	4 1/4	1 9/16	1.0	3.2	3.2	2.2	BIAS DETECTOR	250		20								56
											AMPLIFIER	250		13.5	5.0	13.8	9500	1450	0.26	47000		
57	DETECTOR AMPLIFIER	PENTODE	HEATER	6F SM. 6 PIN	4 11/16	1 9/16	1.0	0.007 MAX.	5.0	6.5	DETECTOR	250	100	3.8						0.25 MΩ		57
											AMPLIFIER	250	100	3	2.0	2000	2.0 MΩ	1225			7	
58	DETECTOR AMPLIFIER	REMOTE CUT-OFF PENTODE	HEATER	6F SM. 6 PIN	4 11/16	1 9/16	1.0	0.007 MAX.	5.0	6.5	1ST. DETECTOR	250	100	10								58
											AMPLIFIER	250	100	3	8.2	1280	0.8 MΩ	1600			50	
59	POWER AMPLIFIER	TRIPLE GRID	HEATER	7A MED. 7 PIN 1.6 PIN CIRCLE	5 3/8	2 1/16	2.0				CLASS A TRIODE	250		28	26	6	2400	2600	1.25	5000		59
											CLASS A PENTODE	250	250	18	35	100	40000	2500	3	6000		
											CL. B TRIODE (AV. 2 TUBES)	400		0	25 TO 75				20	6000 min		
2A3	POWER AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	5 3/8	2 1/16	2.5				SINGLE AMPLIFIER	250		45	60	4.2	800	5250	3.5	2500		2A3
2A3H			HEATER	4Q			2.8				CLASS AB (2 TUBES)	300	SELF BIAS	62	80 TO 100				10	5000		2A3H
												300	FIXED BIAS	62	80 TO 150				15	3000		
2A5	POWER AMPLIFIER	PENTODE	HEATER	6B MED. 6 PIN	4 11/16	1 13/16	1.75				PENTODE	250	250	16.5	34	220	0.1 MΩ	2300	3	7000		2A5
											*2 GR. TO PL. CLASS AB TRIODE 2 TUBES	350		38	42 TO 90				18	8000		
2A6	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	6G SM. 6 PIN	4 17/32	1 9/16	0.8	2.0	2.0	4.0	DIODE DETECTOR	250		2	0.8	100	91000	1100				2A6
											TRIODE AMPLIFIER	250		2	0.1					0.25 MΩ		
2A7	OSCILLATOR DETECTOR	HEPTODE	HEATER	7C SM. 7 PIN	4 17/32	1 9/16	0.8	1.0	7	5.5	OSC. SECTION	250		50000Ω	4					R_g 0.02 MΩ		2A7
								0.3	8.5	9	MIXER SECTION	250	100	3	4		0.36 MΩ	520	CONVERSION CONDUCTANCE		45	
2B7	DETECTOR AMPLIFIER	DUPLEX DIODE PENTODE	HEATER	7D SM. 7 PIN	4 17/32	1 9/16	0.8	0.010 MAX.	3.3	10	DIODE DETECTOR	100	100	3	5.8	285	0.3 MΩ	950			17	2B7
											R.F. AMPLIFIER	250	100	3	6.0	800	0.8 MΩ	1000			17	
											DIO. PT. & A.F. AMPLIFIER	250	50	4.5	0.65					0.20 MΩ		

TYPE NO.	DESCRIPTION USE	TYPE	CATHODE	BASING SEE VIEW AT RIGHT	MAX. DIMEN. OVERALL HEIGHT	DIAM.	FIL. CURR. AMPS.	CAPACITANCES MICRO-MICRO-FARADS GRID PLATE	INPUT	OUTPUT	OPERATING CONDITIONS AND CHARACTERISTICS WHEN USED AS	PLATE SUPPLY VOLTS	SCR. GRID VOLTS	GRID BIAS VOLTS	PLATE CURRENT M.A.	AMPL. FACTOR	PLATE RESIS. OHMS	MUT. COND. UMHOS	MAX. UNDIST. OUTPUT WATTS	RECOMM. LOAD RES. OHMS	CUT-OFF BIAS VOLTS	TYPE NO.
d											**3.3 VOLT DC DETECTOR AND AMPLIFIER TUBES**											
20	POWER AMPLIFIER	TRIODE	FIL.	4D SM. 4 PIN	4 1/8	1 3/16	0.132				AMPLIFIER	135		22.5	6.5	3.3	6300	525	0.110	6500		20
V-99 X-99	DETECTOR AMPLIFIER	TRIODE	FIL.	4E SM. 4 PIN / 4D SMALL 4 PIN	3 1/2 / 4 1/8	1 1/16 / 1 3/16	0.063	3.3	2.5	2.5	GRID LEAK DETECT.	45		+A	1.5	6.6	17000	370				V-99 X-99
											AMPLIFIER	90		4.5	2.5	6.6	15500	425	0.007	15500		
22	AMPLIFIER	SCREEN GRID	FIL.	4K MED. 4 PIN	5 5/32	1 13/16	0.132	0.020 MAX.	3.3	12	R.F. AMPLIFIER	135	67.5	1.5	3.7	160	0.32 MΩ	500			7.5	22
											AUDIO AMPLIFIER	180	22.5	0.75	0.3	350	2.0 MΩ	175		0.25 MΩ		
e											**5.0 VOLT DC DETECTOR AND AMPLIFIER TUBES**											
12A	AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	4 11/16	1 13/16	0.25	8.0	4.0	2.0	AMPLIFIER	135		9.0	6.2	8.5	5100	1650	0.13	9000		12A
												180		13.5	7.7	8.5	4700	1800	0.285	10700		
71A	POWER AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	4 11/16	1 13/16	0.25				AMPLIFIER	135		27.0 29.5	17.3	3.0	1820	1650	0.40	3000		71A
												180		40.5 43.0	20	3.0	1750	1700	0.79	4800		
200A	DETECTOR	Cs VAPOR TRIODE	FIL.	4D MED. 4 PIN	4 11/16	1 13/16	0.25	8.5	3.2	2.0	GRIDLEAK DETECT.	45		-A	1.5	20	30000	670				200A
01A	DETECTOR AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	4 11/16	1 13/16	0.25	8.1	3.1	2.2	GRID LEAK DETECT.	45		+A	1.8	8.0	12000	670				01A
											AMPLIFIER	90		4.5	2.5	8.0	11000	725	0.015	25000		
												135		9	3.0	8.0	10000	800	0.055	20000		
40	DETECTOR AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	4 11/16	1 13/16	0.25	8.8	3.4	1.5	BIAS DETECTOR	180		4.5	0.1					0.25 MΩ		40
											AUDIO AMPLIFIER	180		3	0.2	30	0.15 MΩ	200		0.25 MΩ		
f											**6.3 VOLT AC OR DC DETECTOR AND AMPLIFIER TUBES**											
36	DETECTOR AMPLIFIER	TETRODE	HEATER	5E SM. 5 PIN	4 17/32	1 9/16	0.30	0.007 MAX.	3.7	9.2	DETECTOR	180	67.5	6						0.25 MΩ		36
											AMPLIFIER	100	55	1.5	1.8	470	0.55 MΩ	850			7	
												250	90	3	3.2	595	0.55 MΩ	1080			7	
37	DETECTOR AMPLIFIER	TRIODE	HEATER	5A SM. 5 PIN	4 1/4	1 9/16	0.30	2.0	3.5	2.2	BIAS DETECTOR	180		20								37
											AMPLIFIER	90		6	2.5	9.2	11500	800	0.03	17500		
												250		18	7.5	9.2	8400	1100	0.34	20000		
38	POWER AMPLIFIER	PENTODE	HEATER	5F SM. 5 PIN	4 17/32	1 9/16	0.30				AMPLIFIER	100	100	9	7	80	85000	950	0.27	13500		38
												135	135	13.5	9	100	0.1 MΩ	1000	0.525	13500		
												250	250	25	22	120	0.1 MΩ	1200	2.5	10000		
39/44	DETECTOR AMPLIFIER	REMOTE CUT-OFF PENTODE	HEATER	5F SM. 5 PIN	4 17/32	1 9/16	0.30	0.007 MAX.	3.5	10	1st. DETECTOR	90 TO 250	90	7 APP.								39/44
											AMPLIFIER	90	90	3	5.6	360	0.375 MΩ	960			42	
												250	90	3	5.8	1050	1.0 MΩ	1050			42	
41	POWER AMPLIFIER	PENTODE	HEATER	6B SM. 6 PIN	4 1/4	1 9/16	0.40				AMPLIFIER	180	180	13.5	18.5	150	81000	1850	1.5	9000		41
												250	250	18	32	150	68000	2200	3.4	7600		
42	POWER AMPLIFIER	PENTODE	HEATER	6B MED. 6 PIN	4 11/16	1 11/16	0.70				PENTODE AMPLIFIER	250	250	16.5	34	185	79000	2350	3	7000		42
												315	315	22	42	230	0.1 MΩ	2300	5	7000		
								#2 GR TO PL. CLASS AB TRIODE (2 TUBES)				350		38	42 TO 90				18	8000		
52	POWER AMPLIFIER	DOUBLE GRID TRIODE	FIL.	5C MED. 5 PIN	4 11/16	1 13/16	0.30				CLASS A	110		0	43	5.2	1750	3000	1.5	2000		52
											CL. B (AVG. 2 TUBES)	150		0	8 TO 40				6	9000 MIN.		

75	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	6G SM. 6 PIN	4 9/32	1 9/16	0.30	2.0	2.0	4.0	DIODE DETECTOR	250		2	0.8	100	91000	1100				75
											TRIODE AMPLIFIER	250		2	0.1					0.25 MΩ		
76	OSCILLATOR AMPLIFIER	TRIODE	HEATER	5A SM. 5 PIN	4 1/8	1 9/16	0.30	2.8	3.5	2.5	OSCILLATOR	90		0								76
											AMPLIFIER	250		13.5	5.0	13.8	9500	1450	0.25	50000		
77	DETECTOR AMPLIFIER	PENTODE	HEATER	6F SM. 6 PIN	4 17/32	1 9/16	0.30	0.007 MAX.	4.0	11	DETECTOR	250	100	4.3								77
											AMPLIFIER	250	100	3	2.3	1500	1.5 MΩ	1250			7.5	
78	DETECTOR AMPLIFIER	REMOTE CUT-OFF PENTODE	HEATER	6F SM. 6 PIN	4 17/32	1 9/16	0.30	0.007 MAX.	4.0	11	1st. DETECTOR	250	100	10								78
											AMPLIFIER	250	100	3	7.0	1160	0.8 MΩ	1450			42	
79	POWER AMPLIFIER	TWIN TRIODE	HEATER	6H SM. 6 PIN	4 9/32	1 9/16	0.60				COMPLETE CL. B (BOTH SECTIONS)	250		0	20 TO 60				8	14000		79
85	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	6G SM. 6 PIN	4 17/32	1 9/16	0.30	2.0	2.0	4.0	DIODE DETECTOR	180		13.5	6	8.3	8500	975	0.16	20000		85
											TRIODE AMPLIFIER	250		20	8	8.3	7500	1100	0.35	20000		
89	POWER AMPLIFIER	TRIPLE GRID	HEATER	6F SM. 6 PIN	4 17/32	1 9/16	0.40				CLASS A TRIODE	250		31	32	4.7	2600	1800	0.9	5500		89
											CL. A PENTODE	250	250	25	32	125	70000	1800	3.4	6750		
											CL. B TRIODE (2 TUBES)	250		0	6 TO 50				5	10000		
6A3	POWER AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	5 3/8	2 1/16	1.0				SINGLE AMPLIFIER	250		45	60	4.2	800	5250	3.3	2500		6A3
											CLASS AB (2 TUBES)	325	[illegible]	63	[illegible]				10	5000		
												325	[illegible]	63	140 TO 200				15	3000		
6A4 LA	POWER AMPLIFIER	PENTODE	FIL.	5B MED. 5 PIN	4 11/16	1 13/16	0.30				AMPLIFIER	180	180	12	22	100	45000	2200	1.4	8000		6A4 LA
											CL. AB (2 TUBES)	230	230	22	32	SELF BIAS R_{c1} = 700 Ω			4.2	16000		
12A5	POWER AMPLIFIER	PENTODE	HEATER	7F SM. 7 PIN	4 1/8	1 9/16	6.3V 0.6A / 12.6V 0.3A	8.5	4	2	AMPLIFIER	100	100	15	17			1700	0.65	4500		12A5
												180	180	27	38			2300	2.6	3800		
6A6	POWER AMPLIFIER	TWIN TRIODE	HEATER	7B MED. 7 PIN 1 6 PIN CIRCLE	4 11/16	1 9/16	0.8				CL. A (PARALLEL CONN.)	294		6	7	35	11000	3200	0.37	35000		6A6
											COMPLETE CLASS B (BOTH SECTIONS)	250		0	28 TO 50				8	8000		
												300		0	35 TO 50				10	10000		
6A7	OSCILLATOR DETECTOR	HEPTODE	HEATER	7C SM. 7 PIN	4 9/32	1 9/16	0.30	1.0	7	5.5	OSC. SECTION	250		50000Ω	4					R_{c2} 0.02 MΩ		6A7
								0.3	8.5	9	MIXER SECTION	250	100	3	4		0.36 MΩ	520 CONVERSION CONDUCTANCE			45	
6B5	POWER AMPLIFIER	DUAL TRIODE	HEATER	6D MED. 6 PIN	4 11/16	1 13/16	0.80				SINGLE TUBE	300		0	45 6	58	24000	2400	4	7000	15	6B5
												*325		0	51 9				5.2	7000	17	
											TWO TUBES	*250		0	33 6.5				8.5	10000	38	
												*325		0	51 9				13.5	10000	42	
6B7	DETECTOR AMPLIFIER	DUPLEX DIODE PENTODE	HEATER	7D SM. 7 PIN	4 9/32	1 9/16	0.30	0.010 MAX.	3.3	10	DIODE DETECTOR	100	100	3	5.8	265	0.3 MΩ	950			17	6B7
											R.F. AMPLIFIER	250	100	3	6.0	800	0.8 MΩ	1000			17	
											DIODE DET. & A.F. AMPLI.	250	50	4.5	0.65					0.2 MΩ		
6C6	DETECTOR AMPLIFIER	PENTODE	HEATER	6F SM. 6 PIN	4 15/16	1 9/16	0.30	0.007 MAX.	5.2	6.8	DETECTOR	250	100	3.8						0.25 MΩ		6C6
											AMPLIFIER	250	100	3	2.0	2500	2.0 MΩ	1225			7	
6D6	DETECTOR AMPLIFIER	REMOTE CUT-OFF PENTODE	HEATER	6F SM. 6 PIN	4 15/16	1 9/16	0.30	0.007 MAX.	5.2	6.8	1st DETECTOR	250	100	10								6D6
											AMPLIFIER	250	100	3	8.2	1280	0.8 MΩ	1600			50	
6E5	TUNING INDICATOR	CATHODE RAY	HEATER	6R SM. 6 PIN	4 1/2	1 9/16	0.30				TUNING INDICATOR	WITH PLATE 250V (THRU 1 MΩ), TARGET 250V. I_b = 0.25 ma & SHADOW ANGLE IS 90° AT E_c = 0V; ANGLE IS ZERO AT E_c = -8V APPROX.										6E5
6E6	POWER AMPLIFIER	TWIN TRIODE	HEATER	7B MED. 7 PIN	4 11/16	1 13/16	0.60				COMPLETE CLASS A (BOTH SECTIONS)	180		20	23	6.0	2150	2800	0.75	15000		6E6
												250		27.5	36	6.0	1750	3400	0.6	14000		
6F7	OSCILLATOR DETECTOR	TRIODE PENTODE	HEATER	7E SM. 7 PIN	4 9/32	1 9/16	0.30	2.0	2.5	3.0	TRIODE AMPLIFIER	100		3	3.5	8	18000	500				6F7
								0.008 MAX.	3.2	12	PENTODE 1st DET.	250	100	10								
											PENTODE AMPLI.	250	100	3	6.5	900	0.85 MΩ	1100			50	
6G5	TUNING INDICATOR	CATHODE RAY	HEATER	6R SM. 6 PIN	4 1/4	1 9/16	0.30				TUNING INDICATOR	WITH PLATE 250V (THRU 1 MΩ), TARGET 250V. I_b = 0.25 ma AND SHADOW ANGLE IS 90° AT E_c = 0V; ANGLE IS ZERO AT E_c = -22V APPROX										6G5
6N7G	POWER AMPLIFIER	TWIN TRIODE	HEATER	8B OCTAL AND SHELL 8 PIN	4 5/8	1 13/16	0.80								SAME	AS	6A6					6N7G

9 7.5 VOLT AC POWER AMPLIFIER TUBES

10	POWER AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	5 5/8	2 1/16	1.25				AMPLIFIER	350		31	16	8.0	5150	1550	0.9	11000		10
												425		39	18	8.0	5000	1600	1.6	10000		
50	POWER AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	6 1/4	2 7/16	1.25				AMPLIFIER	350		63	45	3.8	1900	2000	2.4	4100		50
												450		84	55	3.8	1800	2100	4.6	4350		

TYPE NO.	DESCRIPTION: USE	DESCRIPTION: TYPE	DESCRIPTION: CATHODE	BASING SEE VIEW AT RIGHT	MAX. DIMEN. OVERALL: HEIGHT	MAX. DIMEN. OVERALL: DIAM.	FIL. CURR. AMPS.	CAPACITANCES MICRO-MICRO-FARADS: GRID PLATE	INPUT	OUTPUT	OPERATING CONDITIONS AND CHARACTERISTICS: WHEN USED AS	PLATE SUPPLY VOLTS	SCR. GRID VOLTS	GRID BIAS VOLTS	PLATE CURRENT M.A.	AMPL. FACTOR	PLATE RESIS. OHMS	MUT. COND. μMHOS	MAX. UNDIST. OUTPUT WATTS	RECOMM. LOAD RES. OHMS	CUT-OFF BIAS VOLTS	TYPE NO.
h											**SERIES FILAMENT POWER AMPLIFIER TUBES**											
43	POWER AMPLIFIER	PENTODE	HEATER	6B MED. 6 PIN	4 11/16	1 13/16	0.3 A 25 V				AMPLIFIER	95 160	95 135	15 20	20 38	90 100	45000 40000	2000 2500	0.9 2.75	4500 5000		43
48	POWER AMPLIFIER	PENTODE	HEATER	6B MED. 6 PIN	5 3/8	2 1/16	0.4 A 30 V				AMPLIFIER	96 125	96 100	19 22.5	52 56			3800 3900	2.0 2.5	1500 1500		48
12A7	POWER AMPL. & RECTIFIER	PENTODE & DIODE	HEATER	7K SM. 7 PIN	4 17/32	1 9/16	0.3 A 12.6 V				AMPLIFIER RECTIFIER	135 125 RMS	135	13.5	9 30 MA.	100	0.1 MA	975	0.55	13500		12A7

TYPE NO.	USE	TYPE	CATHODE	BASING	HEIGHT	DIAM.	FIL. AMPS.	FIL. VOLTS	MAX. AC VOLTS PER ANODE	MAX. DC OUT. CURR. (AMPS)	MAX. PEAK INVERSE VOLTS	MAX. PEAK PLATE CURR.	MIN. CHOKE BEFORE FILTER CONDENSER	MAX. HEATER CATHODE BIAS	MAX. DC VOLTS DEL. TO FILTER (NOM.): CONDENSER INPUT	MAX. DC VOLTS DEL. TO FILTER (NOM.): CHOKE INPUT	TYPE NO.
j								**RECTIFIER TUBES**									
BA	FULL WAVE	GAS	COLD	4J MED. 4 PIN	5 5/8	2 7/16	—	—	350	0.350	1000	1.00				300	BA
BH	FULL WAVE	GAS	COLD	4J MED. 4 PIN	4 5/8	1 13/16	—	—	350	0.125	1000	0.40				300	BH
BR	HALF WAVE	GAS	COLD	4H MED. 4 PIN	3 3/4	1 9/16	—	—	300	0.050	850	0.20			300		BR
1-V	HALF WAVE	HIGH VACUUM	HEATER	4G SM. 4 PIN	4 1/4	1 9/16	0.3	6.3	350	0.050	1000	0.20		500	400		1-V
80	FULL WAVE	HIGH VACUUM	FIL.	4C MED. 4 PIN	4 11/16	1 13/16	2.0	5.0	350 400 550	0.125 0.110 0.135	1000 1100 1500	0.40 0.35 0.30	20 HENRIES		300 370	225 275 425	80
81	HALF WAVE	HIGH VACUUM	FIL.	4B MED. 4 PIN	6 1/4	2 7/16	1.25	7.5	700	0.085	2000	0.60 FULL WAVE			750	550	81
82	FULL WAVE	MERCURY VAPOR	FIL.	4C MED. 4 PIN	4 5/16	1 13/16	3.0	2.5	500	0.125	1400	0.40			590	425	82
83	FULL WAVE	MERCURY VAPOR	FIL.	4C MED. 4 PIN	5 1/8	2 1/16	3.0	5.0	500	0.250	1400	0.80			530	400	83
83V	FULL WAVE	HIGH VACUUM	HEATER	4L MED. 4 PIN	4 5/16	1 13/16	2.0	5.0	500	0.250	1400	0.80			510	385	83V
84	FULL WAVE	HIGH VACUUM	HEATER	5D SM. 5 PIN	4 1/4	1 9/16	0.5	6.3	350	0.050	1000	0.20		500	425	300	84
0Z3	FULL WAVE	GAS	COLD	5N SM. 5 PIN	4 1/8	1 9/16	—	—	350	0.075 max. 0.030 min.	1250	0.20			425	300	0Z3
5Y3	FULL WAVE	HIGH VACUUM	FIL.	5L OCTAL MED. SHELL 8 PIN	4 5/16	1 13/16	2.0	5.0		SAME	AS	TYPE	80				5Y3
5Z3	FULL WAVE	HIGH VACUUM	FIL.	4C MED. 4 PIN	5 1/8	2 1/16	3.0	5.0	500	0.250	1400	0.70			480	360	5Z3
6Z4/84	FULL WAVE	HIGH VACUUM	HEATER	5D SM. 5 PIN	4 1/8	1 9/16	0.5	6.3	350	0.060	1000	0.20		500	425	300	6Z4/84
12Z3	HALF WAVE	HIGH VACUUM	HEATER	4G SM. 4 PIN	4 1/8	1 9/16	0.3	12.6	250	0.060	700	0.30		350	310		12Z3
25Z5	RECTIFIER DOUBLER	HIGH VACUUM	HEATER	6E SM. 6 PIN	4 1/8	1 9/16	0.3	25.0	125	0.200 0.100	700 700	0.40 0.20	RECTIFIER DOUBLER	350	200 120		25Z5

K — RAYTHEON SPECIAL "GLASS" TYPE TUBES

(SUPPLIED FOR REPLACEMENT USE ONLY)

TYPE NO.	FILAMENT VOLTS	FILAMENT AMPS.	BASING VIEW	BASING SHIELD CONN. TO	CHARACTERISTICS, USE & DIMEN.	TYPE NO.
25/0S	2.5	1.35	5D	CATHODE PIN	APPROXIMATELY 40 MA ON EACH DIODE PLATE AT 50 VOLTS DC DUPLEX DIODE DETECTOR	25/0S
15	2.0	0.22	5F	NO SHIELD	USE & DIM. SIMILAR TO 36 EXCEPT MU. COND. [illegible] PLATE CURR. [illegible] PLATE VOLTS = 135 MAX. SCREEN GRID [illegible] MAX. CONT. GRID BIAS [illegible]	15
24S	2.5	1.75	5E	CATHODE PIN	SAME AS 24A	24S
27S	2.5	1.75	5E	CATHODE PIN	SAME AS 27	27S
35/51 S	2.5	1.75	5E	CATHODE PIN	SAME AS 35	35/51S
55S	2.5	1.0	6G	CATHODE PIN	SAME AS 55	55S
56S	2.5	1.0	5A	CATHODE PIN	SAME AS 56	56S
57S	2.5	1.0	6F	CATHODE PIN	SAME AS 57	57S
57AS	6.3	0.4	6F	CATHODE PIN	SAME AS 6C6, EXCEPT HEATER AMPS	57A S
58S	2.5	1.0	6F	CATHODE PIN	SAME AS 58	58S
58A S	6.3	0.4	6F	CATHODE PIN	SAME AS 6D6. EXCEPT HEATER AMPS.	58A S
75 S	6.3	0.3	6G	CATHODE PIN	SAME AS 75	75 S
85A S	6.3	0.3	6G	HEATER PIN ADJACENT TO CATHODE PIN	SIMILAR TO 85 EXCEPT AMP. FACTOR = 20; MUTUAL COND. = 1250; PLATE CURRENT = 5.5 MA; PLATE VOLTS = 250; GRID BIAS = [illegible]	85A S
182 B	5.0	1.25	4D	NO SHIELD	SIM. TO 45 EXCEPT FIL. VOLTS, AMP FACTOR = 5.0 MUTUAL COND. = 1500 PLATE CURRENT = 18 MA, PLATE VOLTS = 250, GRID BIAS = -35	182 B
183	5.0	1.25	4D	NO SHIELD	SIMILAR TO 45 EXCEPT FIL. VOLTS, AMP FACTOR = 3.2, MUT. COND. = [illegible] PLATE CURR. = [illegible] MA, PLATE VOLTS = 250, GRID BIAS = [illegible]	183
485	3.0	1.25	5A	NO SHIELD	SIMILAR TO 27 EXCEPT HEATER VOLTS, AMP FACTOR = 12.8, MUT. COND. = 1500, PLATE CURR. = 5.2 MA, PLATE VOLTS = 180, GRID BIAS = [illegible]	485
950	2.0	0.12	5K	NO SHIELD	SIMILAR TO 33 EXCEPT FIL. AMPS., PLATE CURRENT [illegible], POWER OUTPUT = 0.45 WATTS, PLATE & SCREEN VOLTS = 135 MAX., CONTROL GRID BIAS = -16.5	950

TYPE NO.	FILAMENT VOLTS	FILAMENT AMPS.	BASING VIEW	BASING SHIELD CONN. TO	CHARACTERISTICS, USE & DIMEN.	TYPE NO.
2A7 S	2.5	1.0	7C	CATHODE PIN	SAME AS 2A7	2A7 S
2Z2/G84	2.5	1.5	4B	NO SHIELD	SIMILAR TO 1-V	2Z2/G84
6A7 S	6.3	0.3	7C	CATHODE PIN	SAME AS 6A7	6A7 S
6B7 S	6.3	0.3	7D	CATHODE PIN	SAME AS 6B7	6B7 S
6C7	6.3	0.3	7G	SEPARATE PIN	SAME AS 85A-S	6C7
6D7	6.3	0.3	7H	SEPARATE PIN	SAME AS 6C6	6D7
6E7	6.3	0.3	7H	SEPARATE PIN	SAME AS 6D6	6E7
6F7S	6.3	0.3	7E	CATHODE PIN	SAME AS 6F7	6F7 S
6Y5	6.3	0.8	6J	SEPARATE PIN	SIMILAR TO 6Z4/84	6Y5
6Z5	12.6/6.3	0.4/0.8	6K	NO SHIELD	SIMILAR TO 6Z4/84	6Z5

TUBE SOCKET CONNECTION CHART – FOR "GLASS" TYPE TUBES

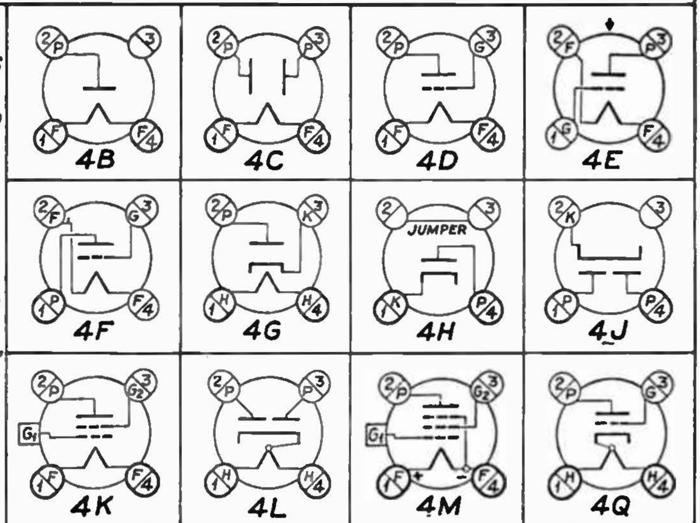
(LOOKING UP AT BOTTOM OF SOCKET)

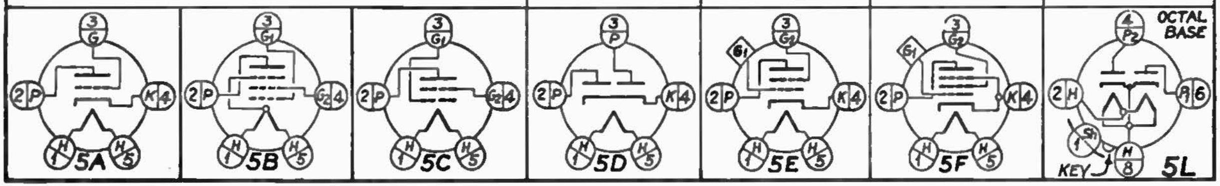
Oct. 1936

THE SOCKET CONNECTIONS SHOWN IN THIS CHART ARE THOSE WHICH APPEAR WHEN LOOKING UP AT THE SOCKET CONNECTIONS FROM THE BOTTOM. THE Nº1 TERMINAL IS THE LEFT HAND FILAMENT CONNECTION AND THE OTHER PINS ARE NUMBERED IN CLOCKWISE ROTATION

THE LETTER SYMBOLS USED IN THIS CHART ARE AS FOLLOWS.

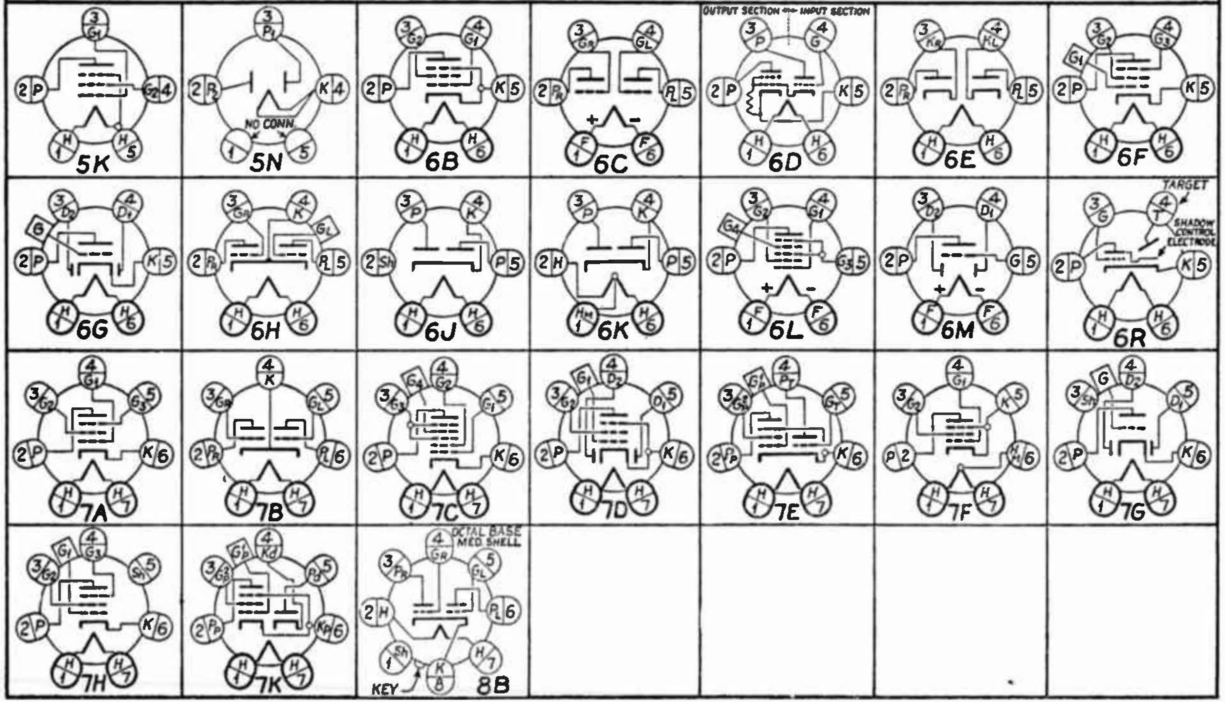
F-Filament; H-Heater; P-Plate; K-Cathode; G_1-Control Grid; G_2-Screen Grid; G_3-Suppressor grid; G_L-Grid (triode); G_R Grid (triode-2); G_T-Triode grid; G_P-pentode grid; P-plate; P_L-plate (triode-1); P_R-plate (triode-2); P_T triode plate; P_P-pentode plate; D_1-one diode plate; D_2 other diode plate; □-top cap. (NOTE: these do not apply to tube bases 6L and 7C.)





TUBE SOCKET CONNECTION CHART – FOR "GLASS" TYPE TUBES (Continued)

OCT. 1936



BASE PIN POSITIONS & PIN NUMBERS FOR OCTAL-BASED "ALL-METAL" AND "G" TYPE TUBES

STANDARD-"GLASS" TUBE EQUIVALENTS OF "ALL-METAL" & "G" TUBES

Revised Oct. 1937

"All-Metal" or "G" Tube Type No.	Equivalent "Standard" Glass Type	PIN POSITIONS AND NUMBERS								Top Cap
		1	2	3	4	5	6	7	8	
0Z4 (Metal)		Sh	NC	P1	—	P2	—	NC	K	—
1C7G	1C6	NC	F+	P	G3-G5	G1	G2	F-	NC	G4
1D5G	1A4	NC	F+	P	G2	NC	—	F-G3	NC	G1
1D7G	1A6	NC	F+	P	G3-G5	G1	G2	F-	NC	G4
1E5G	1B4	NC	F+	P	G2	NC	—	F-G3	NC	G1
1E7G	Twin 1F4	NC	F+	P (R)	G1 (R)	G1 (L)	P (L)	F-	G2	—
1F5G	1F4	NC	F+	P	G2	G1	—	F-	NC	—
1G5G		NC	F	P	G2	G1	—	F-G3	—	—
1H4G	30	NC	F+	P	NC	G1	—	F-	NC	—
1H6G	1B5	NC	F+	P	D (+)	D (—)	G	F-	NC	—
1J6G*	19	NC	F+	P (R)	G (R)	G (L)	P (L)	F-	NC	—
5T4 (Metal)		NC	F	—	P	—	P	—	F	—
5U4G	5Z3	NC	F	NC	P	NC	P	NC	F	—
5V4G	83V	NC	H	NC	P2	NC	P1	NC	H-K	—
5W4 (Metal)		Sh	F	—	P2	—	P1	—	F	—
5W4G		NC	F	NC	P	NC	P	NC	F	—
5X4G	5Z3	NC	NC	P2	NC	P1	NC	F	F	—
5Y3G	80	NC	F	—	P2	—	P1	—	F	—
5Y4G	80	NC	NC	P2	NC	P1	NC	F	F	—
5Z4 (Metal)		Sh	H	—	P2	—	P1	—	H-K	—
6A5G		NC	H	P	NC	G	NC	H	K and Center Ht'r.	—
6A8 (Metal)		Sh	F	P	G3-G5	G1	G2	H	K	G4
6A8G	6A7	NC	H	P	G3-G5	G1	G2	H	K	G4
6B4G	6A3	NC	H	P	NC	G	NC	F	NC	—
6B6G	75	NC	H	P	D (R)	D (L)	—	H	K	G1
6B8 (Metal)		Sh	H	P	D2	D1	G2	H	K	G1
6B8G	6B7	NC	H	P	D2	D1	G2	H	K	G1
6C5 (Metal)		Sh	H	P	—	G	—	H	K	—
6C5G		Sh	H	P	—	G	—	H	K	—
6C8G		NC	H	P (R)	K (R)	G (L)	P (L)	H	K (L)	G (R)
6D8G		NC	H	P	G3-G5	G1	G2	H	K	G4
6F5 (Metal)		Sh	H	—	P	—	—	H	K	G1
6F5G		NC	H	—	P	—	—	H	K	G1
6F6 (Metal)		Sh	H	P	G2	G1	—	H	K-G3	—
6F6G	42	NC	H	P	G2	G1	—	H	K-G3	—
6F8G		NC	H	P (R)	K (R)	G (L)	P (L)	H	K (L)	G (R)
6H6 (Metal)		Sh	H	P2	K2	P1	—	H	K	—
6H6G		Sh	H	P2	K2	P1	—	H	K1	—
6J5 (Metal)		Sh	H	P	NC	G	—	H	K	—
6J5G	76 (Mu 20)	NC	H	P	NC	G	—	H	K	—

—Continued on next page.

"G" at the end of a Tube Type No. indicates that it is a "metal-glass" tube. "—" indicates pin omitted. "NC" indicates no lead wire in pin. * Filament current 0.240 Ampere.

(Cont'd over)

BASE PIN POSITIONS & PIN NUMBERS, AND STANDARD-"GLASS" TUBE EQUIVALENTS, OF OCTAL-BASED "ALL-METAL" & "G" TUBES—*(Cont'd)*

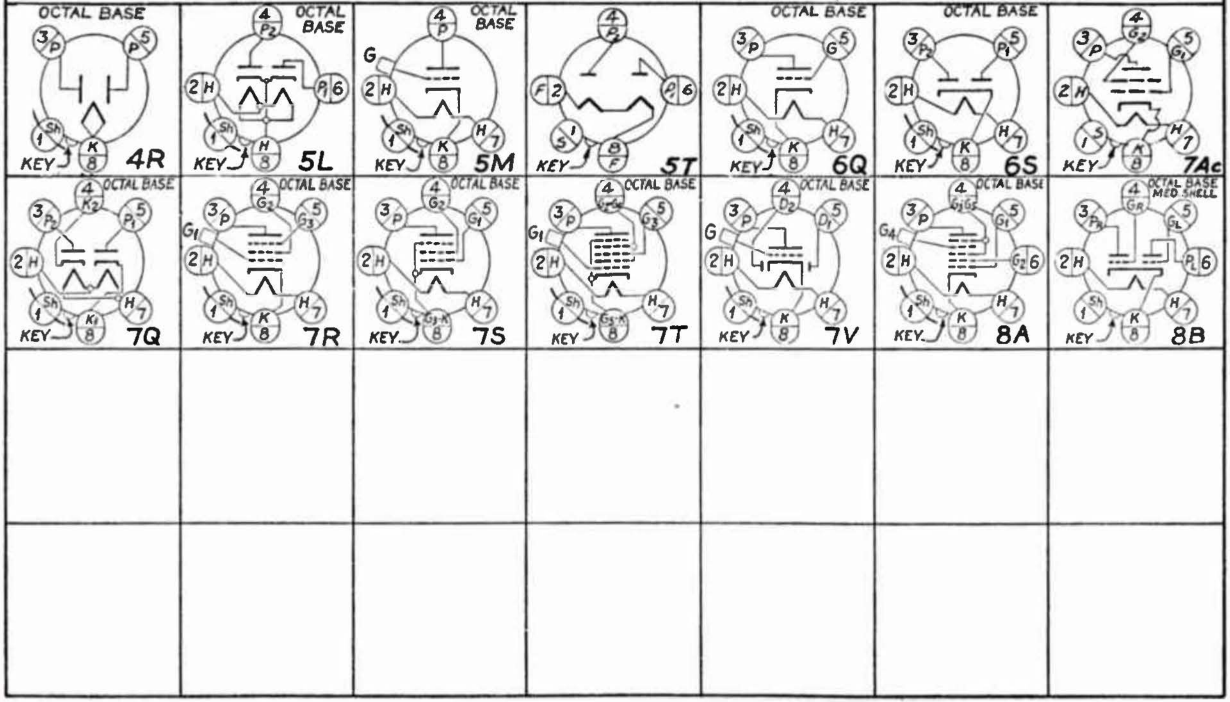
"All-Metal" or "G" Tube Type No.	Equivalent "Standard" Glass Type	PIN POSITIONS AND NUMBERS								Top Cap
		1	2	3	4	5	6	7	8	
6J7 (Metal)		Sh	H	P	G2	G3	—	H	K	G1
6J7G	77	Sh	H	P	G2	G3	—	H	K	G1
6K5G	(High Mu Triode)	NC	H	P	NC	NC	—	H	K	G1
6K6G	41	NC	H	P	G2	G1	—	H	K-G3	—
6K7 (Metal)		Sh	H	P	G2	G3	—	H	K	G1
6K7G	78	NC	H	P	G2	G3	—	H	K	G1
6L5G		NC	H	P	—	G	—	H	K	—
6L6 (Metal)		Sh	H	P	G2	G1	—	H	K	—
6L6G		NC	H	P	G2	G1	—	H	K	—
6L7 (Metal)		Sh	H	P	G2-G4	G3	—	H	K-G5	G1
6L7G		NC	H	P	G2-G4	G3	—	H	K-G5	G1
6N6G	6B5	NC	H	P (out)	P (in)	G (in)	—	H	K (out)	—
6N6 MG	6B5	NC	H	P (out)	P (in)	G (in)	—	H	K (out)	—
6N7 (Metal)		Sh	H	P1	G1	G2	P2	H	K	—
6N7G	6A6	NC	H	P1	G1	G2	P2	H	K	—
6P7G	6F7	NC	H	H	P (P)	G2	P (T)	G (T)	K-G3	G1
6Q7 (Metal)		Sh	H	P	D (R)	D (L)	—	H	K	G1
6Q7G		NC	H	P	D (R)	D (L)	—	H	K	G1
6R7 (Metal)		Sh	H	P	D (R)	D (L)	—	H	K	G1
6R7G		NC	H	P	D (R)	D (L)	—	H	K	G1
6S7G		NC	H	P	G2	G3	—	H	K	G1
6T7G		NC	H	P	D2	D1	—	H	K	G
6U7G	6D6	NC	H	P	G2	G3	—	H	K	G1
6V6 (Metal)		Sh	H	P	G2	G1	—	H	K	—
6V6G		NC	H	P	G2	G1	—	H	K	—
6V7G	85	NC	H	P	D2	D1	—	H	K	G
6W5G		NC	H	P2	—	P1	—	H	K	
6X5 (Metal)		Sh	H	P1	—	P2	—	H	K	—
6X5G	84	NC	H	P1	—	P2	—	H	K	—
6Y6G		NC	H	P	G2	G1	—	H	K	—
6Y7G	79	NC	H	P (R)	G (R)	G (L)	P (L)	H	K	—
6ZY5G		NC	H	P2	—	P1	—	H	K	—
6Z7G		NC	H	P (R)	G (R)	G (L)	P (L)	H	K	—
25A6 (Metal)		Sh	H	P	G2	G1	—	H	K-G3	—
25A6G	43	NC	H	P	G2	G1	—	H	K-G3	—
25A7G		K (D)	H	P (P)	G2	G1	P (D)	H	K (D)	
25B6G		NC	H	P	G2	G1	—	H	K-G3	—
25L6		Sh	H	P	G2	G1	—	H	K	—
25L6G		NC	H	P	G2	G1	—	H	K	—
25Z6 (Metal)		Sh	H	P2	K2	P1	—	H	K1	—
25Z6G	25Z5	NC	H	P2	K2	P1	—	H	K1	—

"G" at the end of a Tube Type No. indicates that it is a "metal-glass" tube. "—" indicates pin omitted. "NC" indicates no lead wire in pin. * Filament current 0.240 Ampere.

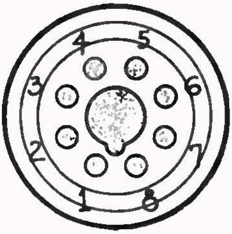
Courtesy RAYTHEON PRODUCTION CORP.

TUBE SOCKET CONNECTION CHART - FOR "ALL METAL" TYPE TUBES

(LOOKING UP AT BOTTOM OF SOCKET)



responding metal types, and in general they are interchangeable with them* except in those cases where there is not sufficient space on the chassis for them, or where it is necessary to provide



An 8-pin "Octal" tube base (*viewed from the bottom*) showing the eight pins, their numbers, and the guiding lug at the center.

them with external shields). This table also lists those ordinary "glass" type tubes which are equivalent to some "all-metal" and "G" type tubes.

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*Note: For type numbers of equivalent "glass" and "G" type tubes, see table on page 10-5.

PIN POSITIONS, PIN NUMBERS & BASE TERMINAL ARRANGEMENTS FOR OCTAL AND "G" TYPE TUBES

Type Tube	Equivalent Glass Type	PIN POSITIONS AND NUMBERS								Top Cap
		1	2	3	4	5	6	7	8	
0Z4 (Metal)		Sh	NC	P1	—	P2	—	NC	K	—
1C7G	1C6	NC	F+	P	G3-G5	G1	G2	F−	NC	G4
1D5G	1A4	NC	F+	P	G2	NC	—	F−G3	NC	G1
1D7G	1A6	NC	F+	P	G3-G5	G1	G2	F−	NC	G4
1E5G	1B4	NC	F+	P	G2	NC	—	F−G3	NC	G1
1E7G	Twin 1F4	NC	F+	P (R)	G1 (R)	G1 (L)	P (L)	F−	G2	—
1F5G	1F4	NC	F+	P	G2	G1	—	F−	NC	—
1H4G	30	NC	F+	P	NC	G1	—	F−	NC	—
1H6G	1B5	NC	F+	P	D (+)	D (—)	G	F−	NC	—
1J6G*	19	NC	F+	P (R)	G (R)	G (L)	P (L)	F−	NC	—
5V4G	83V	NC	H	NC	P2	NC	P1	NC	H-K	—
5W4 (Metal)		Sh	F	—	P2	—	P1	—	F	—
5X4G	5Z3	NC	NC	P2	NC	P1	NC	F	F	—
5Y3G	80	NC	F	—	P2	—	P1	—	F	—
5Y4G	80	NC	NC	P2	NC	P1	NC	F	F	—
5Z4 (Metal)		Sh	H	—	P2	—	P1	—	H-K	—
6A8 (Metal)		Sh	F	P	G3-G5	G1	G2	H	K	G4
6A8G	6A7	NC	H	P	G3-G5	G1	G2	H	K	G4
6B4G	6A3	NC	H	P	NC	G	NC	F	NC	—
6B6G	75	NC	H	P	D (R)	D (L)	—	H	K	G1
6C5 (Metal)		Sh	H	P	—	G	—	H	K	—
6C5G		Sh	H	P	—	G	—	H	K	—
6F5 (Metal)		Sh	H	—	P	—	—	H	K	G1
6F5G		NC	H	—	P	—	—	H	K	G1
6F6 (Metal)		Sh	H	P	G2	G1	—	H	K-G3	—
6F6G	42	NC	H	P	G2	G1	—	H	K-G3	—
6H6 (Metal)		Sh	H	P2	K2	P1	—	H	K	—
6H6G		Sh	H	P2	K2	P1	—	H	K1	—
6J5G	76 (Mu 20)	NC	H	P	NC	G	—	H	K	—
6J7 (Metal)		Sh	H	P	G2	G3	—	H	K	G1
6J7G	77	Sh	H	P	G2	G3	—	H	K	G1
6K5G	(High Mu Triode)	NC	H	P	NC	NC	—	H	K	G1
6K6G	41	NC	H	P	G2	G1	—	H	K-G3	—
6K7 (Metal)		Sh	H	P	G2	G3	—	H	K	G1
6K7G	78	NC	H	P	G2	G3	—	H	K	G1
6L6 (Metal)		Sh	H	P	G2	G1	—	H	K	—
6L6G		NC	H	P	G2	G1	—	H	K	—
6L7 (Metal)		Sh	H	P	G2-G4	G3	—	H	K-G5	G1
6L7G		NC	H	P	G2-G4	G3	—	H	K-G5	G1
6N6G	6B5	NC	H	P (out)	P (in)	G (in)	—	H	K (out)	—
6N6 MG	6B5	NC	H	P (out)	P (in)	G (in)	—	H	K (out)	—
6N7 (Metal)		Sh	H	P1	G1	G2	P2	H	K	—
6N7G	6A6	NC	H	P1	G1	G2	P2	H	K	—
6P7G	6F7	NC	H	H	P (P)	G2	P (T)	G (T)	K-G3	G1
6Q7 (Metal)		Sh	H	P	D (R)	D (L)	—	H	K	G1
6Q7G		NC	H	P	D (R)	D (L)	—	H	K	G1
6R7 (Metal)		Sh	H	P	D (R)	D (L)	—	H	K	G1
6R7G		NC	H	P	D (R)	D (L)	—	H	K	G1
6X5 (Metal)		Sh	H	P1	—	P2	—	H	K	—
6X5G	81	NC	H	P1	—	P2	—	H	K	—
25A6 (Metal)		Sh	H	P	G2	G1	—	H	K-G3	—
25A6G	43	NC	H	P	G2	G1	—	H	K-G3	—
25Z6 (Metal)		Sh	H	P2	K2	P1	—	H	K1	—
25Z6G	25Z5	NC	H	P2	K2	P1	—	H	K1	—

(MG) indicates "metal-glass" tubes. "—" indicates pin omitted. "NC" indicates no lead wire in pin.
* Filament current 0.240 Ampere.

Courtesy RAYTHEON PRODUCTION CORP.

REPLACEMENT TUBE TYPES

Raytheon tubes can be used as replacement for tubes of other manufacturers as follows:

A. Tube types having the same RMA type numbers (with a letter between two numbers—as 6A7) are interchangeable.

B. On standard tube types with two or three figure type numbers, the last two figures form the significant type numbers regardless of letter prefixes. For example, the Raytheon 45 will replace UX-245, CX-345, or SX-245 tubes.

C. Types differing in number by the suffix letters "A", "G", "H", "MG", or "V" are interchangeable in general, regardless of this letter. For example the 12A may replace a 112 or 112A, the 2A3 may replace a 2A3H, and the 6A8 may replace a 6A8G or 6A8MG.

D. Shielded types distinguished by the added letter "S" may or may not be interchangeable with types without this letter suffix.

E. Exceptions to the above tubes are types RA-1, RE-1, SO-1, KR-20, KR-22, 43MG, 59B, 182B, Kellog 401, 482A, 482B, 484, 484A and 25Z5MG which do not correspond with types 1-V 20, 22, etc. The 01A (201A) is not interchangeable with the 1-V or 1, and the WX-12 is not interchangeable with the 12A (112A). Types 57AS, 58AS, 183, and 485 may be replaced only by Raytheon tubes bearing the same full type numbers.

F. The following table lists the obsolete and non-standard tube types with the standard types which normally may be used for replacement.

TYPE NO.	NORMALLY REPLACEABLE BY RAYTHEON TYPES	TYPE NO.	NORMALLY REPLACEABLE BY RAYTHEON TYPES	TYPE NO.	NORMALLY REPLACEABLE BY RAYTHEON TYPES
2A3H	2A3	64 ••	36	224A	24A
5Y3 •••	5Z4 •••	64A	36	226	26
5Z4MG	5Z4	65 ••	39/44	227	27
6A8MG	6A8	65A	39/44	230	30
6B6	6Q7	67 ••	37	231	31
6B6MG	6Q7	67A	37	232	32
6C5MG	6C5	68 ••	38	233	33
6F5MG	6F5	68A	38	234	34
6F6MG	6F6	83	83V	235	35/51
6H6MG	6H6	84	6Z4/84	236	36
6J7MG	6J7	G-84	2Z2/G84	238	38
6K7MG	6K7	95	2A5	239	39/44
6L7MG	6L7	KR-98	6Z4/84	240	40
6Q7MG	6Q7	112	12A	245	45
6R7MG	6R7	112A	12A	247	47
6X5MG	6X5	120	20	250	50
6Z3	1-V	171	71A	280	80
25Z5MG	25Z6	171A	71A	280M	83V
14Z3	12Z3	171AC	71A	281	81
1	1-V	171B	71A	288	83V
RE-1	80	182A	71A	C-299	V-99
RE-2	81	182B	183 †	X-299	X-99
SO-2	50	V-199	V-99	482A	71A
G-2	2S/4S	X-199	X-99	551	35/51
G-2S	2S/4S	200	200A	585	50
G-4	2S/4S	201	01A	586	50
G-4S	2S/4S	201A	01A	P-861	6Z4/84
KR-5	6A4/LA	210	10	951	1B4/951
WD-12	WX-12	213	80	986	83
25S	1B5/25S	216	81	AD	1-V
27-HM	56	216B	81	AF	82
43MG	25A6	220	20	AG	83
44	39/44	222	22	LA	6A4/LA
		224	24A	PZ	47
				PZH	2A5

••• See chart for difference in output voltage. •• In automobile sets only. † Where both power tubes are changed together.

Oct. 1936

Courtesy RAYTHEON PRODUCTION CORP.

TUBE INDEX

CHARACTERISTIC DATA AND SOCKET-CONNECTION CHARTS FOR STANDARD-"GLASS", "ALL-METAL", AND "G" TYPE TUBES

The *Tube Index* which follows enables one to tell exactly in which lettered section of the *Tube Characteristic Chart* the data for any tube type will be found. This makes it possible to find tube data in the main chart quickly.

TUBE INDEX **SHOWING WHERE ANY TYPE TUBE WILL BE FOUND IN THE TUBE CHARACTERISTIC DATA CHART ON THE FOLLOWING PAGES**

Tube Type Number	Will be Found in Section	Tube Type Number	Will be Found in Section	Tube Type Number	Will be Found in Section	Tube Type Number	Will be Found in Section
00A	E	1E5G	B	2A5	C	5X4G	J
01A	E	1E7G	B	2A6	C	5Y3G	J
0Z4	J	1F4	B	2A7	C	5Y4G	J
0Z4G	J	1F5G	B	2A7S	K	5Z3	J
1A4T	B	1F6	B	2B7	C	5Z4	J
1A6	B	1F7G	B	2S/4S	K	6A3	F
1B4/951	B	1G5G	B	2Z2/G84	K	6A4/LA	F
1B5/25S	B	1H4G	B	5T4	J	6A5G	F
1C6	B	1H6G	B	5U4G	J	6A6	F
1C7G	B	1J6G	B	5V4G	J	6A7	F
1D5G	B	1V	J	5W4	J	6A7S	K
1D7G	B	2A3	C	5W4G	J	6A8	F

Tube Index Continued on Page 11-13

The *Tube Characteristic Chart* presented on the pages which follow lists, by tube types, the operating characteristics of all the standard detector, amplifier and rectifier tubes of the "glass", "all-metal and "G" types which are now in use. The headings of the various columns are clearly specified. The Socket Connection chart which follows this shows the base terminal connections as they appear when looking up at the bottom of the sockets. The reference numbers under the drawings refer to the "basing" arrangements specified in the fifth column from the *left* in the "Characteristics" chart. These charts are published here by courtesy of the *RAYTHEON PRODUCTION CORP.*

RAYTHEON
RADIO TUBE CHARACTERISTIC DATA CHART

(Revised Oct. 1937)

TYPE NO.	DESCRIPTION			BASING DATA	MAX. DIMEN. OVERALL		FIL. CURR. AMPS.	CAPACITANCES MICRO-MICRO-FARADS			OPERATING CONDITIONS AND CHARACTERISTICS												TYPE NO.
	USE	TYPE	CATHODE		HEIGHT	DIAM.		GRID PLATE	INPUT	OUTPUT	WHEN USED AS	PLATE SUPPLY VOLTS	SCR. GRID VOLTS	GRID BIAS VOLTS	PLATE CURRENT M.A.	SCREEN CURRENT M.A.	AMPL. FACTOR	PLATE RESIS. OHMS	MUT. COND. UMHOS	MAX. UNDIST. OUTPUT WATTS	RECOMM. LOAD RES. OHMS	CUT-OFF BIAS VOLTS	
(A) 1.1 VOLT DC DETECTOR AND AMPLIFIER TUBES																							
WD-11	DETECTOR AMPLIFIER	TRIODE	FIL.	W SPEC. 4 PIN	4 3/8	1 3/16	0.25	3.3	2.5	2.5	GRID LEAK DETECTOR	45		+F									WD-11
WX-12				4D MED. 4 PIN	4 11/16	1 7/16					AMPLIFIER	90 135		-4.5 -10.5	2.5 3.0		6.6 6.6	15500 15000	425 440	0.007 0.040	15000 15000		WX-12
(B) 2.0 VOLT DC DETECTOR AND AMPLIFIER TUBES																							
1A4T	DETECTOR AMPLIFIER	TETRODE	FIL.	4E SM. 4 PIN	4 17/32	1 9/16	0.06	.017° Max.	4.6	11	AMPLIFIER	180	67.5	-3	2.3	0.8	720	0.96M	750			-20	1A4T
1A6	OSCILLATOR DETECTOR	HEPTODE	FIL.	6L SM. 6 PIN	4 17/32	1 9/16	0.06	0.8	5	6	OSCILLATOR SECTION	135		A50000 Ω D20000 Ω	2.3								1A6
								0.25°	10.5	9	MIXER SECTION	(A) 180 (D) 180	67.5 45	-3 -3	1.3 1.2	2.4 1.6		0.5 M 0.6 M	300 250	CONV. COND.	Rc2 0.02M	-22.5 -11	
[illegible]	DETECTOR AMPLIFIER	PENTODE	FIL.	4M SM. 4 PIN	4 17/32	1 7/16	0.06	0.007° Max.	5.0	11	1ST. DETECTOR AMPLIFIER	180 180	67.5 67.5	-6 -3	 1.7	 0.6	 375	 1.5 M	 650			 -8	[illegible]
1B5 25S	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	FIL.	6M SM. 6 PIN	4 3/16	1 9/16	0.06	3.0	2.0	3.0	DIODE DETECTOR TRIODE AMPLIFIER	135		-3	0.8		20.0	35000	575				1B5 25S
1C6	OSCILLATOR DETECTOR	HEPTODE	FIL.	6L SM. 6 PIN	4 17/32	1 9/16	0.12	1.5 0.3°	6 10	6 10	OSCILLATOR SECTION MIXER SECTION	180 180	 67.5	0.05M Ω -3	3.3 1.5	 2.0		 0.75M	 325 CONV. COND.		 Rc2 0.02M	 -14	1C6
1C7G	OSCILLATOR DETECTOR	HEPTODE	FIL.	7Z OCTAL 8 PIN	4 15/32	1 9/16	0.12	1.5° 0.3°	7° 11°	7° 14°	OSCILLATOR MIXER	SEE DATA FOR TYPE 1C6											1C7G
1D5G	DETECTOR AMPLIFIER	PENTODE	FIL.	5R OCTAL 7 PIN	4 15/32	1 9/16	0.06	0.007° Max.	6.2°	17°	AMPLIFIER	180 90	67.5 67.5	-3 -3	2.3 2.2	0.8 0.9	750 425	1.0 M 0.6 M	750 720			-20 -22	1D5G
1D7G	OSCILLATOR DETECTOR	HEPTODE	FIL.	7Z OCTAL 8 PIN	4 15/32	1 9/16	0.06	1.2° 0.3°	6.5° 11°	9.5° 14°	OSCILLATOR MIXER	SEE DATA FOR TYPE 1A6											1D7G
1E5G	DETECTOR AMPLIFIER	PENTODE	FIL.	5R OCTAL 7 PIN	4 15/32	1 9/16	0.06	0.007° Max.	6.2°	17°	DET. OR AMP.	SEE DATA FOR TYPE 1B4											1E5G
1E7G	POWER AMPLIFIER	TWIN PENTODE	FIL.	8C OCTAL 8 PIN	4 1/4	1 9/16	0.24				PUSH-PULL PWR. AMP. ONE PENTODE SEC.	135 135	135 135	-7.5 -4.5	6.5 7.5	2.0 2.1	 350	 220000	 1600	.850	24000		1E7G
1F4	POWER AMPLIFIER	PENTODE	FIL.	5K MED. 5 PIN	4 11/16	1 13/16	0.12				POWER AMPLIFIER	135	135	-4.5	8.0	2.6	340	0.2 M	1700	0.34	16000		1F4
1F5G	POWER AMPLIFIER	PENTODE	FIL.	6X OCTAL 7 PIN	4 5/8	1 19/32	0.12				POWER AMPLIFIER	SEE DATA FOR TYPE 1F4											1F5G
1F6	DETECTOR AMPLIFIER	DUPLEX DIODE PENTODE	FIL.	6W SMALL 6 PIN	4 17/32	1 9/16	0.06	0.007°	6.0	6	DIODE DET-AF AMP. DIODE DET-AF AMP.	180 135	67.5 135	-1.5 -2.0	2.0 0.42	0.6	650 GAIN = 2	1000000	650	 Rc2 0.8 MEG.	 0.25 MEG	-12	1F6
1F7G	DETECTOR AMPLIFIER	DUPLEX DIODE PENTODE	FIL.	7AD OCTAL 8 PIN	4 15/32	1 9/16	0.06	0.007° Max.	6.0	9	DIODE DETECTOR TRIODE AMPLIFIER	SEE DATA FOR TYPE 1F6											1F7G
1G5G	POWER AMPLIFIER	PENTODE	FIL.	6X OCTAL 7 PIN	4 5/8	1 13/16	0.12				POWER AMPLIFIER	90	90	-6	8.5	2.7	200	133000	1500	.300	8500		1G5G
1H4G	DETECTOR AMPLIFIER	TRIODE	FIL.	5S OCTAL 7 PIN	4 1/8	1 9/16	0.06	5	6.0	3	BIAS DETECTOR AMPLIFIER	SEE DATA FOR TYPE 30											1H4G
1H6G	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	FIL.	7AA OCTAL 8 PIN	4 1/8	1 9/16	0.06	3.0	2.0	3	DIODE DETECTOR TRIODE AMPLIFIER	SEE DATA FOR TYPE 1B5											1H6G
1J6G	POWER AMPLIFIER	TWIN TRIODE	FIL.	7AB OCTAL 8 PIN	4 1/4	1 9/16	0.24				POWER AMPLIFIER	SEE DATA FOR TYPE 19 EXCEPT FIL. CURRENT											1J6G
15	DETECTOR OSCILLATOR	PENTODE	HEATER	5F SMALL 5 PIN	4 17/32	1 9/16	0.22	0.01° Max.	2.4	7.6	R. F. AMPLIFIER	135 67.5	67.5 67.5	-1.5 -1.5	1.85 1.85	0.3 0.3	600 450	0.8MEG. 0.63MEG.	750 710			-8 -6	15
19	POWER AMPLIFIER	TWIN TRIODE	FIL.	6C SM. 6 PIN	4 3/16	1 9/16	0.26				COMPLETE CL. B (BOTH SECTIONS)	135 135		0 -3	10 to 35 4 to 35					2.1 1.9	10000 10000		19

○ INDICATES "CAPACITY VALUE" WITH TUBE EXTERNALLY SHIELDED — FOR ALL CHARTS

30	DETECTOR AMPLIFIER	TRIODE	FIL.	4D SM. 4 PIN	4 3/16	1 9/16	0.06	6.0	3.9	2.1	BIAS DETECTOR AMPLIFIER	180 135 180		-18 -9 -13.5	 3 3.1		 9.3 6.3	 12500 10300	 [illegible] 930	 0.07 0.11	 20000 20000		30
31	POWER AMPLIFIER	TRIODE	FIL.	4D SM. 4 PIN	4 3/16	1 9/16	0.13				AMPLIFIER	135 180		-22.5 -30	8 12.3		3.8 3.8	4100 3600	925 1050	0.185 0.375	7000 5700		31
32	DETECTOR AMPLIFIER	TETRODE	FIL.	4K MED. 4 PIN	5 1/32	1 13/16	0.06	0.015* Max.	5.3	10.5	DETECTOR AMPLIFIER	180 135 180	67.5 67.5 67.5	-6 -3 -3	.2 1.7 1.7	 0.4 Max. 0.4 Max.	 610 780	 .95M 1.2 M	 640 650		0.25M	 -9 -9	32
33	POWER AMPLIFIER	PENTODE	FIL.	5K MED. 5 PIN	4 11/16	1 13/16	0.26				AMPLIFIER	180 135	180 135	-18 -13.5	22.0 14.5	5.0 3.0	90 70	55000 50000	1700 1450	1.4 0.70	6000 7000		33
34	DETECTOR AMPLIFIER	REMOTE CUT-OFF PENTODE	FIL.	4M MED. 4 PIN	5 1/32	1 13/16	0.06	0.015* Max.	6.0	11.5	1ST DETECTOR AMPLIFIER	135 to 180 135 180	67.5 67.5 67.5	-5 -3 -3	 2.8 2.8	 1.0 1.0	 360 620	 0.6 M 1.0 M	 600 620			 -27 -27	34
49	POWER AMPLIFIER	DOUBLE GRID* TRIODE	FIL.	5C MED. 5 PIN	4 11/16	1 13/16	0.12				CLASS A AMPLIFIER CL. B (AVG. 2 TUBES)	135 180		-20 0	5.7 4 to 30		4.5	4000	1125	0.17 3.0	11000 9000MIN		49

(C) 2.5 VOLT AC DETECTOR AND AMPLIFIER TUBES

2A3 2A3H	POWER AMPLIFIER	TRIODE	FIL. HEATER	4D MED. 4 PIN 4Q MED. 4 PIN	5 3/8	2 1/16	2.5 2.5				SINGLE AMPLIFIER CLASS AB (2 TUBES)	250 300 300	 SELF BIAS FIXED BIAS	-45 -62 -62	60 80 to 100 80 to 150		4.2	800	5250	3.5 10 15	2500 5000 3000		2A3 2A3H
2A5	POWER AMPLIFIER	PENTODE	HEATER	6B MED. 6 PIN	4 11/16	1 13/16	1.75				PENTODE #2 GR. TO PL. CLASS AB TRIODE 2 TUBES	250 350	250	-16.5 -38	34 62 to 90	6.5	220	0.1M	2200	3 18	7000 6000		2A5
2A6	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	6G SM. 6 PIN	4 17/32	1 9/16	0.8	1.7	2.0	3.5	DIODE DETECTOR TRIODE AMPLIFIER	250 250		-2 -2	1.0 0.1		100	91000	1100		 0.25M		2A6
2A7	OSCILLATOR DETECTOR	HEPTODE	HEATER	7C SM. 7 PIN	4 17/32	1 9/16	0.8	1.0 0.1	7 8.5	5.5 9	OSC. SECTION MIXER SECTION	250 250	 100	50000 -3	4 4	 3.2		 0.36M	 520 CONV. COND.		Rc 2 0.02M	 -45	2A7
2B7	DETECTOR AMPLIFIER	DUPLEX DIODE PENTODE	HEATER	7D SM. 7 PIN	4 17/32	1 9/16	0.8	0.007* Max.	3.2	10	DIODE DETECTOR R.F. AMPLIFIER DIO. DET. & A.F. AMPLIFIER	100 250 250	100 100 [illegible]	-3 -3 -4.5	5.8 6.0 0.65	1.7 1.5	285 640	0.3 M 0.8 M	950 1000		 0.25M	-17 -17	2B7
24A	DETECTOR AMPLIFIER	TETRODE	HEATER	5E MED. 5 PIN	5 1/32	1 13/16	1.75	0.007* Max.	5.0*	10.5*	DETECTOR A.F. AMPLIFIER R.F. AMPLIFIER	250 250 180 250	45 25 90 90	-5 -1 -3 -3	 0.5 4.0 4.0	 1.7 Max. 1.7 Max.	 1000 400 630	 2.0 M 0.4 M 0.6 M	 500 1000 1050		0.25M 0.1 M	 -15 -15	24A
26	AMPLIFIER	TRIODE	1.5V AC FIL.	4D MED. 4 PIN	4 11/16	1 13/16	1.5V 1.05A	8.1	3.5	2.2	AMPLIFIER BIAS DETECTOR	135 180		-10 -14.5	5.5 6.2		8.3 8.3	7600 7300	1100 1150	0.08 0.18	8800 10500		26
27	DETECTOR AMPLIFIER	TRIODE	HEATER	5A SM. 5 PIN	4 3/16	1 9/16	1.75	3.3	3.5	1.0	AMPLIFIER	135 180 250		-9 -13.5 -21	4.5 5.0 5.2		9 9 9	9000 9000 9250	1000 1000 975	0.08 0.165 0.30	13000 19000 36000		27
35 51	DETECTOR AMPLIFIER	REMOTE CUT-OFF TETRODE	HEATER	5E MED. 5 PIN	5 1/32	1 13/16	1.75	0.007* Max.	5.00	10.5	1ST DETECTOR AMPLIFIER	250 180 250	90 90 90	-7 APP. -3 -3	 6.3 6.5	 2.5 Max. 2.5 Max.	 305 420	 0.3 M 0.4 M	 1020 1050			 -50 -50	35 51
45	POWER AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	4 11/16	1 13/16	1.50				SINGLE AMPLIFIER PUSH PULL (AVG. 2 TUBES)	180 275 300		-31.5 -56 -70	31 36 66 to 70		3.5 3.5	1650 1700	2125 2050	0.82 2.0 10	2700 4600 4000		45
46	POWER AMPLIFIER	DOUBLE GRID TRIODE	FIL.	5C MED. 5 PIN	5 3/8	2 1/16	1.75				CLASS A PWR. AMP. CL. B (AVG. 2 TUBES)	250 300 400		-33 0 0	22 8 to 70 12 to 75		5.6	2400	2350	1.25 16 20	6400 5200MIN 5800MIN		46
47	POWER AMPLIFIER	PENTODE	FIL.	5B MED. 5 PIN	5 3/8	2 1/16	1.75				POWER AMPLIFIER CL. A (PARALLEL CONN.)	250	250	-16.5	31	6.0	150	60000	2500	2.7	7000		47
53	POWER AMPLIFIER	TWIN TRIODE	HEATER	7B MED. 7 PIN LG. PIN CIRCLE	4 11/16	1 13/16	2.0				COMPLETE CLASS B (BOTH SECTIONS)	250 300		0 0	28 to 50 35 to 50					8 10	8000 10000		53
55	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	6G SM. 6 PIN	4 17/32	1 9/16	1.0	1.7	2.0	3.5	DIODE DETECTOR TRIODE AMPLIFIER	180 250		-13.5 -20	6 8		8.3 8.3	8500 7500	975 1100	0.16 0.35	20000 20000		55
56	DETECTOR AMPLIFIER	TRIODE	HEATER	5A SM. 5 PIN	4 3/16	1 9/16	1.0	3.2	3.2	2.2	BIAS DETECTOR AMPLIFIER	250 250		-20 -13.5	 5.0		 13.8	 9500	 1450	 0.26	 [illegible]		56
57	DETECTOR AMPLIFIER	PENTODE	HEATER	5F SM. 6 PIN	4 15/16	1 9/16	1.0	0.007* Max.	5.0	6.5	DETECTOR AMPLIFIER	250 250	100 100	-4.5 -3	 2.0	 0.5	 2500	 2.3 M	 1225		0.5M		57
58	DETECTOR AMPLIFIER	REMOTE CUT-OFF PENTODE	HEATER	6F SM. 6 PIN	4 15/16	1 9/16	1.0	0.007* Max.	5.0	6.5	1ST. DETECTOR AMPLIFIER	250 250	100 100	-10 -3	 8.2	 2.0	 1280	 0.8 M	 1600			 -50	58
59	POWER AMPLIFIER	TRIPLE GRID	HEATER	7A MED. 7 PIN LG. PIN CIRCLE	5 3/8	2 1/16	2.0				CLASS A TRIODE AMP. CLASS A PENTODE AMP. CL. B TRIODE (AV. 2 TUBES)	250 250 400	 250	-28 -18 0	26 35 25 to 75	 9.0	6 100	2300 40000	2600 2500	1.25 3 20	5000 6000 6000MIN		59

TYPE NO.	DESCRIPTION: USE	DESCRIPTION: TYPE	DESCRIPTION: CATHODE	BASING DATA	MAX DIMEN OVERALL: HEIGHT	MAX DIMEN OVERALL: DIAM	FIL. CURR AMPS	CAPACITANCES MICRO-MICRO-FARADS: GRID PLATE	CAPACITANCES: INPUT	CAPACITANCES: OUTPUT	OPERATING CONDITIONS AND CHARACTERISTICS: WHEN USED AS	PLATE SUPPLY VOLTS	SCR. GRID VOLTS	GRID BIAS VOLTS	PLATE CURRENT M.A.	SCREEN CURRENT M.A.	AMPL. FACTOR	PLATE RESIS OHMS	MUT COND UMHOS	MAX. UNDIST OUTPUT WATTS	RECOMM. LOAD RES OHMS	CUT-OFF BIAS VOLTS	TYPE NO
(D) 3.3 VOLT D C DETECTOR AND AMPLIFIER TUBES																							
20	POWER AMPLIFIER	TRIODE	FIL.	4D SM. 4 PIN	4 1/8	1 3/16	0.132				AMPLIFIER	135		-22.5	6.5		3.3	6300	525	0.110	6500		20
V-99	DETECTOR AMPLIFIER	TRIODE	FIL.	4E SPEC. 4 PIN	3 1/2	1 1/16	0.063	3.3	2.5	2.5	GRID LEAK DETECTOR	45		+F	1.5		6.6	17800	370				V-99
X-99				4D SMALL 4 PIN	4	1 3/16					AMPLIFIER	90		-4.5	2.5		6.6	15500	425	0.007	16500		X-99
22	AMPLIFIER	SCREEN GRID	FIL.	4K MED. 4 PIN	5 1/32	1 13/16	0.132	0.020 MAX.	3.1	12	R. F. AMPLIFIER	135	67.5	-1.5	3.7	1.3	160	0.32 M*	500			-7.5	22
											AUDIO AMPLIFIER	180	22.5	-0.75	0.3		3?0	2.0 M*	175		0.25M*		
(E) 5.0 VOLT D C DETECTOR AND AMPLIFIER TUBES																							
01A	DETECTOR AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	4 11/16	1 13/16	0.25	8.1	3.1	2.2	GRID LEAK DETECTOR	45		+F	1.0								01A
											AMPLIFIER	90 135		-4.5 -9	2.5 3.0		8.0 8.0	11000 10000	725 800	0.015 0.055	25000 20000		
12A	AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	4 11/16	1 13/16	0.25	7.5	4.0	3.0	AMPLIFIER	135		-9.0	6.2		8.5	5100	1650	0.13	9000		12A
												180		-13.5	7.7		8.5	4700	1800	0.285	10700		
40	DETECTOR AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	4 11/16	1 13/16	0.25	8.8	3.4	1.5	BIAS DETECTOR	180		-4.5	0.1						0.25M*		40
											AUDIO AMPLIFIER	180		-3	0.2		30	0.15 MEG.	200		0.25M*		
71A	POWER AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	4 11/16	1 13/16	0.25				AMPLIFIER	135		DC AC -27.0-29.5	17.3		3.0	1820	1650	0.40	3000		71A
												180		-40.5-43.0	20		3.0	1750	1700	0.79	4800		
200A	DETECTOR	CS VAPOR TRIODE	FIL.	4D MED. 4 PIN	4 11/16	1 13/16	0.25	6.5	3.2	2.0	GRID LEAK DETECTOR	45		+F	1.5		20	30000	690				200A
(F) 6.3 VOLT A C-D C DETECTOR AND AMPLIFIER TUBES																							
6A3	POWER AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	5 1/8	2 1/16	1.0				SINGLE AMPLIFIER	250		-45	60		4.2	800	5250	3.2	2500		6A3
											CLASS AB (2 TUBES)	325 325	SELF BIAS FIXED BIAS	-68 -68	80 to 100 80 to 150					10 15	5000 3000		
6A4/LA	POWER AMPLIFIER	PENTODE	FIL.	5B MED. 5 PIN	4 11/16	1 13/16	0.3				AMPLIFIER	180	180	-12	22	3.9	100	45500	2200	1.4	8000		6A4/LA
											CL. AB. (2 TUBES)	230	230	-22	32		SELF BIAS R = 700*			4.2	16000		
6A5G	POWER AMPLIFIER	TRIODE	HEATER	6T OCTAL 8 PIN	5 5/16	2 1/16	1.25				CLASS A AMPLIFIER	250		-45	60		4.2	800	5250	3.75	2500		6A5G
											CLASS AB PUSH PULL	325	SELF	-68	80-100					10	[illegible]		
											CLASS AB PUSH PULL	325	FIXED	-68	80-150					15	[illegible]		
6A6	POWER AMPLIFIER	TWIN TRIODE	HEATER	7B MED. 7 PIN LG. PIN CIRCLE	4 11/16	1 9/16	0.8				CL. A (PARALLEL CONN.)	294		-6	7		35	11000	3200	0.37	35000		6A6
											COMPLETE CLASS B (BOTH SECTIONS)	250 300		0 0	26 to 50 35 to 50					8 10	8000 10000		
6A7	OSCILLATOR DETECTOR	HEPTODE	HEATER	7C SM. 7 PIN	4 17/32	1 9/16	0.3	1.0*	7	5.5	OSC. SECTION	250		50000*	4						[illegible]		6A7
								0.1	8.5	7	MIXER SECTION	250	100	-3	4	3.2		0.36M*	[illegible]	[illegible]		-45	
6A8	OSCILLATOR DETECTOR	HEPTODE	HEATER	8A OCTAL 8 PIN	4 1/8	2 1/16	0.3	0.2	6.5	5	OSC. SECTION	250		50000*	4								6A8
								[illegible]	13	13	MIXER SECTION	250	100	-3	4	3.2		0.36M*	520	[illegible]		-35	
6A8G	OSCILLATOR DETECTOR	HEPTODE	HEATER	8A OCTAL 8 PIN	4 15/32	1 9/16	0.3	1.1*	6.8*	5*	OSCILLATOR SECTION	SEE DATA FOR TYPE 6A8											6A8G
								0.1*	10.0*	10.5*	MIXER SECTION												
6AB5	TUNING INDICATOR	CATHODE RAY	HEATER	6P SMALL 6 PIN	4 1/8	1 3/16	0.15				TUNING INDICATOR	WITH PLATE 135V (THRU 0.25M*). TARGET 135V. I = 0.5 mA. & SHADOW ANGLE IS 90° AT E = 0°; ANGLE IS ZERO AT E = -7.5V APPROX.											6AB5
6B4G	POWER AMPLIFIER	TRIODE	FILAMENT	5S OCTAL 8 PIN	5 5/16	2 1/16	1.0				POWER AMPLIFIER	SEE DATA FOR TYPE 6A3											6B4G
6B5	POWER AMPLIFIER	DUAL TRIODE	HEATER	6D MED. 6 PIN	4 11/16	1 13/16	0.8				SINGLE POWER AMP.	EACH 300 • 325		0 0	OUTPUT 45 51	INPUT 8 9	58	24000	2400	4 5.2	7000 7000	VOLT & AMP 15 17	6B5
											PUSH-PULL (2 TUBES)	• 250 • 325		0 0	66 102	13 18				8.5 13.5	10000 10000	38 42	
6B6G	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	7V OCTAL 7 PIN	4 15/32	1 9/16	0.3	1.3	2.7	4.5	DIODE DETECTOR TRIODE AMPLIFIER	SEE DATA FOR TYPE 75											6B6G
6B7	DETECTOR AMPLIFIER	DUPLEX DIODE PENTODE	HEATER	7D SM. 7 PIN	4 17/32	1 9/16	0.3	0.007* MAX.	3.2	10	DIODE DETECTOR R.F. AMPLIFIER	100 250	100 100	-3 -3	5.8 6.0	1.7 1.5	285 800	0.3M* 0.8M*	950 1000			-17 -37	6B7
											DIO. DET. & A.F. AMPLI.	250	50	4.5	0.65						0.2M*		

6B8	DETECTOR AMPLIFIER	DUPLEX DIODE PENTODE	HEATER	8E OCTAL 8 PIN	• 1/8	1 5/16	0.3	0.005 MAX.	6	9	DIODE DETECTOR PENTODE AMPLIFIER	250	125	-3	10	2.3	800	0.6 MEG.	1325			-21	6B8
6B8G	DETECTOR AMPLIFIER	DUPLEX DIODE PENTODE	HEATER	8E OCTAL 8 PIN	• 15/32	1 9/16	0.3	0.007* MAX.	3.2	10	DIODE DETECTOR PENTODE AMPLIFIER	SEE DATA FOR TYPE 6B7											6B8G
6C5	OSCILLATOR AMPLIFIER	TRIODE	HEATER	6Q OCTAL 6 PIN	2 5/8	1 5/16	0.3	1.8	4.0	13	OSCILLATOR	90		-0									6C5
											AMPLIFIER	250		-8	8		20	10000	2000				
6C5G	OSCILLATOR AMPLIFIER	TRIODE	HEATER	6Q OCTAL 6 PIN	• 1/8	1 9/16	0.3	2.4	4.5	9.5	OSCILLATOR-AMPLIFIER	SEE DATA FOR TYPE 6C5											6C5G
6C6	DETECTOR AMPLIFIER	PENTODE	HEATER	6F SM. 6 PIN	• 15/16	1 9/16	0.3	0.007* MAX.	5.0	6.5	DETECTOR	250	100	[illegible]							5		6C6
											AMPLIFIER	250	100	-3	2.0	0.5	2500	2.0 M*	1225			-7	
6C8G	AMPLIFIER INVERTER	DUAL TRIODE	HEATER	8G OCTAL 8 PIN	• 15/32	1 9/16	0.3	2.5	3.4	3.5	AMPLIFIER-ONE SEC.	250		-4.5	3.1		36	26000	1450				6C8G
											INVERTER-BOTH SECTIONS	250		-3.0	1.0 COMMON CATH. RES. 1500 OHMS EACH PLATE PLATE RES. 0.1 MEG.-FOLLOW'G. GRID RES. 0.1 MEG. OUTPUT 80' RMS.								
								2.4	3.5	3.9		250		-3.0	1.7 COMMON CATH. RES. 900 OHMS EACH PLATE PLATE RES. .05 MEG.-FOLLOW'G GRID RES. 0.1 MEG. OUTPUT 60' RMS.								
6D6	DETECTOR AMPLIFIER	REMOTE CUT-OFF PENTODE	HEATER	6F SM. 6 PIN	• 15/16	1 9/16	0.3	0.007* MAX.	5.0	6.5	1ST. DETECTOR	250	100	-10									6D6
											AMPLIFIER	250	100	-3	8.2	2.0	1280	0.8M*	1600			-50	
6D8G	CONVERTER	HEPTODE	HEATER	8A OCTAL 8 PIN	• 15/32	1 9/16	0.15	1.3°	6°	5.0°	OSCILLATOR SECTION	250 THRU 20000 OHMS		50000*	4.0								6D8G
								0.3°	9.8°	11°	MIXER SECTION	250	100	-3	3.5	3.2		.32	CONV. COND. 500 UMHOS.			-18.5	
6E5	TUNING INDICATOR	CATHODE RAY	HEATER	6R SM. 6 PIN	• 3/16	1 9/16	0.3				TUNING INDICATOR	WITH PLATE 250V (THRU 1 M*). TARGET 250V. I_T =0.25 M.A. A SHADOW ANGLE IS 90° AT E_G =0V; ANGLE IS ZERO AT E_G = -8V APPROX.											6E5
6E6	POWER AMPLIFIER	TWIN TRIODE	HEATER	7B MED. 7 PIN	• 11/16	1 13/16	0.6				COMPLETE CLASS A (BOTH SECTIONS)	180 250		-20 -27.5	23 35		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		6E6
6F5	AMPLIFIER	TRIODE	HEATER	5M OCTAL 5 PIN	• 1/8	1 5/16	0.3				AMPLIFIER	250 250		-2 -1.5	0.9 0.4		100	66000	1500		0.25M*		6F5
6F5G	AMPLIFIER	TRIODE	HEATER	5M OCTAL 5 PIN	• 15/32	1 9/16	0.3	2.0	3.5	3.5	AMPLIFIER	SEE DATA FOR TYPE 6F5											6F5G
6F6	POWER AMPLIFIER	PENTODE	HEATER	7S OCTAL 7 PIN	3 1/8	1 5/16	0.7				PENTODE AMPLI.	250	250	-16.5	34	6.5	[illegible]	80000	2500	3	7000		6F6
											TRIODE (G_2 TO P)	250		-20	31		7.0	2600	2700	0.85	4000		
											CLASS AB PENT. AMPLI. (2 TUBES)	375 375	250 250	340' SELF -26 FIXED	54 34					19 19	10000 10000		
6F6G	POWER AMPLIFIER	PENTODE	HEATER	7S OCTAL 7 PIN	• 5/8	1 3/16	0.7				POWER AMPLIFIER	SEE DATA FOR TYPE 6F6 AND TYPE 42											6F6G
6F7	OSCILLATOR DETECTOR	TRIODE PENTODE	HEATER	7E SM. 7 PIN	• 17/32	1 9/16	0.3	2.0 0.008* MAX.	2.5 3.2	3.0 12	TRIODE SECTION	100		-3	3.5		8	16000	500				6F7
											PENTODE 1ST. DET.	250	100	-10									
											PENTODE AMPLI.	250	100	-3	6.5	1.5	900	0.85M*	1100			-50	
6G5 6H5	TUNING INDICATOR	CATHODE RAY	HEATER	6R SM. 6 PIN	• 3/16	1 9/16	0.3				TUNING INDICATOR	WITH PLATE 250V (THRU 1M*). TARGET 250V: I_T = 0.25 M.A. AND SHADOW ANGLE IS 90° AT E_G =0V ANGLE IS ZERO AT E_G = -22V APPROX.											6G5 6H5
6H6	DETECTOR	TWIN DIODE	HEATER	7Q OCTAL 7 PIN	1 5/8	1 5/16	0.3				DIODE DETECTOR	100 MAX. AC			2 MAX EACH DIODE								6H6
6H6G	DETECTOR	TWIN DIODE	HEATER	7Q OCTAL 7 PIN	• 1/8	1 9/16	0.3				DIODE DETECTOR	SEE DATA FOR TYPE 6H6											6H6G
6J5	AMPLIFIER	TRIODE	HEATER	6Q OCTAL 7 PIN	2 5/8	1 5/16	0.3	3.4	3.4	3.6	AMPLIFIER	250		-8	9.0		20	* 7700	2600				6J5
6J5G	AMPLIFIER	TRIODE	HEATER	6Q OCTAL 7 PIN	• 1/8	1 9/16	0.3	3.0	3.8	3.1	AMPLIFIER	250		-8	9.0		20	7700	2600				6J5G
6J7	DETECTOR AMPLIFIER	PENTODE	HEATER	7R OCTAL 7 PIN	3 1/8	1 5/16	0.3	0.005 MAX.	7	12	DETECTOR	250	100	-4.3							2.5		6J7
											AMPLIFIER	250 250	125 100	-3 -3	8 2	.9 .5	2500	2.0 M*	1550 1225			-3 -7	
6J7G	DETECTOR AMPLIFIER	PENTODE	HEATER	7R OCTAL 7 PIN	• 15/32	1 9/16	0.3	.005* MAX.	4.5	12	DETECTOR-AMPLIFIER	SEE DATA FOR TYPE 6J7											6J7G
6K5G	AMPLIFIER	TRIODE	HEATER	5U OCTAL 7 PIN	• 15/32	1 9/16	0.3	2.0	2.4	1.6	AMPLIFIER	100 250		-1.5 -3.0	0.35 1.1		70 70	78000 50000	900 1400				6K5G
6K6G	PWR. AMP.	PENTODE	HEATER	7S OCTAL 7 PIN	• 1/8	1 9/16	0.4				AMPLIFIER	SEE DATA FOR TYPE 41											6K6G
6K7	DETECTOR AMPLIFIER	PENTODE	HEATER	7R OCTAL 7 PIN	3 1/8	1 5/16	0.3	0.005 MAX.	7	12	1ST. DETECTOR	250	100	-10									6K7
											AMPLIFIER	250 250	125 100	-3 -3	10.5 7	2.6 1.7	990 1160	0.6 M* 0.8 M*	1650 1450			-52 -42	
6K7G	DETECTOR AMPLIFIER	PENTODE	HEATER	7R OCTAL 7 PIN	• 15/32	1 9/16	0.3	0.005* MAX.	4.5	12	1ST DETECTOR-AMP.	SEE DATA FOR TYPE 6K7											6K7G
6L5G	DETECTOR AMPLIFIER	TRIODE	HEATER	6Q OCTAL 6 PIN	• 1/8	1 9/16	0.15	2.7°	3°	5°	AMPLIFIER	135 250		-5 -9	3.5 8.0		17 17	11300 9000	1500 1900			-11 -20	6L5G
6L6	PWR. AMP.	TETRODE	HEATER	7AC OCTAL 7 PIN	• 5/16	1 5/8	0.9				CLASS A AMPLIFIER	250	250	-14 FIXED	72 - 79	5.0-7.3	135	22500	6000	6.5	2500		6L6
											CLASS A (2 TUBES)	250	250	-16 FIXED	120-140	10-16				14.5	5000	VALUES FOR TWO TUBES	
											CLASS AB1 (2 TUBES)	400	300	-25 FIXED	100-152	5-17				34	6600		
											CLASS AB1 (2 TUBES)	400	300	200' SELF	112-128	7-16				32	6600		
											CLASS AB2 (2 TUBES)	400	250	-20 FIXED	88-168	4-19				40	6000		
											CLASS AB2 (2 TUBES)	400	300	-25 FIXED	102-230	6-20				60	3800		

TYPE NO.	DESCRIPTION USE	DESCRIPTION TYPE	DESCRIPTION CATHODE	BASING DATA	MAX DIMEN OVERALL HEIGHT	MAX DIMEN OVERALL DIAM	FIL CURR AMPS	CAPACITANCES MICRO-MICRO-FARADS GRID PLATE	CAPACITANCES INPUT	CAPACITANCES OUTPUT	WHEN USED AS	PLATE SUPPLY VOLTS	SCR. GRID VOLTS	GRID BIAS VOLTS	PLATE CURRENT M A	SCREEN CURRENT M A	AMPL. FACTOR	PLATE RESIS OHMS	MUT COND UMHOS	MAX UNDIST OUTPUT WATTS	RECOMM. LOAD RES. OHMS	CUT-OFF BIAS VOLTS	TYPE NO.
Ⓕ CONTINUED											6.3 VOLT A C-D C DETECTOR AND AMPLIFIER CONTINUED												
6L6G	PWR. AMP.	TETRODE	HEATER	7AC OCTAL 7 PIN	5 5/16	2 1/16	0.9				POWER AMPLIFIER	SEE DATA FOR TYPE 6L6											6L6G
6L7	MIXER AMPLIFIER	HEPTODE	HEATER	7T OCTAL 7 PIN	3 1/8	1 5/16	0.3	Max. G1 0.0005 G3 .025	G1 8.5 G3 11.5	13	MIXER	250	150	G1-3 G3-15	3.3	8.3		1.0 M	350	CONV. COND.		G1-45	6L7
											AMPLIFIER	250	100	G1-3 G3-3	5.3	5.5	880	0.8 M	1100			G1-15 G3-15	
6L7G	MIXER AMPLIFIER	HEPTODE	HEATER	7T OCTAL 7 PIN	4 15/32	1 9/16	0.3	G1 0.020* G3 0.3	5.8* 11*	9*	MIXER AMPLIFIER	SEE DATA FOR TYPE 6L7											6L7G
6N5	TUNING INDICATOR	CATHODE RAY	HEATER	6R SMALL 6 PIN	4 3/16	1 9/16	0.15				TUNING INDICATOR	WITH PLATE 135V (THRU 0.25 MEG), TARGET 135V, I_b = 0.5 M.A. AND SHADOW ANGLE IS 90° AT E_c = 0V, ANGLE IS ZERO AT E_c = -12V APPROX.											6N5
6N6G	PWR. AMP.	DOUBLE TRIODE	HEATER	7W OCTAL 7 PIN	4 5/8	1 13/16	0.8				POWER AMPLIFIER	SEE DATA FOR TYPE 6B5											6N6G
6N7	PWR. AMP.	TWIN TRIODE	HEATER	8B OCTAL 8 PIN	3 1/4	1 5/16	0.8				CL. A (PARALLEL CONN.)	294		-6	7		35	11000	3200	0.17	15000		6N7
											COMPLETE CLASS B (BOTH SECTIONS)	250 300		0 0	28 to 50 35 to 50					8 10	8000 10000		
6N7G	POWER AMPLIFIER	TWIN TRIODE	HEATER	8B OCTAL MED. SHELL 8 PIN	4 5/8	1 13/16	0.8				POWER AMPLIFIER	SEE DATA FOR TYPE 6N7											6N7G
6P7G	DUAL AMPLIFIER	COMB. TRIODE PENTODE	HEATER	7U OCTAL 8 PIN	4 15/32	1 9/16	0.3				TRIODE AMPLIFIER PENTODE DET.-AMP.	SEE DATA FOR TYPE 6F7											6P7G
6Q7	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	7V OCTAL 7 PIN	3 1/8	1 5/16	0.3	1.5	5.5	5.0	DIODE DETECTOR TRIODE AMPLIFIER	100		-1.5	0.35		70	87500	800				6Q7
												250		-3	1.1		70	58000	1200				
6Q7G	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	7V OCTAL 7 PIN	4 15/32	1 9/16	0.3	1.3	2.7	4.5	DIODE DETECTOR TRIODE AMPLIFIER	SEE DATA FOR TYPE 6Q7											6Q7G
6R7	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	7V OCTAL 7 PIN	3 1/8	1 5/16	0.3	2.5	5.5	4.0	DIODE DETECTOR TRIODE AMPLIFIER	250		-9	9.5		16	8500	1900	0.28	10000		6R7
6R7G	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	7V OCTAL 7 PIN	4 15/32	1 9/16	0.3	3.5	2.5	4.5	DIODE DETECTOR TRIODE AMPLIFIER	SEE DATA FOR TYPE 6R7											6R7G
6S7G	AMPLIFIER	PENTODE	HEATER	7R OCTAL 7 PIN	4 15/32	1 9/16	0.15	0.007* MAX.	4.6*	7.0*	R.F. AMPLIFIER	250 135	100 67.5	-3.0 -3.0	8.5 3.7	2.0 0.9	1100 850		1750 1250			-38.5 -25	6S7G
6T5	TUNING INDICATOR	CATHODE RAY	HEATER	6R SMALL 6 PIN	4 1/8	1 1/8	0.3				TUNING INDICATOR	WITH PLATE 250V (THRU 1 MEG), TARGET 250V, I_b = 0.25 M.A. & SHADOW DIA. MAX AT E_c = 0V, SHADOW DIA. IS MIN AT E_c = -22V APPROX.											6T5
6T7G / 6Q6G	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	7V OCTAL 7 PIN	4 15/32	1 9/16	0.15	1.3	3.7	4.5	DIODE DETECTOR TRIODE AMPLIFIER	250 135		-3 -1.5	1.2 0.9		65 65	62000 65000	1050 1000				6T7G / 6Q6G
6U5	TUNING INDICATOR	CATHODE RAY	HEATER	6R SMALL 6 PIN	4 1/8	1 3/16	0.3				TUNING INDICATOR	SEE DATA FOR TYPE 6G5. BULB IS TUBULAR T-9											6U5
6U7G	AMPLIFIER	PENTODE	HEATER	7R OCTAL 7 PIN	4 13/16	1 9/16	0.3	0.007* MAX.	4.5*	9.0*	1ST DETECTOR AMPLIFIER	SEE DATA FOR TYPE 6D6											6U7G
6V6	POWER AMPLIFIER	TETRODE	HEATER	7AC OCTAL 7 PIN	3 1/8	1 5/16	0.45				CLASS A AMPLIFIER	250	250	-12.5	45-47	4.5-6.5	218	52000	4100	4.25	5000		6V6
											CLASS AB (2 TUBES) CLASS AB (2 TUBES)	250 300	250 300	-15 -20	70-79 78-90	5-13 5-13.5				8.5 13.0	10000 8000		
6V6G	POWER AMPLIFIER	TETRODE	HEATER	7AC OCTAL 7 PIN	4 5/8	1 13/16	0.45				CLASS A AMPLIFIER	250	250	-12.5	45-47	4.5-6.5	218	52000	4100	4.25	5000		6V6G
											CLASS AB (2 TUBES) CLASS AB (2 TUBES)	250 300	250 300	-15 -20	70-79 78-90	5-13 5-13.5				8.5 13.0	10000 8000		
6V7G	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	7V OCTAL 7 PIN	4 7/8	1 9/16	0.3	1.7	7.0	3.5	DIODE DETECTOR TRIODE AMPLIFIER	SEE DATA FOR TYPE 85											6V7G
6Y6G	POWER AMPLIFIER	TETRODE	HEATER	7AC OCTAL 7 PIN	4 5/8	1 13/16	1.25				POWER AMPLIFIER	135	135	-13.5	58-60	3-15			7000	3.6	2000		6Y6G
6Y7G	POWER AMPLIFIER	DUAL TRIODE	HEATER	8B OCTAL 8 PIN	4 1/8	1 9/16	0.6				POWER AMPLIFIER	SEE DATA FOR TYPE 79											6Y7G
6Z7G	POWER AMPLIFIER	TWIN TRIODE	HEATER	8B OCTAL 8 PIN	4 1/8	1 9/16	0.3				CLASS B POWER AMPLIFIER (BOTH SECTIONS)	180 135	0 0		8.4 6.0					4.2 2.5	12000 9000		6Z7G
12A5	POWER AMPLIFIER	PENTODE	HEATER	7F SMALL 7 PIN	4 1/4	1 9/16	6.3V:0.6A 12.6V:0.3A				AMPLIFIER	100 180	100 180	-15 -27	17 30				1700 2300	0.85 2.6	6500 3800		12A5

36	DETECTOR AMPLIFIER	TETRODE	HEATER	5E SM. 5 PIN	4 17/32	1 9/16	0.3	0.007* Max.	3.7	9.2	DETECTOR	180	67.5	-6							0.25M*		36
											AMPLIFIER	100 250	55 90	-1.5 -3	1.8 3.2	1.7 Max.	470 595	0.35M* 0.55M*	850 1080			-7 -7	
37	DETECTOR AMPLIFIER	TRIODE	HEATER	5A SM. 5 PIN	4 3/16	1 9/16	0.3	2.0	3.5	2.2	BIAS DETECTOR	180		-20									37
											AMPLIFIER	90 250		-6 -18	2.5 7.5		9.2 9.2	11500 8400	800 1100	0.03 0.34	17500 20000		
38	POWER AMPLIFIER	PENTODE	HEATER	5F SM. 5 PIN	4 17/32	1 9/16	0.3				AMPLIFIER	100 135 250	100 135 250	-9 -13.5 -25	7 9 22	1.2 1.5 3.8	80 100 120	85000 0.1M* 0.1M*	950 1000 1200	0.27 0.525 2.5	13500 13500 10000		38
39 44	DETECTOR AMPLIFIER	REMOTE CUT-OFF PENTODE	HEATER	5F SM. 5 PIN	4 17/32	1 9/16	0.3	0.007* Max.	3.5	10	1ST. DETECTOR	90 to 250	90	-7 APP.									39 44
											AMPLIFIER	90 250	90 90	-3 -3	5.6 5.8	1.6 1.4	360 1050	0.375M* 1.0M*	960 1050			-42 -42	
41	POWER AMPLIFIER	PENTODE	HEATER	6B SM. 6 PIN	4 3/16	1 9/16	0.4				AMPLIFIER	180 250	180 250	-13.5 -18	18.5 32	3.0 5.5	150 150	81000 68000	1850 2200	1.5 3.4	9000 7600		41
42	POWER AMPLIFIER	PENTODE	HEATER	6B MED. 6 PIN	4 11/16	1 13/16	0.7				PENTODE AMPLIFIER	250 315	250 315	-16.5 -22	34 42	6.5 8.0	185 260	78000 0.1M*	2350 2600	3 5	7000 7000		42
								#2 GR TO PL. CLASS AB TRIODE (2 TUBES)				350		-38	42 to 90					18	6000		
52	POWER AMPLIFIER	DOUBLE GRID TRIODE	FIL.	5C MED. 5 PIN	4 11/16	1 13/16	0.3				CLASS A	110		0	43		5.2	1750	3000	1.5	2000		52
											CL. B (AVG. 2 TUBES)	100		0	6 to 60					6	9000 MIN		
75	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	6G SM. 6 PIN	4 17/32	1 9/16	0.3	1.7	2.0	3.5	DIODE DETECTOR TRIODE AMPLIFIER	250		-2	1.0		100	91000	1100				75
												250		-2	0.1						0.25M*		
76	OSCILLATOR AMPLIFIER	TRIODE	HEATER	5A SM. 5 PIN	4 3/16	1 9/16	0.3	2.8	3.5	2.5	OSCILLATOR	90		0									76
											AMPLIFIER	250		-13.5	5.0		13.8	9500	1450	0.25	50000		
77	DETECTOR AMPLIFIER	PENTODE	HEATER	6F SM. 6 PIN	4 17/32	1 9/16	0.3	0.007* Max.	8.0	11	DETECTOR	250	100	-4.3									77
											AMPLIFIER	250	100	-3	2.3	0.5	1500	1.5M*	1250			-7.5	
78	DETECTOR AMPLIFIER	REMOTE CUT-OFF PENTODE	HEATER	6F SM. 6 PIN	4 17/32	1 9/16	0.3	0.007* Max.	8.0	11	1ST. DETECTOR	250	100	-10									78
											AMPLIFIER	250	100	-3	7.0	1.7	1160	0.8M*	1450			-42	
79	POWER AMPLIFIER	TWIN TRIODE	HEATER	6H SM. 6 PIN	4 17/32	1 9/16	0.6				COMPLETE CL. B (BOTH SECTIONS)	250		0	20 to 60					8	14000		79
85	DETECTOR AMPLIFIER	DUPLEX DIODE TRIODE	HEATER	6G SM. 6 PIN	4 17/32	1 9/16	0.3	1.7	2.0	3.5	DIODE DETECTOR TRIODE AMPLIFIER	180 250		-13.5 -20	6 8		8.3 8.3	8500 7500	975 1100	0.16 0.35	20000 20000		85
89	POWER AMPLIFIER	TRIPLE GRID	HEATER	6F SM. 6 PIN	4 17/32	1 9/16	0.4				CLASS A TRIODE	250		-31	32		4.7	2600	1800	0.9	5500		89
											CL. A PENTODE	250	250	-25	32	5.5	125	70000	1800	3.4	6750		
											CL. B TRIODE (AV. 2 TUBES)	250		0	6 to 50				—	5	10000 MIN		
G	7.5 VOLT A.C POWER AMPLIFIER TUBES																						
10	POWER AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	5 3/8	2 3/16	1.25				AMPLIFIER	350 425		-31 -39	16 18		8.0 8.0	5150 5000	1550 1600	0.9 1.6	11000 10000		10
50	POWER AMPLIFIER	TRIODE	FIL.	4D MED. 4 PIN	6 1/4	2 7/16	1.25				AMPLIFIER	350 450		-63 -84	45 55		3.8 3.8	1900 1800	2000 2100	2.4 4.6	4100 4350		50
H	SERIES FILAMENT POWER AMPLIFIER TUBES																						
12A7	POWER AMPL. & RECTIFIER	PENTODE & DIODE	HEATER	7K SM. 7 PIN	4 17/32	1 9/16	0.3A 12.6V				AMPLIFIER	135	135	-13.5	9	2.5	100	0.1M*	975	0.55	13500		12A7
											RECTIFIER SECTION	125 RMS			30 MAX.								
25A6	POWER AMPLIFIER	PENTODE	HEATER	7S OCTAL 7 PIN	3 1/4	1 5/16	0.3A 25.0V				AMPLIFIER	95 180	95 135	-15 -20	20 38	4.0 7.5	90 100	45000 40000	2000 2500	0.9 2.75	4500 5000		25A6
25A6G	POWER AMPLIFIER	PENTODE	HEATER	7S OCTAL 7 PIN	4 5/8	1 13/16	0.3A 25.0V				POWER AMPLIFIER	SEE DATA FOR TYPE 43											25A6G
25A7G	POWER AMPL. & RECTIFIER	PENTODE & DIODE	HEATER	8F OCTAL 8 PIN	4 5/8	1 13/16	0.3A 25.0V				POWER AMPLIFIER	100	100	-15	20.5	4.0	90	30000	1800	.77	4500		25A7G
											RECTIFIER SECTION	125 RMS			75 MAX.								
25B6G	POWER AMPLIFIER	PENTODE	HEATER	7S OCTAL 7 PIN	4 5/8	1 13/16	0.3A 25.0V				POWER AMPLIFIER	95	95	-15	45	4-12			4000	1.75	2000		25B6G
25L6	POWER AMPLIFIER	TETRODE	HEATER	7AC OCTAL 7 PIN	3 1/4	1 5/16	0.3A 25.0V				POWER AMPLIFIER	110	110	-7.5	49	4-11	82	10000	8200	2.2	2000		25L6
25L6G	POWER AMPLIFIER	PENTODE	HEATER	7AC OCTAL 7 PIN	4 5/8	1 13/16	0.3A 25.0V				POWER AMPLIFIER	110	110	-7.5	69	4-11	82	10000	8200	2.2	2000		25L6G
43	POWER AMPLIFIER	PENTODE	HEATER	6B MED. 6 PIN	4 11/16	1 13/16	0.3A 25V				POWER AMPLIFIER	95 180	95 135	-15 -20	20 38	4.0 7.5	90 100	45000 40000	2000 2500	0.9 2.75	4500 5000		43
48	POWER AMPLIFIER	PENTODE	HEATER	6A MED. 6 PIN	5 3/8	2 1/16	0.4A 30V				POWER AMPLIFIER	96 125	96 100	-19 -20.0	52 56	9.0 9.5			3800 3900	2.0 2.5	1500 1500		48

J

RECTIFIER TUBES

							FIL AMPS	FIL VOLTS	MAX AC VOLTS PER ANODE	MAX DC OUT. CURR (AMPS)	MAX PEAK INVERSE VOLTS	MAX PEAK PLATE AMPS	MIN CHOKE BEFORE FILTER CONDENSER	MAX HEATER CATHODE BIAS	MAX DC VOLTS DEL TO FILTER (NOM)		
															CONDENSER INPUT	CHOKE INPUT	
0Z4	FULL WAVE	GAS	COLD	4R OCTAL 6 PIN	2 5/8	1 5/16	—	—	350	0.075 MAX 0.030 MIN	1250	0.200			425	300	0Z4
0Z4G	FULL WAVE	GAS	COLD	4R OCTAL 5 PIN	2 5/8	1 3/64	—	—	350	0.075 MAX 0.030 MIN	1250	0.200			425	300	0Z4G
1-V	HALF WAVE	HIGH VACUUM	HEATER	4G SM. 6 PIN	4 3/16	1 9/16	0.3	6.3	350	0.050	1000	0.200		500	400		1-V
5T4	FULL WAVE	HIGH VACUUM	FIL.	5T OCTAL 5 PIN	4 1/8	1 23/32	2.0	5.0	450	0.250	1250				450	325	5T4
5U4G	FULL WAVE	HIGH VACUUM	FIL.	5T OCTAL 8 PIN	5 5/16	2 1/16	3.0	5.0	SEE DATA FOR TYPE 5Z3								5U4G
5V4G	FULL WAVE	HIGH VACUUM	HEATER	5L OCTAL 8 PIN	4 5/8	1 13/16	2.0	5.0	SEE DATA FOR TYPE [illegible]								5V4G
5W4	FULL WAVE	HIGH VACUUM	FIL.	5T OCTAL 5 PIN	3 1/4	1 5/16	1.5	5.0	350	0.110	1000				375	250	5W4
5W4G	FULL WAVE	HIGH VACUUM	FIL.	5T OCTAL 4 PIN	4 5/8	1 13/16	1.5	5.0	350	0.110	1000				375	250	5W4G
5X4G	FULL WAVE	HIGH VACUUM	FIL.	5Q OCTAL 8 PIN	5 5/16	2 1/16	3.0	5.0	SEE DATA FOR TYPE 5Z3								5X4G
5Y3G	FULL WAVE	HIGH VACUUM	FIL.	5T OCTAL 5 PIN	4 5/8	1 15/16	2.0	5.0	SEE DATA FOR TYPE 80								5Y3G
5Y4G	FULL WAVE	HIGH VACUUM	FIL.	5Q OCTAL 8 PIN	4 5/8	1 13/16	2.0	5.0	SEE DATA FOR TYPE 80								5Y4G
5Z3	FULL WAVE	HIGH VACUUM	FIL.	4C MED. 4 PIN	5 3/8	2 1/16	3.0	5.0	500	0.250	1400	0.700			460	350	5Z3
5Z4	FULL WAVE	HIGH VACUUM	HEATER	5L OCTAL 5 PIN	3 1/4	1 5/16	2.0	5.0	400	0.125	1100	0.500			425	275	5Z4
6W5G	FULL WAVE	HIGH VACUUM	HEATER	6S OCTAL 6 PIN	4 1/8	1 9/16	0.9	6.3	350	0.100	1750	0.350		500	425	310	6W5G
6X5	FULL WAVE	HIGH VACUUM	HEATER	6S OCTAL 6 PIN	3 1/4	1 5/16	0.6	6.3	350	0.075	1250	0.325		500	475	310	6X5
6X5G	FULL WAVE	HIGH VACUUM	HEATER	6S OCTAL 6 PIN	4 1/8	1 9/16	0.6	6.3	350	0.075	1250	0.325		500	475	310	6X5G
6Z4 84	FULL WAVE	HIGH VACUUM	HEATER	5D SM. 5 PIN	4 3/16	1 9/16	0.5	6.3	350	0.060	1000	0.200		500	425	300	6Z4 84
6ZY5G	FULL WAVE	HIGH VACUUM	HEATER	6S OCTAL 6 PIN	4 1/8	1 9/16	0.3	6.3	350	0.035	1000	0.150		400			6ZY5G
12Z3	HALF WAVE	HIGH VACUUM	HEATER	4G SM. 4 PIN	4 3/16	1 9/16	0.3	12.6	250	0.060	700	0.300		350	310		12Z3
25Z5	RECTIFIER DOUBLER	HIGH VACUUM	HEATER	6E SM. 6 PIN	4 3/16	1 9/16	0.3	25.0	125	0.200 0.100	700 700	0.500 0.500	RECTIFIER DOUBLER	350	200 120		25Z5
25Z6	RECTIFIER DOUBLER	HIGH VACUUM	HEATER	7Q OCTAL 7 PIN	3 1/4	1 5/16	0.3	25.0	125	0.170 0.085	700 700	0.500 0.500	RECTIFIER DOUBLER	350	225 115		25Z6
25Z6G	RECTIFIER DOUBLER	HIGH VACUUM	HEATER	7Q OCTAL 7 PIN	4 1/8	1 9/16	0.3	25.0	SEE DATA FOR TYPE 25Z5								25Z6G
80	FULL WAVE	HIGH VACUUM	FIL.	4C MED. 4 PIN	4 11/16	1 13/16	2.0	5.0	350 400 550	0.125 0.110 0.135	1000 1100 1500	0.400 0.350 0.300	20 HENRIES		300 370	225 275 425	80
81	HALF WAVE	HIGH VACUUM	FIL.	4B MED. 4 PIN	6 1/4	2 3/16	1.25	7.5	700	0.085	2000	0.600			750	550	81
82	FULL WAVE	MERCURY VAPOR	FIL.	4C MED. 4 PIN	4 11/16	1 13/16	3.0	2.5	500	0.125	1400	0.400			590	425	82
83	FULL WAVE	MERCURY VAPOR	FIL.	4C MED. 4 PIN	5 3/8	2 1/16	3.0	5.0	500	0.250	1400	0.800			530	400	83
83V	FULL WAVE	HIGH VACUUM	FIL.	4L MED. 4 PIN	4 11/16	1 13/16	2.0	5.0	400	0.200	1100	0.700			425	275	83V
BA	FULL WAVE	GAS	COLD	4J MED. 4 PIN	5 3/8	2 7/16	—	—	350	0.350	1000	1.000				300	BA
BH	FULL WAVE	GAS	COLD	4J MED. 4 PIN	4 3/8	1 13/16	—	—	350	0.125	1000	0.400				300	BH
BR	HALF WAVE	GAS	COLD	4H MED. 4 PIN	3 3/8	1 9/16	—	—	300	0.050	850	0.200			300		BR

K

RAYTHEON SPECIAL TUBES
(SUPPLIED FOR REPLACEMENT USE ONLY)

TYPE NO	FILAMENT VOLTS	FILAMENT AMPS	BASING VIEW	BASING SHIELD CONN TO	CHARACTERISTICS USE & DIMENSIONS	TYPE NO
25AS	2.5	1.35	5D	CATHODE PIN	APPROXIMATELY 40 MA. ON EACH DIODE PLATE AT 10 VOLTS DC DUPLEX DIODE DETECTOR	25AS
24S	2.5	1.75	5E	CATHODE PIN	SAME AS 24 A	24S
27S	2.5	1.75	5A	CATHODE PIN	SAME AS 27	27S
35/51S	2.5	1.75	5E	CATHODE PIN	SAME AS 35/51	35/51S
55S	2.5	1.0	6G	CATHODE PIN	SAME AS 55	55S
56S	2.5	1.0	5A	CATHODE PIN	SAME AS 56	56S
56AS	6.3	0.4	5A	CATHODE PIN	SAME AS 76 EXCEPT HEATER CURRENT	56AS
57S	2.5	1.0	6F	CATHODE PIN	SAME AS 57	57S
57AS	6.3	0.4	6F	CATHODE PIN	SAME AS 6C6, EXCEPT HEATER AMPS	57AS
58S	2.5	1.0	6F	CATHODE PIN	SAME AS 58	58S
58AS	6.3	0.4	6F	CATHODE PIN	SAME AS 6D6, EXCEPT HEATER AMPS.	58AS
75S	6.3	0.3	6G	CATHODE PIN	SAME AS 75	75S
85AS	6.3	0.3	6G	HEATER PIN & CATHODE [illegible] PIN.	SIMILAR TO 85 EXCEPT AMP. FACTOR = [illegible] MUTUAL COND. = [illegible] PLATE CURRENT = 5.5 MA; PLATE VOLTS = 250, GRID BIAS = [illegible]	85AS
182B	5.0	1.25	4D	NO SHIELD	SIM. TO 45 EXCEPT FIL. [illegible] AMP. FACTOR = 5.0 MUTUAL COND. = 1500. PLATE CURRENT = 18 MA; PLATE VOLTS = 250, GRID BIAS = -35V.	182B
183	5.0	1.25	4D	NO SHIELD	SIMILAR TO 45 EXCEPT FIL. VOLTS, AMP. FACTOR = 3.0, MUT. COND = 1500, PLATE CURR. = 31 MA, PLATE VOLTS = 250; GRID BIAS = [illegible]	183
485	3.0	1.25	5A	NO SHIELD	SIMILAR TO 27 EXCEPT HEATER [illegible] AMP. FACTOR [illegible] MUT. COND. = [illegible] PLATE CURR. = [illegible] MA, PLATE VOLTS = 180 [illegible] GRID BIAS = [illegible]	485
950	2.0	0.12	5K	NO SHIELD	SIMILAR TO 33 EXCEPT FIL. AMPS., PLATE [illegible] = 7 MA, POWER OUTPUT = 0.45 WATTS, PLATE & SCREEN VOLTS = 135 MAX, CONTROL GRID BIAS = -16.5V.	950
2A7S	2.5	1.0	7C	CATHODE PIN	SAME AS 2A7	2A7S
222 / G84	2.5	1.5	4B	NO SHIELD	SIMILAR TO [illegible]	222 / G84
6A7S	6.3	0.3	7C	CATHODE PIN	SAME AS 6A7	6A7S
6B7S	6.3	0.3	7D	CATHODE PIN	SAME AS 6B7	6B7S
6C7	6.3	0.3	7G	SEPARATE PIN	SAME AS 85AS	6C7
6D7	6.3	0.3	7H	SEPARATE PIN	SAME AS 6C6	6D7
6E7	6.3	0.3	7H	SEPARATE PIN	SAME AS 78	6E7
6F7S	6.3	0.3	7E	CATHODE PIN	SAME AS 6F7	6F7S
6Y5	6.3	0.8	6J	SEPARATE PIN	SIMILAR TO 6Z4/84	6Y5
6Z5	12.6/6.3	0.4/0.8	6K	NO SHIELD	SIMILAR TO 6Z4/84	6Z5

—TUBE SOCKET CONNECTION CHART—

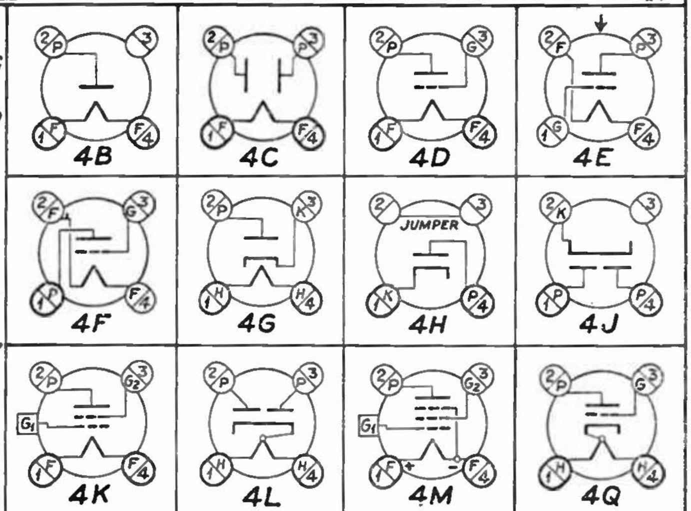
(LOOKING UP AT BOTTOM OF SOCKET)

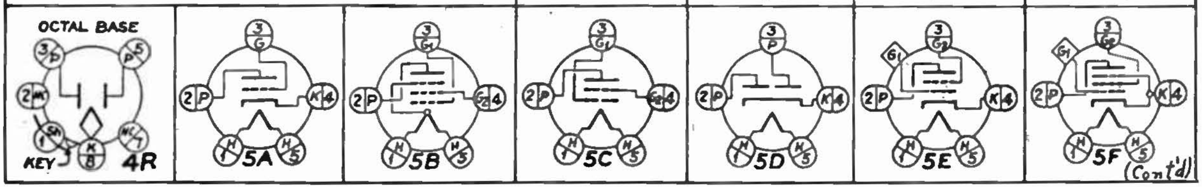
Oct. 1937

THE SOCKET CONNECTIONS SHOWN IN THIS CHART ARE THOSE WHICH APPEAR WHEN LOOKING UP AT THE SOCKET CONNECTIONS FROM THE BOTTOM. THE Nº1 TERMINAL IS THE LEFT-HAND FILAMENT CONNECTION AND THE OTHER PINS ARE NUMBERED IN "CLOCKWISE" ROTATION.

THE "LETTER SYMBOLS" USED IN THIS CHART ARE AS FOLLOWS:

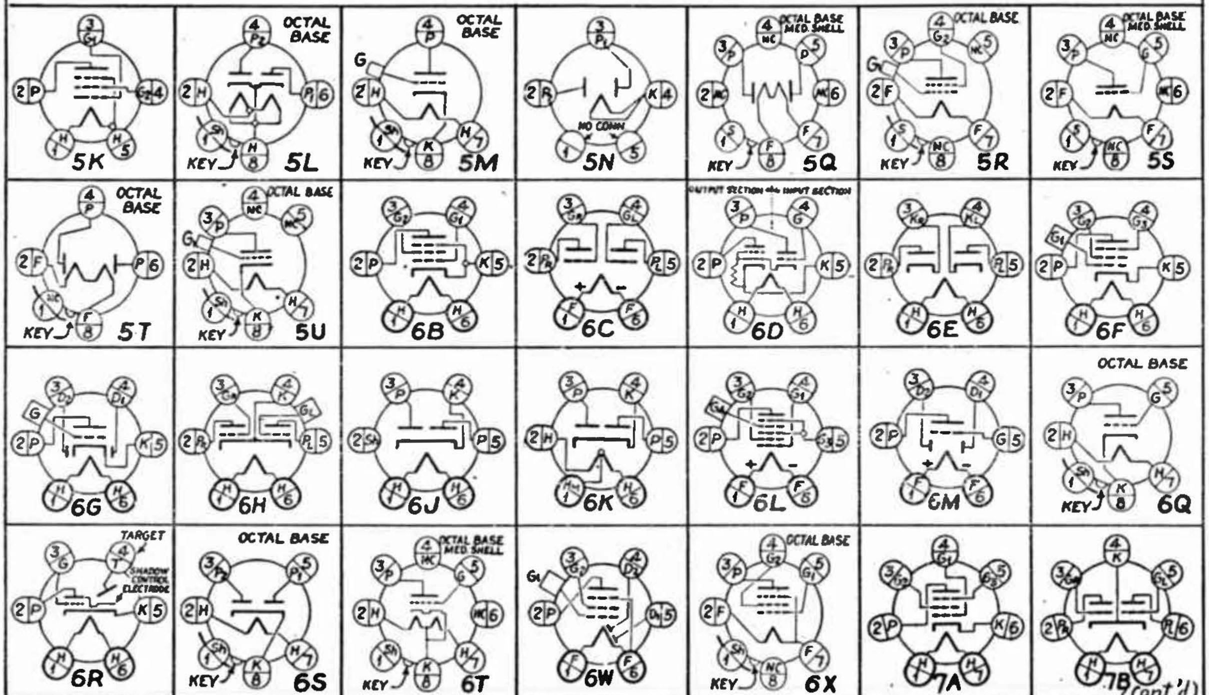
F-Filament; H-Heater; P-Plate; K-Cathode; G_1-Control Grid; G_2-Screen Grid; G_3-Suppressor grid; G_L-Grid (triode); G_R Grid (triode-2); G_T-Triode grid; G_P-pentode grid; P-plate; P_L-plate (triode-1); P_R-plate (triode-2); P_T triode plate; P_P-pentode plate; D_1-one diode plate; D_2 other diode plate; □-top cap. (NOTE: these do not apply to tube bases 6L and 7C.)





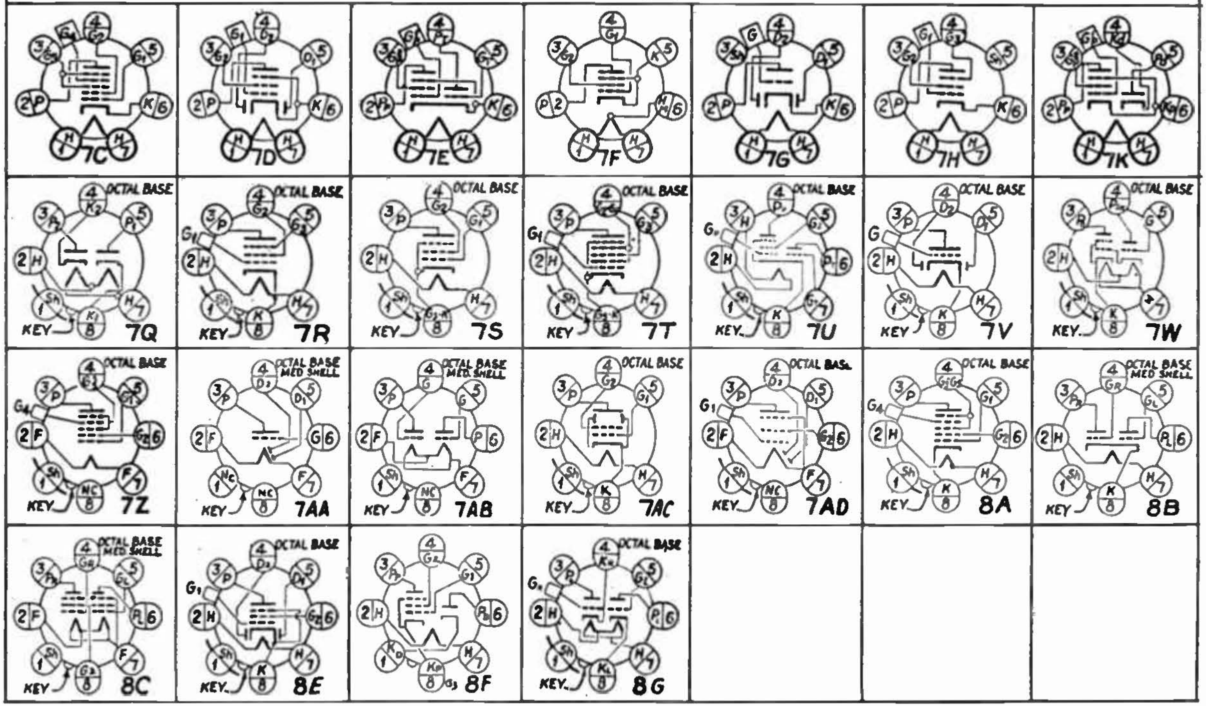
(Cont'd)

TUBE SOCKET CONNECTION CHART— (Continued)



TUBE SOCKET CONNECTION CHART – (Cont'd)

(LOOKING UP AT BOTTOM OF SOCKETS



TUBE INDEX—*Continued from page 11-1**

Tube Type Number	Will be Found in Section	Tube Type Number	Will be Found in Section	Tube Type Number	Will be Found in Section	Tube Type Number	Will be Found in Section
6A8G	F	6L6G	F	25Z5	J	56	C
6AB5	F	6L7	F	25Z6	J	56AS	K
6B4G	F	6L7G	F	25Z6G	J	56S	K
6B5	F	6N5	F	10	G	57	C
6B6G	F	6N6G	F	12A	E	57AS	K
6B7	F	6N7	F	15	B	57S	K
6B7S	K	6N7G	F	19	B	58	C
6B8	F	6P7G	F	20	D	58AS	K
6B8G	F	6Q7	F	22	D	58S	K
6C5	F	6Q7G	F	24A	C	59	C
6C5G	F	6R7	F	24S	K	71A	E
6C6	F	6R7G	F	26	C	75	F
6C7	K	6S7G	F	27	C	75S	K
6C8G	F	6T5	F	27S	K	76	F
6D6	F	6T7G	F	30	B	77	F
6D7	K	6U5	F	31	B	78	F
6D8G	F	6U7G	F	32	B	79	F
6E5	F	6V6	F	33	B	80	J
6E6	F	6V6G	F	34	B	81	J
6E7	K	6V7G	F	35/51	C	82	J
6F5	F	6W5G	J	35S/51S	K	83	J
6F5G	F	6X5	J	36	F	83V	J
6F6	F	6X5G	J	37	F	84/6Z4	J
6F6G	F	6Y5	K	38	F	85	F
6F7	F	6Y6G	F	39/44	F	85AS	K
6F7S	K	6Y7G	F	40	E	89	F
6G5/6H5	F	6Z4/84	J	41	F	V99	D
6H6	F	6Z5	K	42	F	X99	D
6H6G	F	6ZY5G	J	43	H	182B	K
6J5	F	6Z7G	F	45	C	183	K
6J5G	F	12A5	F	46	C	485	K
6J7	F	12A7	H	47	C	950	K
6J7G	F	12Z3	J	48	H	951/1B4	B
6K5G	F	25A6	K	49	B	WD-11	A
6K6G	F	25A6G	H	50	G	WX-12	A
6K7	F	25A7G	H	52	F	BA	J
6K7G	F	25B6G	H	53	C	BH	J
6L5G	F	25L6	H	55	C	BR	J
6L6	F	25L6G	H	55S	K	LA(6A4).	F

CROSS-INDEX OF REPLACEMENT TUBE TYPES

Raytheon tubes can be used as replacement for tubes of other manufacturers as follows:

A. Tube types having the same RMA type numbers (with a letter between two numbers—as 6A7) are interchangeable.

B. On standard tube types with two or three figure type numbers, the last two figures form the significant type numbers regardless of letter prefixes. For example, the Raytheon 45 will replace UX-245, CX-345, or SX-245 tubes.

C. Types differing in number by the suffix letters "A", "G", "H", "MG", or "V" are interchangeable in general, regardless of this letter. For example the 12A may replace a 112 or 112A, the 2A3 may replace a 2A3H, and the 6A8 may replace a 6A8G or 6A8MG.

D. Shielded types distinguished by the added letter "S" may or may not be interchangeable with types without this letter suffix.

E. Exceptions to the above tubes are types RA-1, RE-1, SO-1, KR-20, KR-22, 43MG, 59B, 182B, Kellog 401, 482A, 482B, 484, 484A and 25Z5MG which do not correspond with types 1-V 20, 22, etc. The 01A (201A) is not interchangeable with the 1-V or 1, and the WX-12 is not interchangeable with the 12A (112A). Types 57AS, 58AS, 183, and 485 may be replaced only by Raytheon tubes bearing the same full type numbers.

F. The following table lists the obsolete and non-standard tube types with the standard types which normally may be used for replacement.

TYPE NO.	NORMALLY REPLACEABLE BY RAYTHEON TYPES	TYPE NO.	NORMALLY REPLACEABLE BY RAYTHEON TYPES	TYPE NO.	NORMALLY REPLACEABLE BY RAYTHEON TYPES
2A3H	2A3	64 ••	36	224A	24A
5Y3 •••	5Z4 •••	64A	36	226	26
5Z4MG	5Z4	65 ••	39/44	227	27
6A8MG	6A8	65A	39/44	230	30
6B6	6Q7	67 ••	37	231	31
6B6MG	6Q7	67A	37	232	32
6C5MG	6C5	68 ••	38	233	33
6F5MG	6F5	68A	38	234	34
6F6MG	6F6	83	83V	235	35/51
6H6MG	6H6	84	6Z4/84	236	36
6J7MG	6J7	G-84	2Z2/G84	238	38
6K7MG	6K7	95	2A5	239	39/44
6L7MG	6L7	KR-98	6Z4/84	240	40
6Q7MG	6Q7	112	12A	245	45
6R7MG	6R7	112A	12A	247	47
6X5MG	6X5	120	20	250	50
6Z3	1-V	171	71A	280	80
25Z5MG	25Z6	171A	71A	280M	83V
14Z3	12Z3	171AC	71A	281	81
1	1-V	171B	71A	288	83V
RE-1	80	182A	71A	C-299	V-99
RE-2	81	182B	183 †	X-299	X-99
SO-2	50	V-199	V-99	482A	71A
G-2	2S/4S	X-199	X-99	551	35/51
G-2S	2S/4S	200	200A	585	50
G-4	2S/4S	201	01A	586	50
G-4S	2S/4S	201A	01A	P-861	6Z4/84
KR-5	6A4/LA	210	10	951	1B4/951
WD-12	WX-12	213	80	986	83
25S	1B5/25S	216	81	AD	1-V
27-HM	56	216B	81	AF	82
43MG	25A6	220	20	AG	83
44	39/44	222	22	LA	6A4/LA
		224	24A	PZ	47
				PZH	2A5

••• See chart for difference in output voltage. •• In automobile sets only. † Where both power tubes are changed together.

Oct. 1936

INDEX OF VACUUM TUBE TYPES

TYPE	FOUND IN BLOCK	FIL OR HTR VOLTS	DESCRIPTION AND USE
0Z3	j	..	Full wave gaseous rectifier
0Z4	j	..	Full wave gaseous rectifier
1A4	b	2.0	VariMu tetrode amplifier or det.
1A6	b	2.0	Electron coupled osc. & mixer
1B4/951	b	2.0	Tetrode amplifier or detector
1B5/25S	b	2.0	Diode detector & triode amplifier
1C6	b	2.0	Electron coupled osc. & mixer
1F4	b	2.0	Pentode power amplifier
2A3	c	2.5	Triode power amplifier
2A3H	c	2.5	Triode power amplifier
2A5	c	2.5	Pentode power amplifier
2A6	c	2.5	Diode detector & triode amplifier
2A7	c	2.5	Electron coupled osc. & mixer
2A7S	k	2.5	Electron coupled osc. & mixer
2B7	c	2.5	Duo diode det. & pentode ampli.
2Z2/G84	k	2.5	Half wave filament rectifier
5Y3*	j	5.0	Full wave vacuum rectifier
5Z3	j	5.0	Full wave vacuum rectifier
5Z4	j	5.0	Full wave vacuum rectifier
6A3	f	6.3	Triode power amplifier
6A4/LA	f	6.3	Pentode power amplifier
6A6	f	6.3	Twin triode class B power ampli.
6A7	f	6.3	Electron coupled osc. & mixer
6A7S	k	6.3	Electron coupled osc. & mixer
6A8,6A8G*	f	6.3	Electron coupled osc. & mixer
6B5	f	6.3	Dual triode power amplifier
6B7	f	6.3	Duo diode det. & pentode ampli.
6B7S	k	6.3	Duo diode det. & pentode ampli.
6C5,6C5G*	f	6.3	Triode amplifier or osc.
6C6	f	6.3	Pentode amplifier & detector
6C7	k	6.3	Diode detector & triode amplifier
6D6	f	6.3	VariMu pentode amplifier & det.
6D7	k	6.3	Pentode amplifier & detector
6E5	f	6.3	Cathode ray tuning indicator
6E6	f	6.3	Twin triode class A power ampli.
6E7	k	6.3	VariMu pentode amplifier & det.
6F5,6F5G*	f	6.3	Triode amplifier or detector
6F6,6F6G*	f	6.3	Pentode power amplifier
6F7	f	6.3	Triode & pentode osc. & detector
6F7S	k	6.3	Triode & pentode osc. & detector
6G5	f	6.3	Cathode ray tuning indicator
6H6,6H6G*	f	6.3	Twin diode detector
6J7,6J7G*	f	6.3	Pentode amplifier or detector
6K7,6K7G*	f	6.3	VariMu pentode amplifier or det.
6L7,6L7G*	f	6.3	Heptode mixer or amplifier
6N7G*	f	6.3	Twin triode class B amplifier
6Q7,6Q7G*	f	6.3	Diode detector & triode amplifier
6R7,6R7G*	f	6.3	Diode detector & triode amplifier
6X5,6X5G*	j	6.3	Full wave vacuum rectifier
6Y5	k	6.3	Full wave vacuum rectifier
6Z4/84	j	6.3	Full wave vacuum rectifier
6Z5	k	6.3/12.6	Full wave vacuum rectifier
12A5	f	12.6/6.3	Pentode power amplifier
12A7	h	12.6	Power pentode & rectifier
12Z3	j	12.6	Half wave vacuum rectifier
25A6,25A6G*	h	25.0	Pentode power amplifier
25Z5	j	25.0	Voltage doubling vacuum rectifier
25Z6,25Z6G*	j	25.0	Voltage doubling vacuum rectifier
200A	a	5.0	Triode detector
01A	a	5.0	Triode amplifier or detector
1-V	j	6.3	Half wave vacuum rectifier
2S/4S	k	2.5	Duo diode detector
10	g	7.5	Triode power amplifier or osc.
WD-11	a	1.1	Triode amplifier or detector
WX-12	a	1.1	Triode amplifier or detector
12A	a	5.0	Triode amplifier or detector
15	k	2.0	Tetrode amplifier or detector
19	b	2.0	Twin triode class B power ampli.
20	d	3.3	Triode power amplifier
22	d	3.3	Tetrode amplifier
24A	c	2.5	Tetrode amplifier or detector
24S	k	2.5	Tetrode amplifier or detector
26	c	1.5	Triode ac filament amplifier
27	c	2.5	Triode amplifier or detector
27S	k	2.5	Triode amplifier or detector
30	b	2.0	Triode amplifier or detector
31	b	2.0	Triode power amplifier
32	b	2.0	Tetrode amplifier or detector
33	b	2.0	Pentode power amplifier
34	b	2.0	Pentode tetrode amplifier or det
35/51	c	2.5	VariMu tetrode amplifier or det.
35/51S	k	2.5	VariMu tetrode amplifier or det.
36	f	6.3	Tetrode amplifier or detector
37	f	6.3	Triode amplifier or detector
38	f	6.3	Pentode power amplifier
39/44	f	6.3	VariMu pentode amplifier or det.
40	c	5.0	Triode amplifier
41	f	6.3	Pentode power amplifier
42	f	6.3	Pentode power amplifier
43	h	25.0	Pentode power amplifier
45	c	2.5	Triode power amplifier
46	c	2.5	Dual purpose power triode
47	c	2.5	Pentode power amplifier
48	h	30.0	Pentode power amplifier
49	b	2.0	Dual purpose power triode
50	g	7.5	Triode power amplifier
52	f	6.3	Dual purpose power triode
53	c	2.5	Twin triode class B power ampli.
55	c	2.5	Diode detector & triode amplifier
55S	k	2.5	Diode detector & triode amplifier
56	c	2.5	Triode amplifier or detector
56S	k	2.5	Triode amplifier or detector
57	c	2.5	Pentode amplifier or detector
57S	k	2.5	Pentode amplifier or detector
57AS	k	6.3	Pentode amplifier or detector
58	c	2.5	VariMu pentode amplifier or det.
58S	k	2.5	VariMu pentode amplifier or det.
58AS	k	6.3	VariMu pentode amplifier or det.
59	c	2.5	Triple purpose power amplifier
71A	a	5.0	Triode power amplifier
75	f	6.3	Diode detector & triode amplifier
75S	k	6.3	Diode detector & triode amplifier
76	f	6.3	Triode amplifier or detector
77	f	6.3	Pentode amplifier or detector
78	f	6.3	VariMu pentode amplifier or det.
79	f	6.3	Twin triode class B power ampli.
80	j	5.0	Full wave vacuum rectifier
81	j	7.5	Half wave vacuum rectifier
82	j	2.5	Full wave mercury rectifier
83	j	5.0	Full wave mercury rectifier
83V	j	5.0	Full wave vacuum rectifier
84	j	6.3	See 6Z4/84
85	f	6.3	Diode detector & triode amplifier
85AS	k	6.3	Diode detector & triode amplifier
89	f	6.3	Triple purpose power amplifier
V-99	d	3.3	Triode amplifier or detector
X-99	d	3.3	Triode amplifier or detector
182B	k	5.0	Triode power amplifier
183	k	5.0	Triode power amplifier
485	k	3.0	Triode amplifier or detector
950	k	2.0	Pentode power amplifier
BA	j	..	Full wave gaseous rectifier
BH	j	..	Full wave gaseous rectifier
BR	j	..	Half wave gaseous rectifier
LA	f	6.3	See 6A4/LA

*INTERMEDIATE OR "G" TYPE TUBES

This line of tubes is made with standard size glass bulbs and with octal bases. These tubes have the same characteristics as the corresponding metal types and in general they are interchangeable with them except in some cases for space requirements and the necessity for providing external shields. Types 5Y3 and 6N7G (listed in the characteristic section of this chart) although they do not have metal equivalents are based with octal bases and are used with the above "G" types.

Oct. 1936

Courtesy RAYTHEON PRODUCTION CORP.

RECTIFIER TUBE CHARACTERISTICS

It is often necessary for the radio service man to calculate the value of the voltage which the high-voltage secondary winding of the power transformer in a receiver must deliver to the rectifier tube in order that a certain d-c voltage (as specified by the manufacturer of the receiver) shall be available at the output terminals of the *B*-filter. This information is necessary when a new receiver is designed, and it is often necessary when the power transformer is to be replaced in an "orphan" set for which no voltage specifications are readily available. The proper transformer voltage required can be determined easily by the method which will be described here, if the total plate and bleeder currents, resistance of the filter choke coils, and the load characteristics of the type of rectifier tube to be used are known. The "load characteristics" of the types of rectifier tubes commonly used in receivers are shown in the eight sets of graphs which follow. Each is labeled for identification. (These are reproduced here through the courtesy of the engineering department of the *Raytheon Production Corp.*)

In order to show exactly how a calculation of this kind is carried out, let us consider a typical example: We will assume that the sum of all the plate and screen currents in the entire receiver is 50 ma. and that the bleeder current (the current flowing through the "bleeder" resistance) is 10 ma. The value for the plate and screen currents could be obtained from the set manufacturer's data or from the Tube Characteristic Chart presented here in Section 11. The value of the "bleeder" current could be calculated by dividing the voltage across the bleeder resistor (which is usually the highest d-c voltage) by the resistance of the bleeder. We will assume further that a single filter choke having a resistance of 500 ohms is used, that a voltage of 250 volts d-c is required across the bleeder resistor (this is the voltage output of the *B*-filter system), and that the input tank condenser has a value of 4 mfd. (the size of the tank condenser may be determined from the schematic circuit diagram of the receiver, or by checking with a capacity meter). The problem is to find the r-m-s ("root-mean-square" or "effective" value) voltage which each half of the high-voltage winding of the power transformer must deliver to the rectifier tube when the receiver is operating.

If a type '80 rectifier tube is used, then the set of load characteristic curves (which is shown on page 13-4*) for this tube, must be examined. It will be seen that there are three curves (one drawn *solid*, one drawn *dotted* and one drawn in *dot-dash* form) for each value of rectifier plate (anode) voltage specified. One curve is for each value of the filter tank (input) condenser C_1. Thus, if a 2 mfd. tank condenser and a rectifier plate voltage of 350 volts were employed, the *dotted* curve marked *2* would represent the load current—output voltage characteristic of the rectifier tube for that condition of operation, etc.

Now the horizontal scale on the rectifier characteristic curves shown here represents the d-c output current of the rectifier in milliamperes, and the vertical scale represents the d-c *input* voltage to the filter—not the d-c *output* voltage of the filter. Therefore, it is necessary to obtain the former value indirectly from the known constants of the problem. It is known that the desired d-c *output* voltage of the filter is 250 volts, and it is known also that the current through the 500-ohm filter choke is $50 + 10 = 60$ ma.; therefore, the d-c voltage drop across the choke is $0.06 \times 500 = 30$ volts. This means that the d-c *input* voltage to the filter must be equal to 250 plus 30, or 280 volts in order to obtain an *output* of 250 volts.

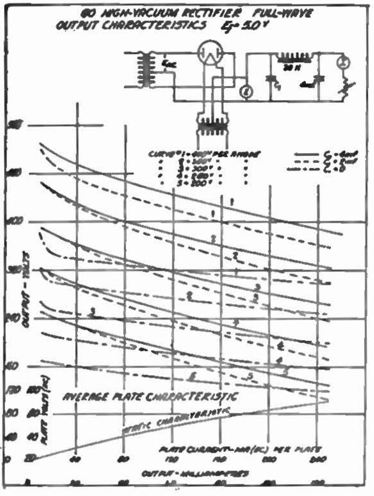
Now we are prepared to refer to the load characteristic chart for the '80 type rectifier tube. Locate the 280-volt point on the vertical "output volts" scale, and locate the 60-ma. point on the horizontal "output-milliamperes" scale. Follow across horizontally from the 280-volt point and vertically from the 60-ma point into the curve sheet until the point of intersection is reached; this point will be found to occur nearly midway between the two solid-line curves labeled *3* and *4*. These curves represent operation with a 4-mfd. tank condenser and 300 and 250 volts per anode (plate voltage) respectively. Therefore, in our case since the point of intersection lies about midway between these curves, the voltage is about 275 volts.

Since the voltage output of the rectifier tube (plus the small internal voltage drop in the tube itself) is practically equal to the a-c voltage across each half of the high-voltage secondary winding of the power transformer, each half of this winding in our power transformer must deliver 275 volts. Therefore it must have a *total* high-voltage secondary voltage output (under load) of $275 \times 2 = 550$ volts. It must also have the necessary proper filament windings which will deliver the required low voltages to the filaments or heaters of all the tubes in the receiver.

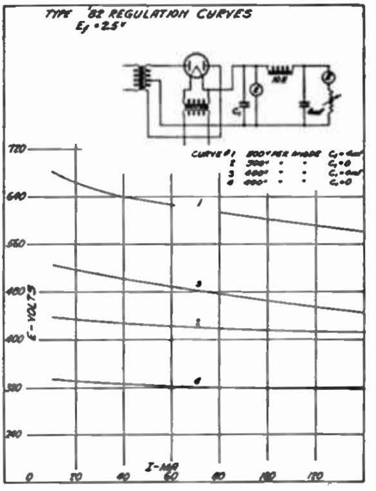
If the filter were of the "choke-input" type, ($C_1 = 0$), then each half of the high-voltage winding would have to deliver a voltage represented by a point slightly above the No. 2 dot-dashed characteristic curve which represents 350 volts per anode operation. By taking the proportional distances between the two adjacent dot-dashed curves and the intersection of the operating lines, the required voltage is found to be about 360 volts across each half of the winding; the *total* secondary voltage is then twice this value, or 720 volts. Notice that more input voltage (for a given output) is required when a choke-input type filter is used than when a condenser-input type filter is employed.

It is always well to allow an extra voltage margin to take care of conditions when the line voltage is below normal, etc. If this is done in our case, a 750-volt center-tapped secondary winding on the power transformer will be about right for the particular receiver and filter system originally specified in our problem. This same procedure may be followed for solving problems involving any of the other types of rectifier tubes whose load-voltage characteristics are shown here.

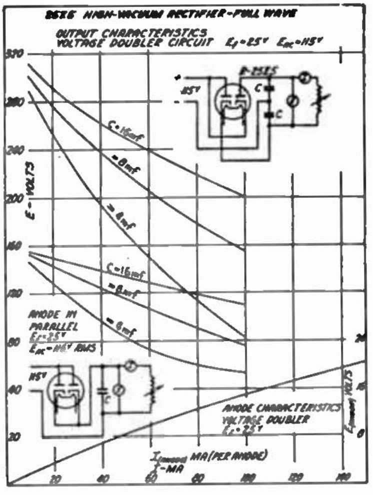
(See Pages 13-4 and 13-5* for charts)*



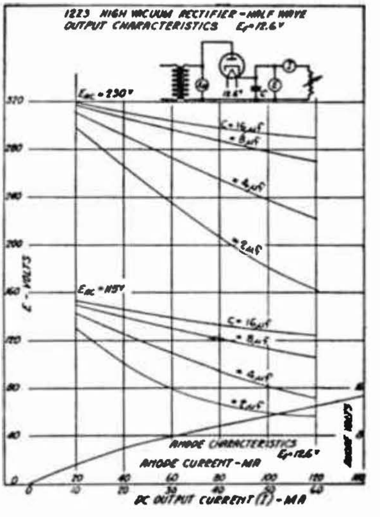
Characteristics of the '80 and 5Y3G rectifier tubes



Characteristics of the '82 rectifier.

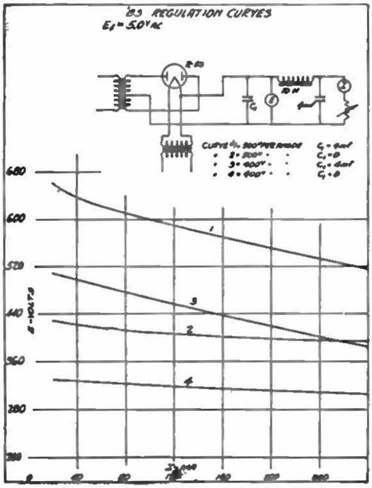


Characteristics of the 25Z5 and 25Z6 rectifier tubes.

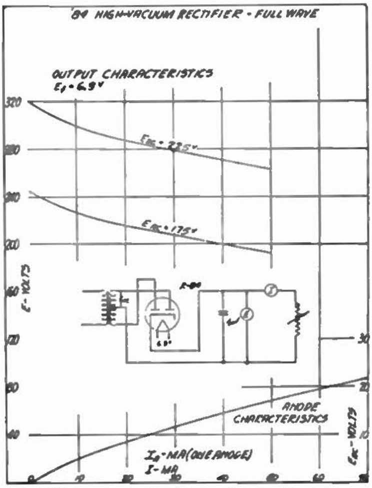


Characteristics of the 12Z3 rectifier.

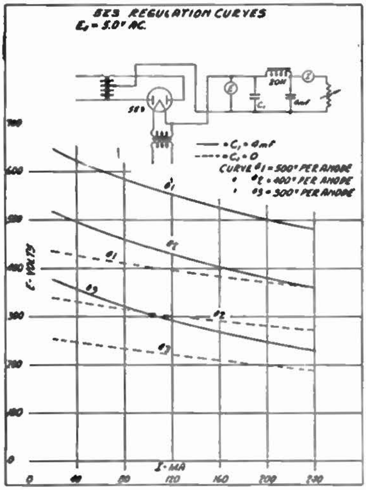
Courtesy Raytheon Production Corp.



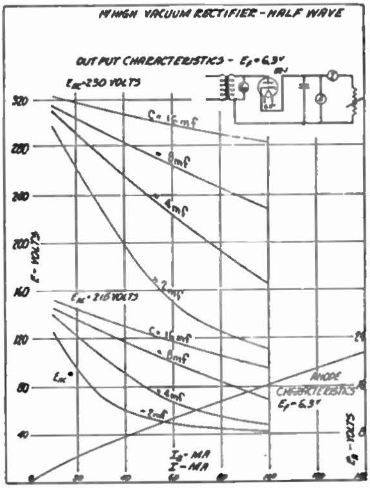
Characteristics of the '83 rectifier.



Characteristics of the '84 rectifier.



Characteristics of the 5Z3 and 5U4G rectifier tubes.



Characteristics of the 1-V rectifier.

Courtesy Raytheon Production Corp.

OPERATING CONDITIONS FOR COMBINATION TUBES EMPLOYED IN RESISTANCE-COUPLED A-F AMPLIFIERS

Combination detector-amplifier tubes, such as the 55, 75, 2B7, etc., require a plate resistor and cathode (grid-bias) resistor of definite value. They also require a grid leak (grid resistor) of definite value in the following stage. The accompanying chart (which is reproduced here through the courtesy of the engineering department of the *RCA Radiotron Co.*) tabulates the operating data for these combination tubes for easy reference. All explanatory notes for the chart are included in the footnotes at the bottom.

The operating data are given for four different values of plate-supply voltage. For each plate-supply voltage, there are four different operating conditions, depending upon the output voltage required. For example, the 2B7 tube may be used with 180 volts of *B* supply. If an undistorted output of 45 volts (peak) is required to work the following tube, then the bias on the pentode portion of the 2B7 should be 2.6 volts *negative*, the cathode resistor should have a value of 7,600 ohms to obtain this bias, the plate resistor should have a value of 0.5 megohm, the grid resistor of the following tube should have a value of 0.25 megohm, and the voltage amplification of the stage will be about 53. (For tabulated data on Grid-Bias Resistors, Power Rating of Resistors, etc., see Sections 15 and 16 of this book.)

(Chart on the following page)

OPERATING CONDITIONS FOR RESISTANCE—COUPLED A-F AMPLIFIER SERVICE

Type																	
2A6 and 75	PLATE SUPPLY** (Volts)	100				135				180				250			
	SCREEN SUPPLY (Volts)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GRID BIAS (Volts)	-1.05	-1.05	-1.10	-1.05	-1.05	-1.10	-1.05	-1.10	-1.25	-1.20	-1.30	-1.30	-1.30	-1.30	-1.35	-1.35
	CATHODE RESISTOR (Ohms)	10500	15400	11550	15000	6200	9150	5850	10000	4900	7100	5450	9000	3170	5200	3380	5600
	PLATE RESISTOR (Megohm)	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50
	GRID RESISTOR* (Megohm)	0.25	0.25	0.50	0.50	0.25	0.25	0.50	0.50	0.25	0.25	0.50	0.50	0.25	0.25	0.50	0.50
	PLATE CURRENT (Milliamp.)	0.10	0.07	0.09	0.07	0.17	0.12	0.18	0.11	0.25	0.17	0.24	0.14	0.41	0.25	0.40	0.24
	VOLT. OUTPUT** (Peak Volts)	11-16	10-14	15-19	14-19	17-23	17-21	20-30	18-27	26-33	24-30	32-40	30-38	33-38	28-35	36-46	35-44
	VOLTAGE AMPLIFICATION	30	29	36	37	42	38	50	48	48	46	56	55	51	48	59	58
2B7 and 6B7	PLATE SUPPLY** (Volts)	100				135				180				250			
	SCREEN SUPPLY (Volts)	20	20	20	20	20	20	20	20	25	25	25	25	50	50	50	50
	GRID BIAS (Volts)	-2.00	-2.50	-2.15	-2.60	-1.80	-2.25	-1.95	-2.40	-2.10	-2.60	-2.10	-2.60	-4.5	-5.0	-4.5	-5.0
	CATHODE RESISTOR (Ohms)	5550	12200	9350	19250	3800	8300	4850	10900	3700	7600	3500	7300	5500	11400	5500	11400
	PLATE RESISTOR (Megohm)	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50
	GRID RESISTOR* (Megohm)	0.25	0.25	0.50	0.50	0.25	0.25	0.50	0.50	0.25	0.25	0.50	0.50	0.25	0.25	0.50	0.50
	PLATE CURRENT (Milliamp.)	0.27	0.15	0.23	0.13	0.35	0.20	0.30	0.16	0.43	0.26	0.45	0.26	0.65	0.35	0.65	0.35
	VOLT. OUTPUT** (Peak Volts)	28-30	25-27	36-38	32-33	38-40	32-35	48-50	42-44	50-53	45-48	65-68	64-66	55-65	55-60	65-70	65-75
	VOLTAGE AMPLIFICATION	35	36	47	46	36	38	53	56	50	53	63	70	54	55	65	75
55 and 85	PLATE SUPPLY** (Volts)	100				135				180				250			
	SCREEN SUPPLY (Volts)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GRID BIAS (Volts)	-4.75	-3.75	-5.00	-5.50	-6.80	-4.75	-7.00	-7.00	-7.50	-7.00	-7.00	-7.50	-11	-10	-14	-12
	CATHODE RESISTOR (Ohms)	16800	25800	21200	46000	21200	24300	22000	42500	16300	28000	14900	31200	17600	28500	25200	38600
	PLATE RESISTOR (Megohm)	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50
	GRID RESISTOR* (Megohm)	0.25	0.25	0.50	0.50	0.25	0.25	0.50	0.50	0.25	0.25	0.50	0.50	0.25	0.25	0.50	0.50
	PLATE CURRENT (Milliamp.)	0.28	0.14	0.23	0.12	0.32	0.19	0.31	0.16	0.46	0.25	0.47	0.24	0.625	0.35	0.55	0.32
	VOLT. OUTPUT** (Peak Volts)	24-26	17-22	27-29	26-27	34-36	27-30	38-42	36-40	38-40	36-38	40-44	40-45	55-60	45-55	65-75	65-70
	VOLTAGE AMPLIFICATION	6.1	6.0	6.6	6.2	6.1	6.1	6.5	6.3	6.4	6.4	6.7	6.5	6.4	6.3	6.7	6.6
57, 77 and 6C6	PLATE SUPPLY** (Volts)	100				135				180				250			
	SCREEN SUPPLY (Volts)	20	20	20	20	25	25	25	25	30	30	30	30	52	54	50	52
	GRID BIAS (Volts)	-1.10	-1.25	-1.05	-1.25	-1.20	-1.35	-1.25	-1.40	-1.25	-1.50	-1.30	-1.55	-2	-2.2	-2.1	-2.3
	CATHODE RESISTOR (Ohms)	3760	6450	3400	7250	3100	5600	3750	6300	2180	4550	2600	4850	3100	5700	3500	6200
	PLATE RESISTOR (Megohm)	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50	0.25	0.50
	GRID RESISTOR* (Megohm)	0.25	0.25	0.50	0.50	0.25	0.25	0.50	0.50	0.25	0.25	0.50	0.50	0.25	0.25	0.50	0.50
	PLATE CURRENT (Milliamp.)	0.22	0.14	0.23	0.13	0.29	0.18	0.25	0.17	0.43	0.25	0.38	0.24	0.52	0.31	0.48	0.295
	VOLT. OUTPUT** (Peak Volts)	15-23	17-22	16-29	18-28	21-32	27-31	29-37	34-38	31-43	36-41	36-52	45-52	50-60	50-55	60-70	60-70
	VOLTAGE AMPLIFICATION	40	39	54	53	54	52	61	62	76	65	92	93	80	75	100	110

** Voltage at plate will be PLATE SUPPLY voltage minus voltage drop in plate resistor caused by plate current.

* For the following amplifier tube. The tabulated values illustrate design practice. For any particular set of conditions, however, the grid resistor for the following amplifier tube should conform to the recommendations given on the DATA page of the type involved.

** Developed across plate resistor of inter-stage coupling circuit including grid resistor of following tube. Value to left is maximum undistorted output voltage obtainable; value to right is maximum output voltage obtainable with some distortion.

Note: In the above data, the use of a coupling condenser between the plate resistor and the grid resistor of the following tube is assumed. A 0.1-microfarad condenser is usually adequate to insure good low-frequency response.

GRID-BIAS RESISTOR CHART

The Bias Resistor Chart presented herewith through the courtesy of *Radio Retailing* is designed to facilitate the determination of the proper values of grid-bias resistors for self-biased tubes for the usual operating conditions. The various columns list the following data: tube type, use, *B* supply voltage, grid-bias, screen-grid current and voltage(the latter in parentheses), the value of the bias resistor, and the power rating of the resistor.

By *use* is meant the function of the tube in the circuit. When a tube may be used for more than one purpose or under different operating conditions, the bias resistor for each purpose and condition is specified.

Combination tubes such as the 6F7 and the 6A7 are included in this chart. Unless otherwise specified, only the amplifier or detector portion of the combination tubes is considered, for the diode section of a 6B7 for example, has nothing to do with the value of the bias resistor required by the pentode section.

Certain tubes may be connected in push-pull; the resistance value of the bias resistor to be employed for tubes connected in push-pull is *half* of that specified in this chart unless otherwise stated. The wattage rating of the resistor employed should be *double* that specified in this chart. The 2A3, for example, uses slightly more than the usual one-tube bias when two are connected in push-pull; this occurs because the bias is different for two tubes than it is for one tube. The various common circuit arrangements which are employed for obtaining grid-bias voltages in modern receivers are discussed in detail in the book *Modern Radio Servicing*.

The "total" *B* supply voltage (not the voltage between plate and cathode or filament) is listed in this chart. This is import-

(Text continued on Page 15-6 after the chart)

GRID-BIAS RESISTOR CHART

Tube Type	Tube Use	B Supply Volts	Grid Bias Volts Neg.	Plate Ma.	Screen Ma. (Screen Volts)	Grid Bias Resist. (Ohms)	Bias Resist. Rating (Watts)
1A6	Pent. Conv.....	183	3	.....	....	500	½
		138	3	.....	....	500	½
2A3	Pr. Amp. (1).....	295	45	60	....	750	3
	P-P (2).........	362	62	40x2	....	800	5
2A5	Pr. Amp. 1......	266	16.5	34	6.5	400	1
2A6	Res. Coup. Volt.. Amp.	250	1.35	0.4	....	3,500	½
		180	1.30	0.24	....	5,000	½
		135	1.10	0.09	....	11,000	½
	Imp. Coup......	252	2	0.8	....	2,500	½
2A7	Sup. Conv......	250	1.5	.....	....	300	½
		150	1.5	.....	....	150	½
		100	3	.....	....	150	½
2B7	Volt Amp. Pent.. (RF) (IF)	250	3	9.0	2.3(125v)	250	½
		250	3	6.0	1.5(100v)	400	½
		180	3	3.4	0.9(75v)	750	½
		100	3	5.8	1.7(100v)	400	½
	Volt Amp. Pent A.F.	180	2.10	0.45	0.15(25v)	4,000	½
		135	1.95	0.30	0.10(20v)	5,000	½
		100	2.15	0.23	0.0(20v)	10,000	½
6A4	Pwr. Amp Pent.. Single..........	180	12	22	3.9	500	½
		165	11	20	3.5	500	½
		135	9	14	2.5	500	½
		100	6.5	9	1.6	600	½
	P-P...........	180	.....	.....	....	250	1
		165	.....	.....	....	250	1
		135	.....	.....	....	250	½
		100	.....	.....	....	300	½
6A7	Sup. Conv.....	250	1.5	....	....	300	½
		150	1.5	.....	....	150	½
6B7	Volt Amp. Pent. (RF) (IF)	250	3	9.0	2.3(125v)	250	½
		250	3	6.0	1.5(100v)	400	½
		180	3	3.4	0.9(75v)	750	½
		100	3	5.8	1.7(100v)	400	½
	Volt Amp. Pent. A.F	180	2.10	0.45	0.15(25v)	4,000	½
		135	1.95	0.30	0.10(20v)	5,000	½
		100	2.15	0.23	0.0(20v)	10,000	½
6C6	Biased Det.....	250	4.3	....	(100v)	10,000	½
		250	3.86	....	(100v)	4,000	½
		250	1.7	....	(33v)	8,000	½
		250	1.95	....	(50v)	3,000	½
	Amp...........	253	3	2.0	0.5(100v)	1,250	½
	Amp. Res. Coup.	180	1.30	0.38	0.12(30)	2,500	½
		135	1.25	0.25	0.08(25)	3,500	½
		100	1.05	0.23	0.08(20)	3,500	½
6D6	Amp...........	253	3	8.2	2.0(100v)	300	½
	Superhet. Mix:.	260	10	3.0	0.5(100v)	3,000	½
6F7	Superhet Conv..	P 260	10	2.8	0.6(100v)	1,750	½
		T 260	(0.1 ~	2.4	....	.....	..
	Diode Det. & Pent. A.F. Amp	250	3	....	(50v)	5,000	½
'01A	Amp...........	145	9	3	....	3,000	½
		95	4.5	2.5	....	2,000	½
	Biased Det.....	150	13.5	0.2	....	65,000	½
		100	7.5	0.2	....	40,000	½

GRID-BIAS RESISTOR CHART (Cont'd)

Tube Type	*Tube Use*	*B Supply Volts*	*Grid Bias Volts Neg.*	*Plate Ma.*	*Screen Ma. (Screen Volts)*	*Grid Bias Resist. (Ohms)*	*Bias Resist. Rating (Watts)*
'10	Class A Amp	465	39	18	....	2,000	1
		380	31	16	....	2,000	1
		270	22	10	....	2,250	½
11 (WD11) (WX12)	Amp........	145	10.5	3	....	3,500	½
		95	4.5	2.5	....	2,000	½
	Biased Det..	155	18	0.2	....	75,000	½
		100	10	0.2	....	50,000	½
12-A	Class A Amp	195	13.5	7.7	....	2,000	½
		145	9	6.2	....	1,500	½
		95	4.5	5.0	....	1,000	½
	Biased Det..	200	20	0.2	....	100,000	½
		150	15	0.2	....	65,000	½
20	Pr. Amp....	155	22.5	6.5	....	3,500	½
		105	16.5	3	....	6,000	½
'22	Amp RF....	135	1.5	3.7	1.3(67.5v)	300	½
		135	1.5	1.7	0.6(45v)	600	½
'24	Amp........	250	3	4	1.7(90v)	500	½
		180	3	4	1.7(90v)	500	½
	Biased Det..	275	5	0.1	0.05(45v)	30,000	½
26	Amp.......	195	14.5	6.2	....	2,500	½
		145	10	5.5	....	2,000	½
		95	7	2.9	....	2,500	½
27	Amp.......	270	21	5.2	....	4,000	½
		195	13.5	5.0	....	2,500	½
		145	9	4.5	....	2,000	½
		95	6	2.7	....	2,250	½
	Biased Det..	310	33	0.2	....	150,000	½
		280	30	0.2	....	150,000	½
30	Amp........	195	13.5	3.1	....	4,000	½
		145	9	3.0	....	3,000	½
		95	4.5	2.5	....	2,000	½
	Biased Det...	200	18	0.2	....	75,000	½
		150	13.5	0.2	....	65,000	½
		100	9	0.2	....	40,000	½
31	Pwr. Amp...	210	30	12.3	....	2,500	½
		155	22.5	8.0	....	2,500	½
32	Amp.......	180	3	1.7	0.4(67.5v)	1,500	½
		135	3	1.7	0.4(67.5v)	1,500	½
		180	1.0	0.25	0.1(30v)	3,000	½
	Biased Det..	180	6	0.2	0.05	25,000	½
		135	4.5	0.2	0.05	20,000	½
33	Pwr. Amp. Pent	150	13.5	14.5	3.0	750	½
34	RF Amp.......	180	3	2.8	1.0(67.5v)	850	½
		135	3	2.8	1.0(67.5v)	850	½
		67.5	3	2.7	1.1(67.5v)	850	½
	Superhet. Mix.	185	5	1.8	1.0(67.5v)	2,000	½
		140	5	1.8	1.0(67.5v)	2,000	½
		72.5	5	1.7	1.1(67.5v)	2,000	½
35	RF Amp......	250	3	6.5	2.5(90v)	350	½
		180	3	6.3	2.5(90v)	350	½
	Superhet Mix.	250	7	3.7	2.5(90v)	1,250	½
36	Amp.........	250	3	3.2	0.4(90v)	850	½

GRID-BIAS RESISTOR CHART (Cont'd)

Tube Type	Tube Use	B Supply Volts	Grid Bias Volts Neg	Plate Ma.	Screen Ma. (Screen Volts)	Grid Bias Resist. (Ohms)	Bias Resist. Rating (Watts)
37		180	3	3.1	0.4(90v)	850	[illegible]
		135	1.5	2.8	0.4(67.5v)	500	[illegible]
		100	1.5	1.8	0.4(55v)	750	[illegible]
	Amp..........	270	18	7.5	....	2,500	[illegible]
		195	13.5	4.3	....	3,000	[illegible]
		145	9	4.1	....	2,500	[illegible]
		95	6	2.5	....	2,500	[illegible]
	Biased Det.....	280	28	0.2	....	100,000	[illegible]
		200	20	0.2	....	100,000	[illegible]
		150	15	0.2	....	75,000	[illegible]
		100	10	0.2	....	50,000	[illegible]
38	Pwr. Amp. Pent.	275	25	22	3.8	1,000	[illegible]
		200	18	14	2.4	1,000	[illegible]
		150	13.5	9	1.5	1,250	[illegible]
		110	9	7	1.2	1,250	[illegible]
39	Amp...........	253	3	5.8	1.4(90v)	400	[illegible]
		183	3	5.8	1.4(90v)	400	[illegible]
		93	3	5.6	1.6(90v)	400	[illegible]
	Superhet Mix...	257	7	2.5	1.0(90v)	2,000	[illegible]
		187	7	2.4	1.0(90v)	2,000	[illegible]
		97	7	2.4	1.0(90v)	2,000	[illegible]
40	Amp...........	180	3	0.18	....	15,000	[illegible]
		135	1.5	0.18	....	10,000	[illegible]
	Biased Det......	180	4.5	0.08	....	50,000	[illegible]
		135	3	0.07	....	40,000	[illegible]
41	Pwr. Amp. Pent.	268	18	32	5.5	500	1
		193	13.5	18.5	3.0	600	[illegible]
		145	10	12.5	2.2	600	[illegible]
		107	7	9.0	1.6	600	[illegible]
42	Pwr. Amp. Pent.	266	16.5	34	6.5	400	1
43	Pwr. Amp. Pent.	155	20	34	7	500	1
		110	15	20	4	600	[illegible]
44	Amp...........	253	3	5.8	1.4(90v)	400	[illegible]
		183	3	5.8	1.4(90v)	400	[illegible]
		93	3	5.6	1.6(90v)	400	[illegible]
	Superhet. Mix...	257	7	2.5	1.0(90v)	2,000	[illegible]
		187	7	2.4	1.0(90v)	2,000	[illegible]
		97	7	2.4	1.0(90v)	2,000	[illegible]
45	Pwr. Amp......	331	56	36	....	1,555	5
		300	50	34	....	1,500	2
		211	31.5	31	....	1,000	2
46	Class A Driver..	283	33	22	....	1,500	1
47	Pwr. Amp. Pent.	266	16.5	31	6	450	1
48	Pwr. Amp...... Tet...........	147	22.5	50	9(100v)	400	2
		115	20	48	9(95v)	350	2
49	Pwr. Amp. Class A Tri......	155	20	5.7	....	3,500	[illegible]
50	Pwr. Amp.......	534	84	55	....	1,500	5
		470	70	55	....	1,250	5
		413	63	45	....	1,500	5
		354	54	35	....	1,500	2

GRID-BIAS RESISTOR CHART (Cont'd)

Tube Type	*Tube Use*	*B Supply Volts*	*Grid Bias Volts Neg*	*Plate Ma.*	*Screen Ma. (Screen Volts)*	*Grid Bias Resist. (Ohms)*	*Bias Resist. Rating (Watts)*
53	Pwr. Amp. Class A Tri.	300	6	7	....	850	½
		255	5	6	....	850	½
55	Amp. (Trans .Coup.)	270	20	8	....	2,500	½
		193	13.5	6	....	2,250	½
		145	10.5	3.7	....	2,500	½
	Amp. (Res. Coup.)	180	7.0	0.47	....	15,000	½
		135	7.0	0.31	....	20,000	½
		100	5.0	0.23	....	20,000	½
56	Amp......	263	13.5	5	....	2,500	½
	Biased Det.	270	20	0.2	....	100,000	½
57	Biased. Det	250	4.3	.....	(100v)	10,000	½
		250	3.86	.....	(100v)	4,000	½
		250	1.7	.....	(33v)	8,000	½
		250	1.95	.....	(50v)	3,000	½
	Amp.......	253	3	2.0	0.5(100)	1,250	½
	Amp. (Res. Coup.)	180	1.30	0.38	0.12(30)	2,500	½
		135	1.25	0.25	0.08(25)	3,500	½
		100	1.05	0.23	0.08(20)	3,500	½
58	Amp........	253	3	8.2	2.0(100v)	300	½
	Superhet Mix.	260	10	3.0	0.5(100v)	3,000	½
59	Amp. Class A Tri.	278	28	26	....	1,000	1
	Amp. Class A Pent	....	18	35	9 (250v)	400	1
71A	Pwr. Amp......	220	40.5	20	....	2,000	1
		162	27	17.3	....	1,500	½
		106	16.5	10	....	1,500	½
75	Res. Coup. Volt Amp.	250	1.35	0.4	....	3,500	½
		180	1.30	0.24	....	5,000	½
		135	1.10	0.09	....	11,000	½
	Imp. Coup.....	252	2	0.8	....	2,500	½
77	Amp..........	253	3	2.3	0.6(100v)	1,000	½
		101	1.5	1.7	0.4(60v)	750	½
	Biased Det...	250	4.3	.....	(100v)	10,000	½
		250	1.95	.....	(50v)	3,000	½
		250	1.95	.....	(36v)	12,500	½
78	Amp........	253	3	10.5	3.0(125v)	250	½
		253	3	7.0	2.0(100v)	300	½
		183	3	4.0	1.0(75v)	600	½
		93	3	5.4	1.5(90v)	450	½
79	Class A Tri..	250	1.5	0.5	....	3,000	½
85	Amp.(Trans Coup.)	270	20	8	....	2,500	½
		193	13.5	6	....	2,250	½
		145	10.5	3.7	....	2,500	½
	Amp. (Res. Coup.)	180	7.0	0.47	....	15,000	½
		135	7.0	0.31	....	20.000	½
		100	5.0	0.23	....	20,000	½
89	Amp. Class A. Tri.	281	31	32	....	1,000	2
		202	22.5	20	....	1,250	1
		180	20	17	....	1,250	½
	Amp. Class A. Pent.	275	25	32	5.5	750	2
		198	18	20	3.0	750	½
		148	13.5	14	2.2	850	½
		110	10	9.5	1.6	1,000	½
99	Amp.........	94	4.5	2.5	....	2,000	½
	Biased Det....	100	10.5	0.2	....	50,000	½

GRID-BIAS RESISTOR CHART (Cont'd)

Tube Type	*Tube Use*	*B Supply Volts*	*Grid Bias Volts Neg*	*Plate Ma.*	*Screen Ma. (Screen Volts)*	*Grid Bias Resist. (Ohms)*	*Bias Resist. Rating (Watts)*
841	Amp.......	1,000	9	2.2	....	4,000	½
		425	6	0.7	....	8,000	½
842	Pwr. Amp...	525	100	28	....	3,500	5
		422	72	34	....	2,000	5
864	Amp.......	144	9	3.5	....	2,500	½
		94	4.5	2.9	....	1,500	½
	Biased Det.	150	15	0.2	....	75,000	½
		100	10.5	0.2	....	50,000	½

(*Text continued from Page 15-1*)

ant for, in a resistance-coupled amplifier for instance, the actual plate-cathode voltage as measured will usually differ considerably from the *B* supply voltage, and hence may have little significance unless the supply voltage is known. In any case, the total *B* supply voltage is equal to the voltage drop across the plate circuit load plus the plate-cathode voltage plus the grid bias voltage.

Although the correct bias resistor values for most tubes are given in this chart, it should be remembered that the value of the bias resistor required for any tube may also be computed easily by Ohm's law if the required bias voltage and *cathode* current are known. Thus, suppose the bias resistor for the type '58 tube as an amplifier is to be computed. The required bias voltage is to be 3 volts, the plate current is 8.2 ma. and the screen-grid current is 2.0 ma. (see chart). The sum of the plate and screen currents is the *cathode* current, which is 10.2 ma. in this case. The value of the bias resistor required is, then:

$$R = E/I = 3/0.0102 = 300 \text{ ohms (nearly).}$$

Note that the cathode current is expressed in *amperes* in this calculation (if the other units are in *volts* and *ohms*).

RESISTANCE—CURRENT—VOLTAGE—POWER RATING CHART FOR RESISTORS

The chart shown on the opposite page (through the courtesy of *RADIO TODAY* Magazine) has been designed especially to enable rapid determination of the *potential drop* across, the *current* through, or the *power* dissipated in a given resistor to be made when any two of these four quantities are known. In addition, it enables one to select a resistor of the correct wattage rating for use under radio chassis operating conditions. The entire chart really represents Ohm's law plotted for the ranges of values commonly encountered in radio work, and it makes it unnecessary to carry out numerical calculations for simple problems involving resistor selection and design.

How to Use the Chart: With this chart, it is possible to find any two of the following items—current, voltage, wattage, resistance—if the other two are already known.

Lay a ruler or "straight-edge" across the chart so that it intersects the two scales at the points for which the values are known. The points at which the ruler crosses the other two scales mark the desired values. Do not use scale "B" with scale "A"—always employ similar scales—either "A" exclusively or "B" exclusively.

As an example of the method of using the chart, the dotted line which has been drawn on it indicates the following relationships:

On scale "A":

(1) If 100 volts is applied to a resistor of 5000 ohms, then 20 ma. of current will flow. The power dissipated is 2 watts, and a 2-watt composition type resistor may be used.

(2) If a current of 20 ma. is to flow through a resistor when 100 volts is applied across it, the resistor should

have a value of 5000 ohms and be a 2-watt "composition type unit".

(3) If a current of 20 ma. flows through a resistor of 5000 ohms, there will be a potential drop of 100 volts across it. The resistor must be a 2-watt "composition type unit".

On scale "B":

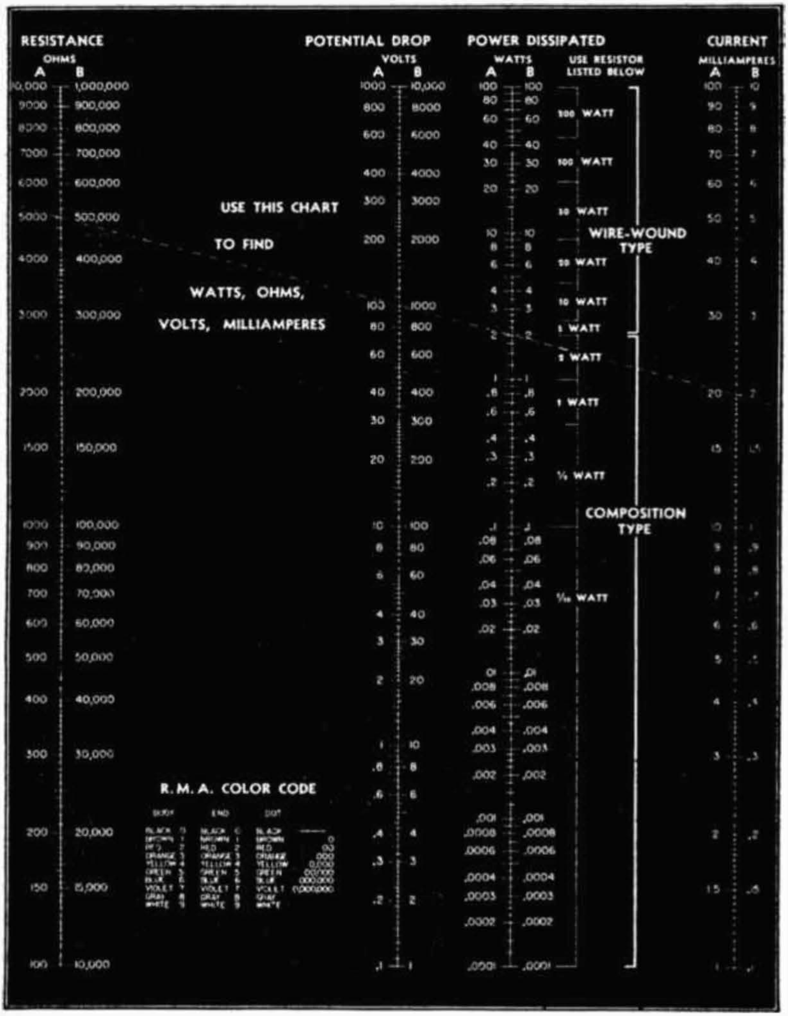
(1) If 1000 volts is applied to a resistor of 500,000 ohms, then 2 milliamperes of current will flow. The power dissipated is 2 watts, and a 2-watt "composition type" resistor may be used.

(2) If a current of 2 ma. is to flow through a resistor when 1000 volts is applied across it, the resistor should have a value of 500,000 ohms and be a 2-watt "composition type unit".

(3) If a current of 2 ma. flows through a resistor of 500,000 ohms, there will be a potential drop of 1000 volts across it. The resistor must have a 2-watt rating and may be the "composition type".

It is standard practice for resistor manufacturers to rate the wattage-dissipation values of their resistors on the basis of the resistors being mounted and operated in *free air*. When such resistors are mounted in the usual restricted, poorly ventilated positions under a radio chassis, they cannot dissipate as much electrical power (in the form of heat) as this without an abnormal and undesirable rise in operating temperature. Therefore, in radio receivers resistors having a larger wattage rating than the scale headed "WATTS" indicates must usually be used. The recommended values for radio set practice are listed in the column headed "USE RESISTOR LISTED BELOW".

Limitations of Chart: Obviously, this chart is of value only when the quantities involved fall within the ranges of the scales; for values beyond these limits, it is best to resort to numerical calculations, using the conventional Ohm's law formulas for resistance calculations and the formula $W=E\times I$, or $W=I^2R$, for power calculations. Then, too, this chart is suitable only when "approximate" results are desired. Of course, the accuracy with which values may be found by means of this chart depends upon



Courtesy "Radio Today"

how accurately the ruler is placed at the exact points on the scales, and the accuracy with which the scales themselves are read. It is well for the student or novice to solve a simple problem first by numerical calculation, and then to work it out by means of the chart in order to familiarize himself with the method of using it. He will then have a check on his own computations as well.

RMA STANDARD COLOR CODES

FIXED RESISTORS—FIXED CONDENSERS—DYNAMIC SPEAKER LEADS—BATTERY CABLE LEADS—RADIO POWER TRANSFORMER LEADS—I-F TRANSFORMER LEADS—AUDIO TRANSFORMER LEADS.

The "Standards Committee" of the Radio Manufacturers Association (RMA) has adopted standard color codes for marking fixed resistors, fixed condensers, dynamic speaker leads, radio power transformer leads, i-f transformer leads, and audio transformer leads. These codes enable one to determine the value of a resistor or a condenser by visual inspection without recourse to measurement. They also allow the service man to trace the connections from radio power, i-f and audio transformers, and from the output of the receiver to the various parts of the dynamic speaker. The codes have been in general use for some time, and may be relied upon where color coding is used on the components of receivers made by manufacturers who are members of the RMA.

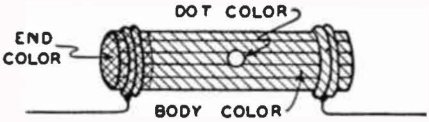
The resistor and condenser color codes are of special importance. If a resistor open- or short-circuits in a receiver, the code enables the service man to determine at a glance the correct value of the replacement resistor; likewise with fixed condensers.

Resistor Color Code: Ten colors have been assigned to this code, one color for every digit, as shown below.

Color	*Figure*	*Color*	*Figure*
Black	0	Green	5
Brown	1	Blue	6
Red	2	Violet	7
Orange	3	Gray	8
Yellow	4	White	9

The resistor is colored in three places: on the *body* (or horizontal part of the unit); at *one* end, or *tip*; and by a *band* or small *dot* placed near the *center* of the resistor. These designations are shown in the accompanying illustration.

The number corresponding to the *body* color represents the first figure of the resistance value; the *end* or *tip* color represents the second figure of the resistance value; and the *band* or *dot* in



How the standard RMA Resistor Color Code is marked on a typical carbon resistor.

the center of the body represents the number of zeros following the first two figures. For example, the "body", or "main", color of a resistor is *blue*, the tip is *red* and the band is *black*. What is the value of the resistor? As seen in the table on page 197, *blue* corresponds to the digit 6, *red* to the digit 2, and the band-color *black* means that there are no zeros following the second figure. The resistor, therefore, has a value of 62 ohms. If the band color were *brown*, then the resistor value would be 620 ohms, since *brown* corresponds to the digit 1, which means that there is one zero following the first two digits. The following table illustrates several additional examples, the various code color markings found on the resistor, and the corresponding resistor value in each case being given.

"Body" Color and Digit	*"End" Color and Digit*	*"Band" or "Dot" Color and Zeros*	*Resistor Value*
Brown (1)	Black (0)	Black (none)	10 ohms
Red (2)	Black (0)	Brown (0)	200 ohms
Orange (3)	Black (0)	Red (00)	3,000 ohms
Orange (3)	Yellow (4)	Red (00)	3,400 ohms
Yellow (4)	Black (0)	Orange (000)	40,000 ohms
Yellow (4)	Yellow (4)	Orange (000)	44,000 ohms
Yellow (4)	Orange (3)	Orange (000)	43,000 ohms

Resistors in the late models of receivers which are manufactured by member companies of the RMA are marked with this color code for easy identification. The service man will find it to his advantage to know this code. Since the resistors in many of the older receivers were not color coded according to this RMA standard code, it is a safe practice on all older models of receivers to refer to the manufacturer's service charts or a good service manual for the color codes used on the resistors.

Condenser Color Code: The condenser color code is applied to fixed mica condensers and is somewhat similar to the resistance code explained previously. The fixed condenser to be coded has three dots on it on the trademark side, each colored differently according to following color code:

Color	*Figure*	*Color*	*Figure*
Black	0	Green	5
Brown	1	Blue	6
Red	2	Violet	7
Orange	3	Gray	8
Yellow	4	White	9

The first dot, reading from left to right, represents the first figure of the condenser value, the second color represents the second figure of the condenser value, and the third figure represents the number of zeros following the first two figures. This code, therefore is almost exactly the same as the resistor color code. The important point here is that the capacity of the condenser must be expressed in micro-microfarads (mmfd). The following table of examples will serve to illustrate the working of this code:

First Color and Digit	*Second Color and Digit*	*Third Color and Zeros*	*Condenser Value (Mmfd.)*	*Condenser Value (Mfd.)*
Black (0)	Green (5)	Black (none)	5	.000005
Brown (1)	Black (0)	Black (none)	10	.00001
Green (5)	Black (0)	Black (none)	50	.00005
Brown (1)	Black (0)	Brown (0)	100	.0001
Red (2)	Green (5)	Brown (0)	250	.00025
Green (5)	Black (0)	Brown (0)	500	.0005
Brown (1)	Black (0)	Red (00)	1,000	.001

This code covers most of the condenser values used in practice, but there may be values in which the third digit is not zero, such as in the case of a condenser having a capacity of 1,250 mmfd. In this case, the first two figures are colored on one side of the condenser and the third is left blank, which indicates that the remaining code is on the reverse side of the condenser. Use is then made of two code rings on the reverse side of the condenser (the reverse side from the trademark), the dot on the left indicating the third digit and the dot on the right indicating the number of zeros following the third digit. For example:

1,250 mmfd. = brown and red on one side (trademark side) and green and brown on the other.

375 mmfd. = orange and violet on the trademark side and green and black on the other.

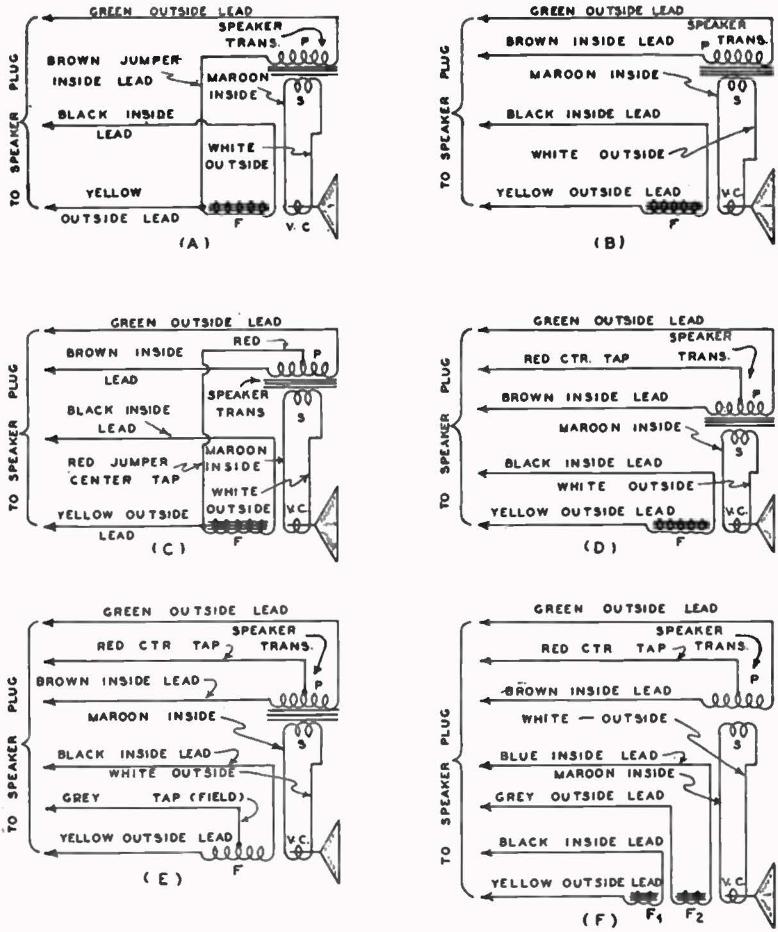
Dynamic Speaker Color Code: The leads from dynamic speakers to the speaker plugs may be color-coded according to the standard RMA color-code system shown in Figs. *A* to *F* inclusive of the illustration on page 17-5. Figure *A* shows the standard color code for a three-wire connection, as one side of the primary of the output transformer is connected internally, as shown, to one side of the field coil.

Figure *B* represents conditions when separate field and output transformer leads are brought out. Figure *C* is similar to Fig. *A* except that the primary of the output transformer is tapped for push-pull use. Figure *D* is similar to Fig. *B* except that the primary of the output transformer is tapped. Figure *E* shows the color coding when the field coil is also tapped. Figure *F* shows the coding when two field coils are used in the same speaker.

Standard Battery Cable Color Code: A standard color code has also been approved by the National Electrical Manufacturers Association (NEMA) for the wires comprising the cables used for connecting battery-operated receivers to the batteries. This wire code is not standard on all battery-operated receivers, but it is being used by manufacturer members of the N.E.M.A. The standard battery cable color code is as follows:

A+ (*yellow*); *A*− (*black* with *yellow tracer*); *B*+ max. (*red*);

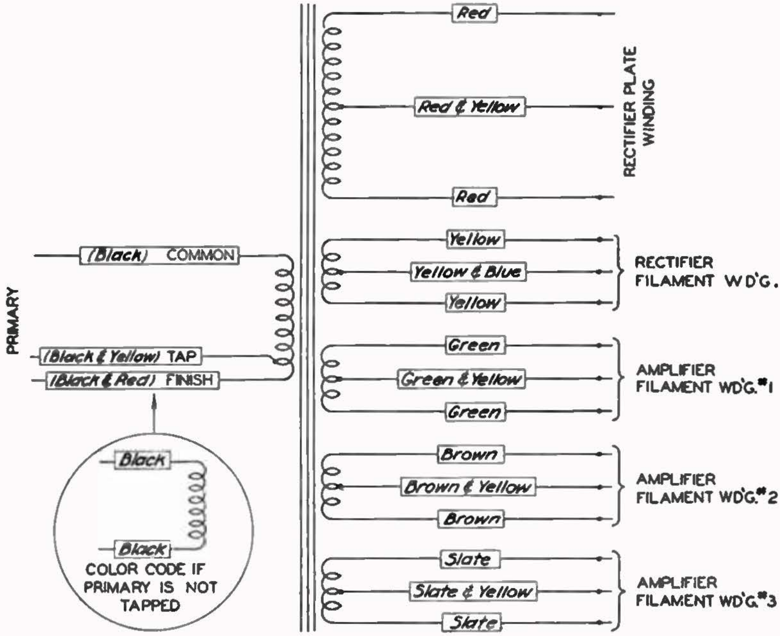
B+ int. (*maroon* and *red*); *B+* det. (*maroon*); *B—* (*black* with *red tracer*); *C+* (*green*); *C— low* (*black* and *green*); *C—* max.



Standard RMA Color Code for the leads of the various dynamic loud speaker arrangements shown. (See explanation on page 17.4).

(*black* with *green tracer*); Loud Speaker, *high side* (*brown*); Loud Speaker, *low side* (*black* with *brown tracer* running through).

Radio Power Transformer-Lead Color Code: It is standard among member manufacturers of the RMA to use the following color code on the leads of power transformers for purposes of terminal identification. (This Color code was adopted on May 17, 1935.)



Standard RMA Color Code for the leads of radio power transformers. (See accompanying text for explanation).

Primary Leads: If the primary winding is not tapped, both primary leads are *black.*

If the primary winding is tapped, the leads are as follows:

Common—*black*

Tap—*black* and *yellow* 50/50 striped design

Finish—*black* and *red* 50/50 striped design

Rectifier Plate Winding: Outside leads—*red;*

Center Tap—*red* and *yellow* 50/50 striped design

Rectifier Filament Winding: Outside leads—*yellow;* Center Tap—*yellow* and *blue* 50/50 striped design

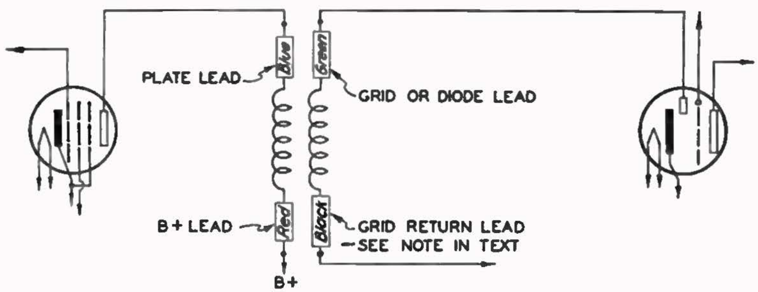
Amplifier Fil. Winding No. 1: Outside leads—*green;* Center Tap—*green* and *yellow* 50/50 striped design

Amplifier Fil. Winding No. 2: Outside leads—*brown;* Center Tap—*brown* and *yellow* 50/50 striped design

Amplifier Filament Winding No. 3: Outside leads—*slate;* Center Tap—*slate* and *yellow* 50/50 striped design

An illustration which shows the various windings of a power transformer with these color-code markings applied to its leads is presented herewith to aid in understanding this code.

I-F Transformer Lead Color Code: The standard RMA color code (adopted as standard on May 17, 1935) employed on



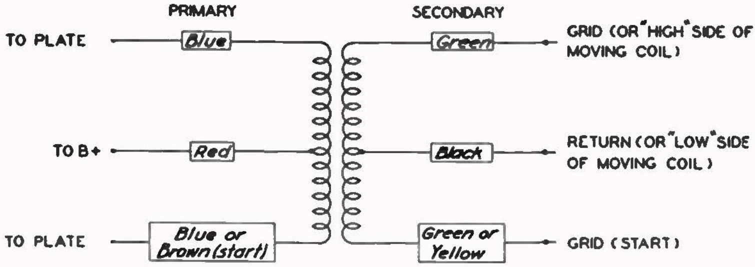
Standard RMA Color Code for the leads of intermediate-frequency transformers. (See accompanying text for explanation).

the leads of intermediate-frequency transformers for purposes of terminal identification is as follows:

Plate Lead—*blue*
B+ Lead—*red*
Grid (or Diode) Lead—*green*
Grid Return Lead—*black*
Note: (For a "full-wave" transformer, the second diode lead is *green-black*)

This color code is shown pictorially in the illustration above.

Audio Transformer Lead Color Code: The standard RMA color code (adopted as standard on May 17, 1935) employed on the leads of audio-frequency transformers for purposes of terminal identification is shown in the accompanying illustration:



Standard RMA Color Code for the leads of audio-frequency transformers. (See accompanying text for explanation).

In cases of use of a single primary and/or a single secondary, only the *top-half* portion of the windings shown in the accompanying illustration should be used to indicate the color coding. When polarity of primary (and/or secondary) is not a factor, both outside leads may be the same color as indicated. Where polarity must be indicated, the *Brown* and *Yellow* leads shall indicate the start of the primary winding and the start of the secondary winding respectively. In the case of an output transformer, the *Black* lead shall be the start of the secondary.

RMA STANDARD PANEL- OR DIAL-LIGHT LAMP BULB DATA

Following are the RMA standard specifications (adopted May 17, 1935) for the miniature incandescent lamp bulbs which are commonly employed to illuminate the tuning dials of radio receivers, act as pilot lights, wave-band indicator lights, etc.

Mazda Lamp No.	*Circuit Volts*	*Design Volts*	*Amperes*	*Normal C.P.*	*Hours Life‡*	*Type Base*
40	6.3	6.3	.15	½	3000	Min.Sc.
41	2.5	2.5	.50	½	3000	Min.Sc.
*44	6.3	6.3	.25	¾	3000	Min.Bay.
*46	6.3	6.3	.25	¾	3000	Min.Sc.
†	2	2	.06	—	1000	Min.Bay.
†	2	2	.06	—	1000	Min.Sc.

*Recommended for new designs.
†For two-volt battery service.
‡Normal average life expectancy at design volts.
Min.Sc.=Miniature Screw base.
Min.Bay.=Miniature Bayonet base.
C.P.=candlepower.

The current, in *amperes*, taken by each bulb is specified in the table. It is often important to know this, especially in the case of series-filament receivers where the light-bulb filament is connected in some type of series or parallel-series arrangement with the receiver tube filament circuit.

PHILCO FIXED RESISTOR COLOR CODE NUMBERING SYSTEM

A special eight-digit numbering system and color code arrangement is being employed by Philco for convenience in the Philco factory and should be understood by radio service men who have occasion to order Philco parts from the factory, or refer to the service bulletins of this manufacturer.

Part numbers for Philco fixed resistors consist of a *prefix* of two figures and a *body* of six figures. The *prefix* in all cases is the number "33". The first three figures of the *body* number refer to the value of the resistor in ohms, and correspond to the Standard RMA Fixed Resistor Color Code already explained on page 17-2, that is:

The *first figure* of the *body* number indicates the *dot* color of the RMA color code (see page 17-2), or the number of zeros after the first two figures of the resistance value.

The *second figure* of the *body* number indicates the *body* color of the RMA color code, or the first figure of the resistance value.

The *third figure* of the *body* number indicates the *tip* color of the RMA color code, or the second figure of the resistance value.

The next (*fourth*) figure of the *body* number represents the *wattage* rating of the resistor, as follows:

1 equals 1/4 watt	*4* equals 1 watt
2 equals 1/3 watt	*5* equals 2 watts
3 equals 1/2 watt	*6* equals 3 watts

The next (*fifth*) figure of the *body* number denotes the manufacturing code of "tolerance".

The last (*sixth*) figure of the *body* number denotes the manufacturing code of "resistor type".

Examples: A resistor numbered *33-215343* is a 1500-ohm, ½-watt insulated resistor. A resistor numbered *33-449431* is a 490,000-ohm, 1-watt lead-end resistor.

In connection with the Philco fixed resistor color coding, it will be noticed that resistors having odd values of resistance are commonly used instead of the more common nearest-even values employed by other manufacturers. For example, examination of a standard Philco chassis may reveal resistors coded 51,000 ohms, 99,000 ohms, etc., instead of the more usual "even" values of 50,000 and 100,000 ohms.

The reason why Philco resistors have these odd values is because of greater convenience in manufacturing under the bluish-green light produced by the Cooper-Hewitt mercury vapor lamps employed for illumination throughout the Philco assembly plant. Under this type of light, it is extremely difficult to distinguish the colors in the color coding of a 50,000-ohm resistor for example, but the color-code colors of a 51,000-ohm resistor show up very clearly. The same applies with respect to other resistor values which may seem rather odd to service men. Of course the circuits are designed to operate correctly with these special values.

CONDENSER REACTANCES AT POWER SUPPLY, AUDIO AND RADIO FREQUENCIES

The necessity for knowing the reactance of a condenser at the commonly used frequencies in radio work arises from time to time, and the service man must usually resort to numerical calculation in order to find it. The formula for the reactance of a condenser is:

$$X_c = \frac{1}{2\pi f C}$$

where X_c is the condenser reactance in ohms, 2π equals 6.28, f is the frequency in cycles per second, and C is the capacity in farads.

As the calculation of capacitive reactance is rather tedious due to the large numbers which are usually involved, the reactances of a number of "standard" size condensers at several commonly encountered frequencies have been calculated by means of this formula, and the answers have been arranged in the reactance chart presented here for convenience. For example, by referring to this chart, it is seen that a 0.05 mfd. condenser has a reactance of about 2.1 ohms at 1,500,000 cycles (the upper end of the broadcast band), and a 0.01 mfd. condenser has a reactance of 318,471 ohms at 50 cycles. The values of condensers shown in the broadcast and power frequency sections are those which are used most in applications at these frequencies, as are those condenser sizes which are listed in the high-frequency section of the chart.

Examination of the foregoing formula shows that the reactance of a condenser is inversely proportional to the frequency. It is also inversely proportional to the capacity. Therefore, if the *frequency* of the voltage applied to the circuit in which a con-

(*Text continued on Page 20-3*)

REACTANCE OF "STANDARD SIZE" CONDENSERS AT POWER SUPPLY, AUDIO AND RADIO FREQUENCIES

CAP. IN MFDS.	FREQUENCY IN CYCLES PER SECOND											
	Power Supply Frequencies			Audio Frequencies		Broadcast Radio Frequencies		Short-Wave Radio Frequencies				
	25*	60**	120	50	10,000	50,000	1,500,000	1.875 Mc. (160 Meters)	3.75 Mc. (80 Meters)	7.5 Mc. (40 Meters)	15 Mc. (20 Meters)	30 Mc. (10 Meters)
	CAPACITIVE REACTANCE IN OHMS											
.00005	127,388,534	53,078,503	26,539,252	63,694,267	318,471	6,369.4	2,123.1	1,696.	848.	424.	212.	106.
.0001	63,694,267	26,539,252	13,269,626	31,847,133	159,235	3,184.7	1,061.6	848.	424.	212.	106.	53.
.00025	25,477,706	10,615,600	5,307,850	12,738,853	63,694	1,273.8	424.6	339.2	169.6	84.8	42.4	21.2
.0005	12,738,853	5,307,850	2,653,925	6,369,426	31,847	636.9	212.3	169.6	84.8	42.4	21.2	10.6
.001	6,369,427	2,653,925	1,326,963	3,184,713	15,924	318.5	106.2	84.8	42.4	21.2	10.6	5.3
.005	1,273,885	530,785	265,393	636,943	3,185	63.7	21.2	16.96	8.48	4.24	2.12	1.0
.01	636,943	265,393	132,696	318,471	1,592	31.8	10.6	8.48	4.24	2.12	1.06	.53
.015	424,629	176,929	88,464	212,314	1,061	21.2	7.1	6.24	3.12	1.56	.73	.36
.02	318,471	132,697	66,348	159,235	796	15.9	5.3	4.16	2.08	1.04	.52	.26
.05	127,389	53,078	26,539	63,694	318	6.4	2.1	1.68	.84	.42	.21	.1
.1	63,694	26,539	13,270	31,847	159	3.2	1.1	.8	.42	.20	.10	.053
.25	25,478	10,616	5,308	12,739	64	1.28	.42	.336	.168	.084	.042	.021
.5	12,739	5,308	2,654	6,369	32	.64	.21	.168	.084	.042	.021	.01
1.0	6,369	2,654	1,327	3,184	15.9	.32	.11	.08	.04	.02	.01	.005
2.0	3,184	1,327	663	1,592	7.9	.16	.05	—	—	—	—	—
4.0	1,592	664	332	769	3.9	.08	.03	—	—	—	—	—
6.0	1,062	442	221	531	2.6	.05	.02	—	—	—	—	—
8.0	796	332	166	398	2.0	.04	.01	—	—	—	—	—
10.0	637	265	133	318	1.6	.03	.01	—	—	—	—	—
15.0	425	177	88	212	1.1	.02	.01	—	—	—	—	—

* Reactance of the condensers in the filter circuit of a full-wave rectifier rectifying a 25-cycle current is equivalent to the reactance values listed in the 50-cycle column under "Audio Frequencies".

** Reactance of the condensers in the filter circuit of a full-wave rectifier rectifying a 60-cycle current is equivalent to the reactance values listed in the 120-cycle column under "Power Supply Frequencies".

Half wave rectification should never be employed for current from a 25-cycle power line because of the difficulty in reducing the hum to a negligible value.

(*Text continued from Page 20-1*)

denser is used is *doubled,* say, the reactance of the condenser is reduced to *half* its former value. Likewise, if the capacity of a condenser is doubled, its reactance at a given frequency will be reduced to half its former value. If these relations are remembered, it is a simple matter to calculate mentally, the reactance of almost any capacity not listed in this chart, and at almost any frequency.

For instance, the reactance of a 0.001 mfd. condenser at a frequency of 30 megacycles is 5.3 ohms (from the chart). At a frequency of 25 megacycles (not listed on the chart) it would be equal to $30/25 \times 5.3 = 6.36$ ohms. Similarly, at a frequency of 50 megacycles (not on the chart) it would be equal to only $30/50 \times 5.3 = 3.18$ ohms.

Likewise, the reactance of a 0.001 mfd. condenser at 30 megacycles is 5.3 ohms (from the chart). The reactance of a 0.003 mfd. condenser (not listed on the chart) at this same frequency is equal to $0.001/0.003 \times 5.3 = 1.77$ ohms. Similarly, the reactance of a 0.0007 mfd. condenser (not listed on the chart) at this same frequency is equal to $0.001/0.0007 \times 5.3 = 7.57$ ohms.

LITZ WIRE TABLE

Litzendraht (commonly abbreviated "Litz") wire is used extensively in r-f coils when the resistance of the coil must be maintained at a low value even though the coil is to be used at very high frequencies. This wire consists of many strands of fine enameled wire bound together by a covering of single silk, double silk, or cotton. The number of strands varies with the requirements of the application.

Litz wire is gauged according to the same numbering system that is used for solid wires, although, due to the fact that there are void spaces between the individual strands of wire, its overall outside diameter is different than the diameter of a solid wire of corresponding gauge number. The table below lists the overall diameters of commonly used sizes of Litz wire. It also specifies the number and size of the individual strands of insulated wire of which it is composed. The number of turns per linear inch may be obtained (approximately) by dividing the diameters given here into 1.

LITZ WIRE

Size B.&S. Gauge	*Construction*	*Max. Overall Diameter (Inches)*
14	24 Strands No. 28	0.100
15	49 " " 32	0.076
16	162 " " 38	0.084
20	16 " " 32	0.057
20	60 " " 38	0.048
21	35 " " 36	0.041
21	48 " " 38	0.054
22	37 " " 38	0.037
23	32 " " 38	0.038
28	10 " " 38	0.021
25	20 " " 38	0.025

WIRE TABLE FOR BARE & MAGNET COPPER WIRE

The following table is a compilation of data on all commonly used sizes of copper wire in both bare form and those insulated forms which are employed extensively for coil windings of all sorts in radio receivers. This tabulation should prove helpful to radio service men. The diameter in mils (thousandths of an inch) may be converted to the more common measurement of area, the *circular mil,* by merely "squaring" the *diameter in mils.* Thus, No. 27 B&S gauge wire (which has a diameter of 0.0142 inches, or $0.0142 \times 1{,}000 = 14.2$ mils) has a cross-sectional area of $14.2 \times 14.2 = 201.6$ CM (circular mils). A column giving the area in *circular mils* of each size of wire is included in this tabulation. The remaining tabulations are self-evident.

The current-carrying capacity of wire wound into the form of a coil depends upon how fast the heat developed within the wire (by the flow of the current against its resistance), can be dissipated. This depends upon several factors; among these, are: (*a*) the ratio of the length to the diameter of the coil (this affects the total surface area effective for ventilation; (*b*) the heat conductivity of the core material; (*c*) whether the coil is impregnated or not; (*d*) the amount of ventilation afforded; (*e*) the proximity of hot objects such as rectifier tubes, etc. It is evident, therefore, that the safe current-carrying capacity of magnet wire may vary over wide limits depending upon the physical makeup of the coil. In general, when a coil is constructed and mounted so that it is well ventilated, the safe current carrying capacity may be taken at 1,500 CM per ampere of current; when it is not well ventilated (such as in a closely-wound multi-layer coil), the current carrying capacity may be taken at the lower value of 1,000 CM per ampere.

COPPER WIRE TABLE

Gauge No. B. & S.	Diam. in Mils*	Area in Circular Mils	Feet per Ohm (25° C.)	Ohms per 1,000 feet (25° C.)	Feet Per Pound					Turns Per Linear Inch†						Turns per Square Inch†			Safe Current Carrying Cap. at 1,500 CM per Amp. ‡	Current Required to Fuse Wire
					Bare	S.S.C.	D.S.C.	S.C.C.	D.C.C.	Bare	S.S.C.	D.S.C.	S.C.C.	D.C.C.	Enam.	Enamel +S.C.C.	D.C.C.	S.C.C.		
1	289.3	83,690	7,914	.1264	3.95	—	—	3.93	3.91	—	—	—	—	—	—	—	—	—	55.7	—
2	257.6	66,370	6,276	.1593	4.98	—	—	4.95	4.92	—	—	—	—	—	—	—	—	—	44.1	—
3	229.4	52,640	4,977	.2009	6.28	—	—	6.24	6.20	—	—	—	—	—	—	—	—	—	35.0	—
4	204.3	41,740	3,947	.2533	7.91	—	—	7.87	7.80	—	—	—	—	—	—	—	—	—	27.7	—
5	181.9	33,100	3,130	.3195	9.98	—	—	9.90	9.83	—	—	—	—	—	—	—	—	—	22.0	—
6	162.0	26,250	2,482	.4028	12.68	—	—	12.48	12.37	—	—	—	5.6	5.44	—	—	—	—	17.5	—
7	144.3	20,820	1,969	.5080	15.87	—	—	15.72	15.62	—	—	—	6.23	6.08	—	—	—	—	13.8	—
8	128.5	16,510	1,561	.6405	20.01	—	—	19.82	19.64	—	—	—	6.94	6.8	7.6	—	—	—	11.0	—
9	114.4	13,090	1,238	.8077	25.23	—	—	25.00	24.60	—	—	—	7.68	7.64	8.6	—	—	—	8.7	—
10	101.9	10,380	981.8	1.018	31.82	—	—	31.6	30.9	—	—	—	8.55	8.51	9.6	84.8	80.0	87.	6.9	333.0
11	90.74	8,234	778.7	1.284	40.12	—	—	39.8	38.8	—	—	—	9.60	9.88	10.7	105.	97.5	110.	5.5	284.0
12	80.81	6,530	617.5	1.619	50.59	—	—	50.2	48.9	—	—	—	10.80	10.62	12.0	131.	121.	136.	4.4	235.0
13	71.96	5,178	489.7	2.042	63.80	—	—	63.2	61.5	—	—	—	12.06	11.88	13.5	163.	150.	170.	3.5	200.0
14	64.08	4,107	388.3	2.575	80.44	—	—	79.6	77.3	15.6	—	—	13.45	13.10	15.0	198.	183.	211.	2.7	166.0
15	57.07	3,257	308.0	3.247	101.4	100.5	100.	100.0	97.3	17.5	—	—	14.90	14.68	16.6	250.	223.	262.	2.2	139.0
16	50.82	2,583	244.2	4.094	127.9	126.6	125.	124.0	119.	19.6	—	—	17.20	16.40	18.9	306.	271.	321.	1.7	117.0
17	45.26	2,048	193.7	5.163	161.8	159.2	158.	155.	150.	22.0	—	—	18.80	18.10	21.2	372.	329.	397.	1.2	99.0
18	40.30	1,634	153.6	6.510	203.4	200.8	198.	196.	188.	25.0	—	—	21.00	20.00	23.6	454.	399.	493.	1.1	82.8
19	35.89	1,288	121.8	8.210	256.5	252.5	248.	247.	237.	27.8	—	—	23.60	21.83	26.4	553.	479.	592.	.88	66.7
20	31.96	1,022	96.6	10.38	322.4	219.	312.	311.	298.	31.0	27.	25.	26.40	23.91	29.4	725.	625.	775.	68	58.3
21	28.46	810.1	76.61	13.08	407.8	398.	389.	389.	370.	35.0	30.	27.	29.70	26.20	33.1	895.	764.	940.	.54	49.3
22	25.35	642.4	60.75	16.48	514.2	504.	492.	491.	461.	39.0	34.	30.5	32.00	28.58	37.0	1,070.	910.	1,150.	.43	41.2
23	22.57	509.5	48.18	20.76	648.4	645.	631.	624.	584.	44.0	38.	34.	34.30	31.12	41.3	1,300.	1,080.	1,400.	34	34.5
24	20.10	404.0	38.21	26.17	817.7	795.	779.	778.	745.	50.0	43.	38.	37.70	32.60	46.3	1,570.	1,260.	1,700.	.27	28.9
25	17.90	320.4	30.30	33.00	1,031.	1,004.	966.	958.	903.	56.0	47.	41.	41.50	36.20	51.7	1,910.	1,510.	2,060.	.31	24.6
26	15.94	254.1	24.03	41.62	1,300.	1,240.	1,202.	1,188.	1,188.	63.0	52.	46.	45.30	39.90	58.0	2,300.	1,750.	2,500.	.17	20.6
27	14.20	201.5	19.06	52.48	1,639.	1,615.	1,542.	1,583.	1,422.	70.0	58.	50.	49.40	42.60	64.9	2,750.	2,020.	3,030.	.13	17.7
28	12.64	159.8	15.11	66.17	2,067.	2,023.	1,917.	1,903.	1,759.	79.0	64.	58.	54.00	45.50	72.7	3,350.	2,310.	3,670.	.11	14.7
29	11.26	126.7	11.98	83.44	2,607.	2,625.	2,485.	2,461.	2,207.	88.0	71.	55.	58.80	48.00	81.6	3,900.	2,700.	4,300.	.084	12.5
30	10.03	100.5	9.50	105.2	3,287.	3,325.	2,909.	2,893.	2,534.	100.	80.	66.	64.40	51.10	90.5	4,660.	3,020.	5,040.	.067	10.25
31	8.92	79.70	7.54	132.7	4,145.	3,820.	3,683.	3,483.	2,768.	112.	87.	71.	69.00	56.80	101.	5,280.	—	5,920.	.053	8.75
32	7.95	63.21	5.98	167.3	5,227.	4,876.	4,654.	4,414.	3,737.	125.	99.	76.	75.00	60.20	113.	6,250.	—	7,060.	.042	7.26
33	7.08	50.13	4.74	211.0	6,591.	6,243.	5,689.	5,688.	4,697.	141.	105.	83	81.00	64.30	127.	7,360.	—	8,120.	.033	6.19
34	6.31	39.75	3.76	266.0	8,310.	7,757.	7,111.	6,400.	6,168.	159.	110.	95.	87.60	68.60	143.	8,310.	—	9,600.	.026	5.12
35	5.62	31.52	2.98	335.0	10,485.	9,660.	8,534.	8,393.	6,737.	179.	130.	104.	94.20	73.00	158.	8,700.	—	10,900.	.021	4.37
36	5.00	25.00	2.36	423.0	13,210.	11,907.	10,040.	9,846.	7,877.	200.	140.	110.	101.	78.50	175.	10,700.	—	12,200.	.017	3.63
37	4.45	19.83	1.87	533.4	16,660.	13,474.	10,670.	11,636.	9,309.	222.	150.	115.	108.	84.00	198.	—	—	—	.013	3.08
38	3.96	15.72	1.49	672.6	21,010.	16,616.	14,220.	13,848.	10,660.	250.	160.	120	115.	89.10	224.	—	—	—	.010	2.55
39	3.53	12.47	1.18	848.1	26,500.	22,260.	16,520.	18,286.	11,910.	295.	180.	130.	122.5	95.00	248.	—	—	—	.008	2.20
40	3.14	9.88	.94	1,069.0	33,410.	26,950.	21,330.	24,381.	14,222.	321.	200.	140.	130.	102.50	282.	—	—	—	.006	1.86
41	2.80	7.84	.75	1,323.0	42,110.	—	—	30,610.	17,920.	—	—	—	153.	112.	—	—	—	—	005	—
42	2.50	6.22	.60	1,667.0	53,110.	—	—	38,700.	22,600.	—	—	—	168.	124.	—	—	—	—	.004	—
43	2.22	4.93	.47	2,105.0	66,970.	—	—	48,600.	28,410.	—	—	—	192.	140.	—	—	—	—	.003	—
44	1.98	3.91	.39	2,655.0	84,440.	—	—	61,400.	35,950.	—	—	—	210.	153.	—	—	—	—	.0025	—

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*A mil is 1/1000 (one thousandth) of an inch.
†These figures are only approximate, as they depend upon the thickness of the insulation. This, in turn, depends upon the manufacturer of the wire.
‡The safe current-carrying capacity in amperes (at 1000 CM per ampere) is equal to the circular mil area (Column 3) divided by 1000.
Note: For hard-drawn copper, increase resistance value 2%.

RESISTANCE DATA FOR COMMON METALS AND ALLOYS

Relative Resistance: The accompanying table lists the relative resistances and temperature coefficients of commonly used elements and alloys. *Relative* resistance may be defined as the ratio of the resistance of a wire made of a certain material to the resistance of an annealed *copper* wire of the same diameter and length and at the same temperature. For instance, if the relative resistance of a certain material is 20, it means that a piece of this material will have 20 times as much electrical resistance as would a piece of annealed copper of exactly the same dimensions and at the same temperature. If the relative resistance of a material is known, the exact resistance of a wire of certain size made of that material may easily be calculated from data which will be found in the Copper Wire Table on page 22-2. To show how this is done, let us consider the following problem:

Example: The resistance of a 1-foot length of No. 14 "nichrome" wire at a temperature of 25 degrees Centigrade is to be found.

Solution: Referring to the Copper Wire Table on page 22-2 of this book we find that the resistance of No. 14 *copper* wire is approximately 2.58 ohms per 1,000 feet (at a temperature of 25 degrees centigrade). The resistance per foot is therefore $2.58 \div 1{,}000 = 0.00258$ ohms. Referring to the Resistance Data table in this section, we find that the relative resistance of "nichrome" wire is 57.9 (i.e., nichrome has 57.9 times as much resistance as copper at the same temperature). Therefore, the resistance of a 1-foot length of No. 14 nichrome wire at a temperature of 25 degrees Centigrade is equal to $0.00258 \times 57.9 = 0.14$ ohms (approximately) *Ans.*

This calculation illustrates the usefulness of the table of "relative resistance" values when the resistance of wires made of various resistance-alloy wires, etc., is to be calculated.

Temperature Coefficient of Resistance: The electrical resistance of pure metals and most alloys *increases* as their temperature *rises*. The resistance of carbon and electrolytes (fluid

"RELATIVE RESISTANCE" AND "TEMPERATURE COEFFICIENT OF RESISTANCE" OF COMMON METALS AND ALLOYS

Material	*Relative Resistance*	*Temperature Coefficient of Resistance*
Advance	27.8	.000002
Aluminum	1.64	.0034
Brass	4.06	.002
Cadmium	4.37	.0042
Carbon	200.	.0005
Climax	50.4	.0007
Cobalt	5.62	.0033
Constantin	25.5	.000002
Copper,		
(annealed)	1.00	.00393
(pure)	.98	.004
Eureka	27.2	.00005
Excello	53.3	.00016
German Silver	19.1	.0004
Graphite	464.	------
Gold	1.41	.0034
Iron	5.79	.005
Lead	12.7	.0043
Magnesium	2.67	.004
Manganin	25.5	.000000
Mercury	55.	.00089
Molybdenum	3.30	.0033
Monel Metal	24.3	.002
Nichrome	57.9	.0004
Nickel	4.52	.006
Platinum	5.79	.003
Silver	.94	.0038
Steel (Piano Wire)	6.84	.0032
Steel (invar.)	46.9	.002
Tantalum	8.98	.0031
Tin	6.66	.0042
Tungsten	3.19	.0045
Zinc	3.33	.0037

conductors) *decreases* as their temperature rises. The amount of change of resistance of different metals differs slightly, as will be seen by inspection of the right-hand column of the accompanying table. Since the temperature of a conductor may be changed greatly either by its surroundings or by the heat developed within it by the passage of current through it, the temperature must be taken into account when calculating its resistance if accurate results are desired. This is especially important if the conductor is operating at high temperature (as is the case in electric heating elements, vacuum tube filaments, etc.).

The amount in *ohms* that the resistance of a material changes *per ohm per degree change in temperature* is known as *the temperature* coefficient of resistance of that material. Values for the temperature coefficients of resistance for various metals and alloys will be found in the right-hand column of the accompanying table. The temperature coefficient of resistance of a material is not a constant value but varies slightly with the temperature. Some of the values given in the accompanying table are for a temperature of 0° Centigrade, others are for 20° C and others are for 25° C. The temperature is not stated in each case because the variation in temperature coefficient is so small throughout the ordinary range of temperatures that it may be neglected for all but the most accurate calculations. The following example illustrates the method of using the data in the table.

Example: A piece of "nichrome" wire whose resistance at the room temperature of 20 degrees Centigrade is 25 ohms is to be coiled up and used as a heater element. When current is sent through the wire to produce the heat, its temperature rises to 110 degrees Centigrade. What is the (hot) resistance of the wire at this temperature?

Solution: Referring to the accompanying table, we find that the temperature coefficient of resistance of nichrome is 0.0004. This is the resistance change *per ohm per degree C* change of temperature. Therefore, multiplying the "cold" resistance by the change in temperature (110-20) and then by the temperature coefficient of resistance, we obtain $25 \times 90 \times 0.0004 = 0.9$ ohm as the *increase* in resistance. The "hot" resistance of the wire is therefore $25 + 0.9 = 25.9$ ohms.

For materials for which the temperature coefficient of resistance is *negative* (resistance *decreases* as the temperature is increased), the "hot" resistance will be less than the "cold" resistance by the amount of the resistance change caused by the change in temperature. Carbon and electrolytes have a *negative* temperature coefficient of resistance. This should be remembered by radio service men when considering the effect which a rise in operating temperature has on the resistance of resistors made of carbon.

TRANSFORMER TURNS-PER-VOLT CHART

The inductance of a coil depends upon the permeability of the substance used for its core; for air-cored transformers, the permeability is 1; for iron and certain grades of steel, the permeability may be as much as 1,000 or more. Moreover, the permeability of a magnetic core depends upon the flux density of the magnetism in the core. When the flux density and the core area in a power transformer are known, the following chart (*reproduced here through the courtesy of the General Electric Co.*) enables one to determine the number of primary-winding turns of wire to wind on that core per volt of applied voltage. It also enables one to find the number of turns of wire which must be wound to form a secondary winding which is to have a certain desired voltage induced in it. The following example will illustrate the use of the chart.

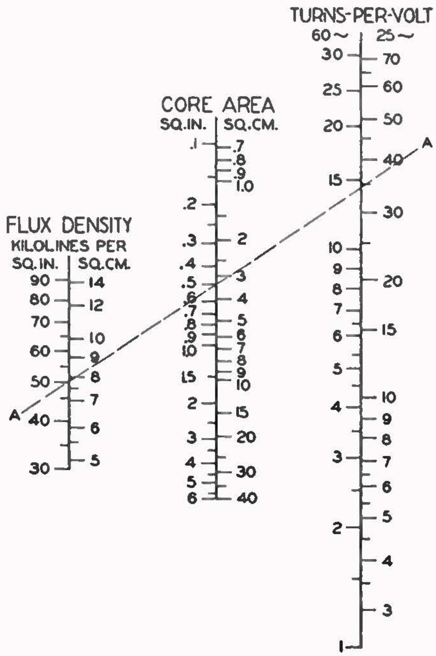
Example: Suppose a simple power transformer is to be wound on a core ½ square inch in cross-sectional area and the proper flux density for the grade and type of core iron to be used is 50,000 lines (50 kilolines) per square inch. (The proper flux density for different grades of iron may be obtained from standard electrical engineering texts or from core-iron manufacturers.) The primary of this transformer is to connect to the 110-volt 60-cycle lighting circuit. A secondary winding which is to deliver 5 volts, and one to deliver 1,000 volts, are to be provided. The primary and secondary windings are to be wound over the center leg of the core.

Solution: Referring to the chart, we lay a ruler between the 50 kiloline point on the *FLUX DENSITY scale* (*SQ. IN.* side) and the 0.5 sq. inch point on the *CORE AREA* scale. A line *A-A* is drawn through these two points. This line meets the 60-cycle *TURNS-PER-VOLT* scale at about 14 turns-per-volt. Therefore, for every volt the primary connects to, or for every volt desired from the secondary winding, 14 turns must be wound. The primary, then, requires $110 \times 14 = 1540$ turns, and the 5-volt secondary must have $5 \times 14 = 70$ turns.

The high-voltage secondary to deliver 1,000 volts must have $1{,}000 \times 14 = 14{,}000$ turns. (The flux density in the

core of a transformer of this type is very nearly the same from no load to full load.)

If the transformer were designed for operation from a 25-cycle line, then the turns-per volt would be about 34 (the point



TRANSFORMER TURNS-PER-VOLT CHART: Knowing the flux density and the core area, the turns-per-volt for either a primary or a secondary winding may be determined by merely drawing the straight line (*A-A*) from the proper point on the "*FLUX DENSITY*" line through the proper point on the "*CORE AREA*" line—the extension of this line intersects the "*TURNS-PER-VOLT*" line at the point which represents the turns-per-volt of the transformer.

For convenience, the "*FLUX DENSITY*" line has "kilolines per square inch" and "kilolines per square centimeter" scales. The "*CORE AREA*" line has "square inch" and "square centimeter" scales. The 'TURNS-PER-VOLT" line gives values for 60 cycles on the left, and for 25 cycles on the right.

where the line *A-A* crosses the 25-cycle scale of the "TURNS-PER-VOLT" line).

The chart shown here also has a *SQ.CM.* scale for use when the flux density is specified in kilolines per sq. *cm.* and the core area is specified in sq. cm.

METRIC PREFIXES USED IN RADIO WORK

It so happens that many of the units used extensively in electrical work are either too small or too large for convenient expression or use in radio work. Instead of using large, cumbersome numbers to indicate the fractional or multiple parts of these units, it has become customary to make use of standard metric prefixes ahead of the standard units to simplify expressions and calculations involving these quantities. These metric prefixes are so commonly used in radio work that the service man should familiarize himself with them, so that he may become proficient in understanding and using them. A list of these prefixes is given below:

Prefix	*Abbreviation*	*Meaning*
deci	*d*	one-tenth part of
centi	*c*	one-hundredth part of
mil or *milli*	*m*	one-thousandth part of
micro	μ	one-millionth part of
pica or *micro-micro*	μμ or *mm*	one-millionth of a millionth part of
deka	*dk*	10 times
hekto	*h*	100 times
kilo	*k*	1,000 times
mega	*M*	1,000,000 times

Thus, the prefix *deci* ahead of a standard unit means that the new unit is 0.1 of the standard unit. Therefore, a *decimeter* is 0.1 of a meter. A *milliampere* is 0.001 of an ampere. A *microhenry* is 0.000001 of a henry. A *microfarad* is 0.000001 of a farad. Instead of saying that a condenser has a capacity of 0.00035 microfarads, for instance, it is more convenient to say that it has a capacity of 350 *micro-microfarads,* etc.

A *centimeter* of inductance is equal to 0.001 of a microhenry. This unit does not follow the general rule.

The prefix *deka* means that the new unit is ten times the standard unit. The prefix *kilo* means that the new unit is 1,000 times the standard unit. Thus, one *kilocycle* equals 1,000 cycles. The prefix *meg* or *mega* means that the new unit is 1,000,000 times the original unit. Thus, one *megohm* equals 1,000,000 ohms, etc.

CONVERSION OF UNITS EXPRESSED WITH METRIC PREFIXES

As it is often very difficult for persons inexperienced in the handling of mathematical computations to correctly convert from one form to another the various electrical units which are expressed with the common metric prefixes, the following factors for conversion have been arranged alphabetically here to assist in this work.

Multiply	*By*	*To Get*
Amperes	× 1,000,000,000,000	micro-microamperes
Amperes	× 1,000,000	microamperes
Amperes	× 1,000	milliamperes
Cycles	× .000001	megacycles
Cycles	× .001	kilocycles
Farads	× 1,000,000,000,000	micro-microfarads or picofarads
Farads	× 1,000,000	microfarads
Farads	× 1,000	millifarads
Henries	× 1,000,000	microhenries
Henries	× 1,000	millihenries
Horsepower	× .7457	kilowatts
Horsepower	× 745.7	watts
Kilocycles	× 1,000	cycles
Kilovolts	× 1,000	volts
Kilowatts	× 1,000	watts
Kilowatts	× 1.341	horsepower
Megacycles	× 1,000,000	cycles
Mhos	× 1,000,000	micromhos
Mhos	× 1,000	millimhos
Microamperes	× .000001	amperes
Microfarads	× .000001	farads
Microhenries	× .000001	henries
Micromhos	× .000001	mhos
Micro-ohms	× .000001	ohms
Microvolts	× .000001	volts

Multiply	*By*	*To Get*
Microwatts	× .000001	watts
Micro-microfarads	× .000000000001	farads
Micro-micro-ohms	× .000000000001	ohms
Milliamperes	× .001	amperes
Millihenries	× .001	henries
Millimhos	× .001	mhos
Milliohms	× .001	ohms
Millivolts	× .001	volts
Milliwatts	× .001	watts
Ohms	× 1,000,000,000,000	micro-micro-ohms
Ohms	× 1,000,000	micro-ohms
Ohms	× 1,000	milliohms
Volts	× 1,000,000	microvolts
Volts	× 1,000	millivolts
Watts	× 1,000,000	microwatts
Watts	× 1,000	milliwatts
Watts	× .001	kilowatts

THE USE OF EXPONENTS IN CALCULATIONS

It is very convenient to express very large or very small quantities by means of whole numbers with suitable exponents. For instance, the rather cumbersome number 350,000,000 may be written as 3.5×10^8, which really means that 3.5 is multiplied by *ten*, eight times. The small number above, and to the side of, the figure 10 is called the *exponent*. In this case the exponent is 8. Numbers less than 1 have *negative* exponents. Thus, five ten-thousandths may be expressed in the following ways:

$$0.0005, \text{ or } 5 \times 10^{-4}, \text{ or } \frac{5}{10{,}000}, \text{ or } \frac{5}{10^4}$$

This representation is really a shorthand method of working with inconveniently large or small quantities, and the student should become thoroughly familiar with it, as it is used extensively in technical work. The table below will be found helpful in understanding how the proper exponent is found.

$$\begin{aligned}
1 &= 10^0 = \text{Units} \\
10 &= 10^1 = \text{Tens} \\
100 &= 10^2 = \text{Hundreds} \\
1{,}000 &= 10^3 = \text{Thousands } (\textit{Kilo.}) \\
1{,}000{,}000 &= 10^6 = \text{Millions } (\textit{Mega.})
\end{aligned}$$

$$\begin{aligned}
1 &= 10^0 = \text{Units} \\
.1 &= 10^{-1} = \text{Tenths} \\
.01 &= 10^{-2} = \text{Hundredths} \\
.001 &= 10^{-3} = \text{Thousandths } (\textit{Milli.}) \\
.000001 &= 10^{-6} = \text{Millionths } (\textit{Micro.})
\end{aligned}$$

The rules dealing with these complicated looking figures are simple, and, when mastered, provide an exceptionally easy method of handling large numbers. They are as follows:

When multiplying numbers, *add* the exponents.
When dividing numbers, *subtract* the exponents.
When squaring numbers, *double* the exponents.
When obtaining square roots, *halve* the exponents.
When transfering an exponent across the dividing line, *change its sign.*

Example: Express the following quantities in simple numbers by the use of exponents. (*a*) 342,000,000,000 (*b*) 9,653,000 (*c*) 0.0000084 (*d*) 0.000432.

Answers: (*a*) 3.42×10^{11} (*b*) 9.653×10^{6} (*c*) 8.4×10^{-6} (*d*) 4.32×10^{-4}. *Ans.*

Example: 6.28×10^{18} electrons flowing past a given point in a second constitute a current of 1 ampere. How many electrons flow past a given point in a second when the number of amperes is (*a*) 600? (*b*) 0.002?

Solutions: (*a*) $6.28\times10^{18}\times6\times10^{2}=37.68\times10^{20}$ or 3.768×10^{21}. *Ans.*

(*b*) $6.28\times10^{18}\times2\times10^{-3}=12.56\times10^{15}$ or 1.256×10^{16}. *Ans.*

SUMMARY OF FORMULAS COMMONLY USED IN RADIO WORK

Voltage, Current, Resistance:

$$amperes = \frac{\text{volts}}{\text{ohms}}, \left(I = \frac{E}{R} \right)$$

$$volts = \text{amperes} \times \text{ohms}, \ (E = I \times R)$$

$$ohms = \frac{\text{volts}}{\text{amperes}}, \left(R = \frac{E}{I} \right)$$

Power (D.C.): $watts = \text{volts} \times \text{amperes}, \ (W = E \times I)$

$$watts = \text{volts squared divided by ohms}, \left(W = \frac{E^2}{R} \right)$$

$$watts = \text{amperes squared} \times \text{ohms}, \ (W = I^2 \times R)$$

Resistance: $R = R_c \times P$, where R_c is the *resistance* of copper of the same size, and P is the *relative resistance* of the material (see tables on pages 22-2 and 23-2 of this book)

Resistance: $R = R_c \times P \ [1 \pm (a \times t)]$, where a is the temperature coefficient of resistance and t is the temperature change.

Resistances in series: (all resistances expressed in the same units)

$R = R_1 + R_2 + R_3 +$ etc. (where R is the total resistance; R_1, R_2, R_3 etc., are the individual resistances).

Resistances in parallel: (all resistances expressed in ohms)

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \textit{etc.} \ \text{(mhos)}$$

$$\text{or, } R = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \textit{etc.}} \ \text{(ohms)}$$

or, $R = \dfrac{R_1 \times R_2}{R_1 + R_2}$ (ohms) for two resistors in parallel.

Capacity of a condenser:

$C = \dfrac{2235\ (N\text{-}1)\ Ak}{10^{10} \times t}$ where C is the capacity in mfd., N is the number of plates, A is the area of one side of one plate (in square inches), K is the dielectric constant, and t is the spacing between the plates (in inches).

Capacity of condensers in parallel: (all capacities must be expressed in same units)
$C = C_1 + C_2 + C_3 + etc.$, (where C is the total capacity; C_1, C_2, C_3, etc. are the individual capacities)

Capacity of condensers in series: (all capacities must be expressed in same units)

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + etc.$$

$$\text{or, } C = \frac{1}{\dfrac{1}{C_1} + \dfrac{1}{C_2} + \dfrac{1}{C_3} + etc.}$$

or, $C = \dfrac{C_1 \times C_2}{C_1 + C_2}$ (for two condensers only)

Inductive Reactance: $X_L = 2\pi fL$ (ohms), where $\pi = 3.14$, f=frequency in cycles per second, and L is the inductance in henries.

Capacitive Reactance: $X_c = \dfrac{1}{2\pi fC}$ (ohms), where C is the capacity in farads.

Impedance (Z) of an a-c circuit containing inductance (L), capacity (C) and resistance (R) at frequency *(f)*.

$$Z = \sqrt{R^2 + X^2}$$

$$= \sqrt{R^2 + \left(2\times3.14\times f\times L - \frac{1}{2\times3.14\times f\times C}\right)^2}$$

$$I = \frac{E}{\sqrt{R^2 + \left(2\pi fL - \frac{1}{2\pi fC}\right)^2}}$$

and, $f = \frac{1}{2\pi\sqrt{LC}}$

Frequency and wavelength relations for radio (not for sound):

$$Meters\ (wavelength) = \frac{300{,}000{,}000}{cycles}$$

$$Frequency\ (cycles) = \frac{300{,}000{,}000}{meters\ (wavelength)}$$

$$Frequency\ (kc) = \frac{300{,}000}{meters\ (wavelength)}$$

Wavelength at which resonance in a series tuned circuit takes place with a given inductance (L) and capacity (C).

$$Meters\ (wavelength) = 1885\ \sqrt{L\ (microhenries) \times C\ (mfd.)}$$

$$Meters\ (wavelength) = 1.885\sqrt{L\ (microhenries) \times C\ (mmfd.)}$$

Frequency at which resonance occurs with given constants of inductance and capacity:

$$Frequency\ (cycles) = \frac{159{,}000}{\sqrt{L\ (microhenries) \times C\ (mfd.)}}$$

$$Frequency\ (cycles) = \frac{159{,}000{,}000}{\sqrt{L\ (microhenries) \times C\ (mmfd.)}}$$

Loud speaker baffle length:

$$L = \frac{282}{frequency}\ \text{(feet)}$$

Inductance of a single-layer air-core coil:

$$L = 0.0251\ d^2\, n^2\, l\, K$$

where L is the inductance in microhenries; d, is the mean diameter of the coil in inches; n, is the number of turns per inch; l, is the length of the *coil* (when wound) in inches; and K is a "form factor" (Nagoaka's correction factor), which depends for its value upon the ratio of the diameter to the length of the coil. Values of K for a wide range of coil diameter-to-length ratios are presented in the table below.

VALUES OF "K" FOR USE IN THE INDUCTANCE FORMULA*

d/l	*K*	*d/l*	*K*	*d/l*	*K*	*d/l*	*K*	*d/l*	*K*
0.00	1.0000	1.20	.6475	2.80	.4452	5.40	.3050	16.00	.1457
.10	.9588	1.30	.6290	3.00	.4292	5.80	.2916	18.00	.1336
.20	.9201	1.40	.6115	3.20	.4145	6.20	.2795	20.00	.1236
.30	.8838	1.50	.5950	3.40	.4008	6.60	.2685	24.00	.1078
.40	.8499	1.60	.5795	3.60	.3882	7.00	.2584	28.00	.0959
.50	.8181	1.70	.5649	3.80	.3764	7.40	.2491	35.00	.0808
.60	.7885	1.80	.5511	4.00	.3654	7.80	.2406	45.00	.0664
.70	.7609	1.90	.5379	4.20	.3551	8.50	.2272	60.00	.0528
.80	.7351	2.00	.5255	4.40	.3455	9.50	.2106	80.00	.0419
.90	.7110	2.20	.5025	4.60	.3364	10.00	.2033	00.00	.0350
1.00	.6884	2.40	.4816	4.80	.3279	12.00	.1790	....	....
1.10	.6673	2.60	.4626	5.00	.3198	14.00	.1605	....	....

*NOTE: This formula assumes the coil to be wound with an infinitely thin conducting tape, the edges of which touch, though electrically insulated. The correction for the commercially available conductors commonly used for winding inductance coils employed in radio equipment (silk, cotton, or enamel-covered wires) is relatively small and may be neglected so far as practical results are concerned.

WAVELENGTH, FREQUENCY AND L $\times$ C CONVERSION TABLE

The formula for determining the frequency to which any circuit containing inductance and capacity will tune is:

$$f = \frac{159{,}000}{\sqrt{L \times C}}$$

$$\text{or, } wavelength = 1885 \sqrt{L \times C}$$

where, f=the frequency in cycles per second
L=the inductance of the coil in microhenries
C=the capacity of the entire circuit in microfarads.

The product of the inductance L and the capacity C of the circuit determines the frequency at which the circuit is resonant or in "tune". For each frequency there is a definite value of this product (called the inductance-capacity product, or the "$L \times C$" value) for which resonance occurs. If this value is known, it is possible to determine the correct amount of inductance required for use with any value of capacity, or the correct amount of capacity for use with any value of inductance, to produce resonance at that frequency. The $L \times C$ value is divided by the known capacity, or the known inductance, the quotient of the division being the required inductance or capacitance.

Thus:

$$\text{Inductance} = \frac{L \times C \text{ value}}{\text{capacity}}$$

$$\text{Capacity} = \frac{L \times C \text{ value}}{\text{inductance}}$$

The following table gives the inductance $\times$ capacity values necessary to produce resonance at wavelengths from 1 to 39,000 meters (corresponding to frequencies from 300,000,000 to 7,690 cycles). The inductance is in microhenries, the capacity is in microfarads, and n is the frequency in cycles per second.

As examples of the use of this table, let it be desired to find the required inductance of a coil to tune to a frequency of 600 kilocycles (500 meters) with a tuning condenser of 0.00035 microfarads maximum capacity. From the table, the $L \times C$ value for this frequency is found to be 0.0704. Dividing this value by the capacity (0.00035) gives the result, 201 microhenries of inductance.

Let it be desired to find the required capacity of this tuning condenser to tune to the frequency of 1,500 kilocycles (200 meters) with the above coil of 201 microhenries inductance. The $L \times C$ value for this frequency is found from the table to be 0.01126. Dividing this by the inductance (201) gives as a result 0.000055 microfarads for the minimum capacity. The tuning condenser must then have a range of capacity from 0.000055 to 0.00035 microfarads to cover this frequency range with this inductor. Any other coil and condenser combination may be calculated in this same way.

A study of the table shows that, as the frequency decreases, the $L \times C$ constant increases. If we divide the frequency by 10, the $L \times C$ constant is 10^2 (or 100) times as large. This must be kept in mind if values beyond the ranges of the table are to be determined. For instance, if we wish to determine the $L \times C$ constant for 2 kc (2,000 cycles), we may look up the value for 20,000 *cycles* in the table (it is 63.3). We then move the decimal point two places to the right; 6,330 is the correct $L \times C$ constant. If it is desired to check the results, remember that resonance occurs when the inductive reactance is equal to the capacitive reactance. The frequency at which this occurs is the *resonance* frequency.

(See Table on following pages)

WAVELENGTH, FREQUENCY AND L × C CONVERSION TABLE

In this table the frequency f is expressed in cycles per second. Also, L×C means the product of the inductance in *microhenries* and the capacity in *microfarads* required to produce resonance at the corresponding frequency or wavelength.

Meters	f	L×C	Meters	f	L×C	Meters	f	L×C
1	300,000,000	0.0000003	200	1,500,000	0.01126	550	546,000	0.0852
2	150,000,000	0.0000011	210	1,429,000	0.01241	555	541,000	0.0867
3	100,000,000	0.0000018	220	1,364,000	0.01362	560	536,000	0.0883
4	75,000,000	0.0000045	230	1,304,000	0.01489	565	531,000	0.0899
5	60,000,000	0.0000057	240	1,250,000	0.01621	570	527,000	0.0915
6	50,000,000	0.0000101	250	1,200,000	0.01759	575	522,000	0.0931
7	42,900,000	0.0000138	260	1,154,000	0.01903	580	517,000	0.0947
8	37,500,000	0.0000180	270	1,111,000	0.0205	585	513,000	0.0963
9	33,330,000	0.0000228	280	1,071,000	0.0221	590	509,000	0.0980
			290	1,034,000	0.0237	595	504,000	0.0996
10	30,000,000	0.0000282	300	1,000,000	0.0253	600	500,000	0.1013
15	20,000,000	0.0000635	310	968,000	0.0270	605	496,000	0.1030
20	15,000,000	0.0001129	320	938,000	0.0288	610	492,000	0.1047
25	12,000,000	0.0001755	330	909,000	0.0306	615	488,000	0.1065
30	10,000,000	0.0002530	340	883,000	0.0325	620	484,000	0.1082
35	8,570,000	0.0003446	350	857,000	0.0345	625	480,000	0.1100
40	7,500,000	0.000450	360	834,000	0.0365	630	476,000	0.1117
45	6,670,000	0.000570	370	811,000	0.0385	635	472,000	0.1135
			380	790,000	0.0406	640	469,000	0.1153
			390	769,000	0.0428	645	465,000	0.1171
50	6,000,000	0.000704	400	750,000	0.0450	650	462,000	0.1189
55	5,450,000	0.000852	410	732,000	0.0473	655	458,000	0.1208
60	5,000,000	0.001014	420	715,000	0.0496	660	455,000	0.1226
65	4,620,000	0.001188	430	698,000	0.0520	665	451,000	0.1245
70	4,290,000	0.001378	440	682,000	0.0545	670	448,000	0.1264
75	4,000,000	0.001583	450	667,000	0.0570	675	444,000	0.1283
80	3,750,000	0.001801	460	652,000	0.0596	680	441,000	0.1302
85	3,529,000	0.002034	470	639,000	0.0622	685	438,000	0.1321
90	3,333,000	0.002280	480	625,000	0.0649	690	435,000	0.1340
95	3,158,000	0.002541	490	612,000	0.0676	695	432,000	0.1360
100	3,000,000	0.00282	500	600,000	0.0704	700	429,000	0.1379
110	2,727,000	0.00341	505	594,000	0.0718	705	426,000	0.1399
120	2,500,000	0.00405	510	588,000	0.0732	710	423,000	0.1419
130	2,308,000	0.00476	515	583,000	0.0747	715	420,000	0.1439
140	2,143,000	0.00552	520	577,000	0.0761	720	417,000	0.1459
150	2,000,000	0.00633	525	572,000	0.0776	725	414,000	0.1479
160	1,875,000	0.00721	530	566,000	0.0791	730	411,000	0.1500
170	1,764,000	0.00813	535	561,000	0.0806	735	408,000	0.1521
180	1,667,000	0.00912	540	556,000	0.0821	740	405,000	0.1541
190	1,579,000	0.01015	545	551,000	0.0836	745	403,000	0.1562

(*Continued on Page 28-4*)

RELATION OF NATURAL WAVELENGTH, ETC.—*Continued*

Meters	f	L×C	Meters	f	L×C	Meters	f	L×C
750	400,000	0.1583	1000	300,000	0.282	1500	200,000	0.633
755	397,000	0.1604	1010	297,100	0.287	1510	198,700	0.642
760	395,000	0.1626	1020	294,200	0.293	1520	197,400	0.650
765	392,000	0.1647	1030	291,300	0.299	1530	196,100	0.659
770	390,000	0.1669	1040	288,500	0.304	1540	194,800	0.667
775	387,000	0.1690	1050	285,700	0.310	1550	193,500	0.676
780	385,000	0.1712	1060	283,000	0.316	1560	192,300	0.685
785	382,000	0 1734	1070	280,400	0.322	1570	191,100	0.694
790	380,000	0 1756	1080	277,800	0.328	1580	189,900	0.703
795	377,000	0.1779	1090	275,200	0.334	1590	188,700	0.712
800	375,000	0 1801	1100	272,700	0.341	1600	187,500	0.721
805	373,000	0.1824	1110	270,300	0.347	1610	186,300	0.730
810	370,000	0.1847	1120	267,900	0.353	1620	185,100	0.739
815	368,000	0 1870	1130	265,500	0.359	1630	184,000	0.748
820	366,000	0.1893	1140	263,200	0.366	1640	182,900	0.757
825	364,000	0.1916	1150	260,900	0.372	1650	181,800	0.766
830	361,000	0.1939	1160	258,600	0.379	1660	180,700	0.776
835	359,000	0.1962	1170	256,400	0.385	1670	179,600	0.785
840	357,000	0 1986	1180	254,200	0.392	1680	178,500	0.794
845	355,000	0.201	1190	252,100	0.399	1690	177,400	0.804
850	353,000	0.203	1200	250,000	0.405	1700	176,400	0.813
855	351,000	0.206	1210	247,900	0.412	1710	175,400	0.823
860	349,000	0.208	1220	245,900	0.419	1720	174,400	0.833
865	347,000	0.211	1230	243,900	0.426	1730	173,400	0.842
870	345,000	0.213	1240	241,900	0.433	1740	172,400	0.852
875	343,000	0.216	1250	240,000	0.440	1750	171,400	0.862
880	341,000	0.218	1260	238,100	0.447	1760	170,500	0.872
885	339,000	0.220	1270	236,200	0.454	1770	169,500	0.882
890	337,000	0.223	1280	234,400	0.461	1780	168,500	0.892
895	335,000	0.225	1290	232,600	0.468	1790	167,600	0.902
900	333,000	0.228	1300	230,800	0.476	1800	166,700	0.912
905	331,000	0.231	1310	229,000	0.483	1810	165,700	0.922
910	330,000	0.233	1320	227,300	0.490	1820	164,800	0.932
915	328,000	0.236	1330	225,600	0.498	1830	163,900	0.943
920	326,000	0 238	1340	223,900	0.505	1840	163,000	0.953
925	324,000	0.241	1350	222,200	0.513	1850	162,200	0.963
930	323,000	0.243	1360	220,600	0.521	1860	161,300	0.974
935	321,000	0 246	1370	219,000	0.528	1870	160,400	0.984
940	319,000	0.249	1380	217,400	0.536	1880	159,600	0.995
945	317,000	0.251	1390	215,800	0.544	1890	158,700	1.005
950	316,000	0.254	1400	214,300	0.552	1900	157,900	1.015
955	314,000	0.257	1410	212,800	0.560	1910	157,100	1.026
960	313,000	0.259	1420	211,300	0.568	1920	156,300	1.037
965	311,000	0.262	1430	209,800	0.576	1930	155,400	1 048
970	309,000	0.265	1440	208,300	0.584	1940	154,600	1.059
975	308,000	0.268	1450	206,900	0.592	1950	153,800	1.070
980	306,000	0.270	1460	205,500	0.600	1960	153,100	1.081
985	305,000	0.273	1470	204,100	0.608	1970	152,300	1.092
990	303,000	0.276	1480	202,700	0.616	1980	151,500	1.103
995	302,000	0 279	1490	201,300	0.625	1990	150,800	1.114

RELATION OF NATURAL WAVELENGTH, ETC.—*Continued*

Meters	f	L×C	Meters	f	L×C	Meters	f	L×C
2000	150,000	1.126	3000	100,000	2.53	4000	75,000	4.50
2020	148,500	1.148	3020	99,400	2.57	4020	74,700	4.55
2040	147,100	1.171	3040	98,700	2.60	4040	74,300	4.59
2060	145,600	1.194	3060	98,100	2.64	4060	73,900	4.64
2080	144,200	1.218	3080	97,400	2.67	4080	73,600	4.69
2100	142,900	1.241	3100	96,800	2.70	4100	73,200	4.73
2120	141,500	1.265	3120	96,200	2.74	4120	72,800	4.78
2140	140,200	1.289	3140	95,600	2.78	4140	72,500	4.82
2160	138,900	1.313	3160	95,000	2.81	4160	72,100	4.87
2180	137,600	1.338	3180	94,400	2.85	4180	71,800	4.92
2200	136,400	1.362	3200	93,800	2.88	4200	71,500	4.96
2220	135,000	1.387	3220	93,200	2.92	4220	71,100	5.01
2240	133,900	1.412	3240	92,600	2.96	4240	70,800	5.06
2260	132,700	1.438	3260	92,000	2.99	4260	70,400	5.11
2280	131,600	1.463	3280	91,500	3.03	4280	70,100	5.16
2300	130,400	1.489	3300	90,900	3.06	4300	69,800	5.20
2320	129,300	1.515	3320	90,400	3.10	4320	69,500	5.25
2340	128,200	1.541	3340	89,800	3.14	4340	69,100	5.30
2360	127,100	1.568	3360	89,300	3.18	4360	68,800	5.35
2380	126,000	1.594	3380	88,800	3.22	4380	68,500	5.40
2400	125,000	1.621	3400	88,300	3.25	4400	68,200	5.45
2420	124,000	1.548	3420	87,700	3.29	4420	67,900	5.50
2440	122,900	1.676	3440	87,200	3.33	4440	67,600	5.55
2460	121,900	1.703	3460	86,700	3.37	4460	67,300	5.60
2480	121,000	1.731	3480	86,200	3.41	4480	67,000	5.65
2500	120,000	1.759	3500	85,700	3.45	4500	66,700	5.70
2520	119,000	1.787	3520	85,300	3.49	4520	66,400	5.75
2540	118,100	1.816	3540	84,800	3.53	4540	66,100	5.80
2560	117,200	1.845	3560	84,300	3.57	4560	65,800	5.85
2580	116,300	1.874	3580	83,800	3.61	4580	65,500	5.90
2600	115,400	1.903	3600	83,400	3.65	4600	65,200	5.96
2620	114,500	1.932	3620	82,900	3.69	4620	65,000	6.01
2640	113,600	1.962	3640	82,400	3.73	4640	64,700	6.06
2660	112,800	1.991	3660	82,000	3.77	4660	64,400	6.11
2680	111,900	2.02	3680	81,500	3.81	4680	64,100	6.17
2700	111,100	2.05	3700	81,100	3.85	4700	63,900	6.22
2720	110,300	2.08	3720	80,700	3.90	4720	63,600	6.27
2740	109,500	2.11	3740	80,200	3.94	4740	63,300	6.32
2760	108,700	2.14	3760	79,800	3.98	4760	63,000	6.38
2780	107,900	2.18	3780	79,400	4.02	4780	62,800	6.43
2800	107,100	2.21	3800	79,000	4.06	4800	62,500	6.49
2820	106,400	2.24	3820	78,600	4.11	4820	62,300	6.54
2840	105,600	2.27	3840	78,200	4.15	4840	62,000	6.59
2860	104,900	2.30	3860	77,700	4.19	4860	61,800	6.65
2880	104,200	2.33	3880	77,300	4.24	4880	61,500	6.70
2900	103,400	2.37	3900	76,900	4.28	4900	61,200	6.76
2920	102,700	2.40	3920	76,500	4.32	4920	61,000	6.81
2940	102,000	2.43	3940	76,200	4.37	4940	60,800	6.87
2960	101,300	2.47	3960	75,800	4.41	4960	60,500	6.92
2980	100,700	2.50	3980	75,400	4.46	4980	60,300	6.98

RELATION OF NATURAL WAVELENGTH, ETC.—*Continued*

Meters	f	L×C	Meters	f	L×C	Meters	f	L×C
5000	60,000	7.04	7500	40,000	15.83	10000	30,000	28.2
5050	59,400	7.18	7550	39,700	16.04	10100	29,700	28.7
5100	58,800	7.32	7600	39,500	16.26	10200	29,400	29.3
5150	58,300	7.47	7650	39,200	16.47	10300	29,100	29.9
5200	57,700	7.61	7700	39,000	16.69	10400	28,800	30.4
5250	57,200	7.76	7750	38,700	16.90	10500	28,600	31.0
5300	56,600	7.91	7800	38,500	17.12	10600	28,300	31.6
5350	56,100	8.06	7850	38,200	17.34	10700	28,000	32.2
5400	55,600	8.21	7900	38,000	17.56	10800	27,800	32.8
5450	55,100	8.36	7950	37,700	17.79	10900	27,500	33.4
5500	54,600	8.52	8000	37,500	18.01	11000	27,300	34.1
5550	54,100	8.67	8050	37,300	18.24	11100	27,000	34.7
5600	53,600	8.83	8100	37,000	18.47	11200	26,800	35.3
5650	53,100	8.99	8150	36,800	18.70	11300	26,500	35.9
5700	52,700	9.15	8200	36,600	18.93	11400	26,300	36.6
5750	52,200	9.31	8250	36,400	19.16	11500	26,100	37.2
5800	51,700	9.47	8300	36,100	19.39	11600	25,900	37.9
5850	51,300	9.63	8350	35,900	19.62	11700	25,600	38.5
5900	50,900	9.80	8400	35,700	19.86	11800	25,400	39.2
5950	50,400	9.96	8450	35,500	20.1	11900	25,200	39.9
6000	50,000	10.13	8500	35,300	20.3	12000	25,000	40.5
6050	49,600	10.30	8550	35,100	20.6	12100	24,800	41.2
6100	49,200	10.47	8600	34,900	20.8	12200	24,600	41.9
6150	48,800	10.65	8650	34,700	21.1	12300	24,400	42.6
6200	48,400	10.82	8700	34,500	21.3	12400	24,200	43.3
6250	48,000	11.00	8750	34,300	21.6	12500	24,000	44.0
6300	47,600	11.17	8800	34,100	21.8	12600	23,800	44.7
6350	47,200	11.35	8850	33,900	22.0	12700	23,600	45.4
6400	46,900	11.53	8900	33,700	22.3	12800	23,400	46.1
6450	46,500	11.71	8950	33,500	22.5	12900	23,300	46.8
6500	46,200	11.89	9000	33,300	22.8	13000	23,100	47.6
6550	45,800	12.08	9050	33,100	23.1	13100	22,900	48.3
6600	45,500	12.26	9100	33,000	23.3	13200	22,700	49.0
6650	45,100	12.45	9150	32,800	23.6	13300	22,600	49.8
6700	44,800	12.64	9200	32,600	23.8	13400	22,400	50.5
6750	44,400	12.83	9250	32,400	24.1	13500	22,200	51.3
6800	44,100	13.02	9300	32,300	24.3	13600	22,100	52.1
6850	43,800	13.21	9350	32,100	24.6	13700	21,900	52.8
6900	43,500	13.40	9400	31,900	24.9	13800	21,700	53.6
6950	43,200	13.60	9450	31,700	25.1	13900	21,600	54.4
7000	42,900	13.79	9500	31,600	25.4	14000	21,400	55.2
7050	42,600	13.99	9550	31,400	25.7	14100	21,300	56.0
7100	42,300	14.19	9600	31,300	25.9	14200	21,100	56.8
7150	42,000	14.39	9650	31,100	26.2	14300	21,000	57.6
7200	41,700	14.59	9700	30,900	26.5	14400	20,800	58.4
7250	41,400	14.79	9750	30,800	26.8	14500	20,700	59.2
7300	41,100	15.00	9800	30,600	27.0	14600	20,600	60.0
7350	40,800	15.21	9850	30,500	27.3	14700	20,400	60.8
7400	40,500	15.41	9900	30,300	27.6	14800	20,300	61.6
7450	40,300	15.62	9950	30,200	27.9	14900	20,100	62.5

Relation of Natural Wavelength, etc.—*Continued*

Meters	f	L×C	Meters	f	L×C	Meters	f	L×C
15000	20,000	63.3	19000	15,790	101.5	26000	11,540	190.3
15100	19,870	64.2	19100	15,710	102.6	26200	11,450	193.2
15200	19,740	65.0	19200	15,630	103.7	26400	11,360	196.2
15300	19,610	65.9	19300	15,540	104.8	26600	11,280	199.1
15400	19,480	66.7	19400	15,460	105.9	26800	11,190	202.0
15500	19,350	67.6	19500	15,380	107.0	27000	11,110	205.0
15600	19,230	68.5	19600	15,310	108.1	27200	11,030	208.0
15700	19,110	69.4	19700	15,230	109.2	27400	10,950	211.0
15800	18,990	70.3	19800	15,150	110.3	27600	10,870	214.0
15900	18,870	71.2	19900	15,080	111.4	27800	10,790	218.0
16000	18,750	72.1	20000	15,000	112.6	28000	10,710	221.0
16100	18,630	73.0	20200	14,850	114.8	28200	10,640	224.0
16200	18,510	73.9	20400	14,710	117.1	28400	10,560	227.0
16300	18,400	74.8	20600	14,560	119.4	28600	10,490	230.0
16400	18,290	75.7	20800	14,420	121.8	28800	10,420	233.0
16500	18,180	76.6	21000	14,290	124.1	29000	10,340	237.0
16600	18,070	77.6	21200	14,150	126.5	29200	10,270	240.0
16700	17,960	78.5	21400	14,020	128.9	29400	10,200	243.0
16800	17,850	79.4	21600	13,890	131.3	29600	10,130	247.0
16900	17,740	80.4	21800	13,760	133.8	29800	10,070	250.0
17000	17,640	81.3	22000	13,640	136.2	30000	10,000	253.0
17100	17,540	82.3	22200	13,510	138.7	31000	9,600	270.0
17200	17,440	83.3	22400	13,390	141.2	32000	9,380	288.0
17300	17,340	84.2	22600	13,270	143.8	33000	9,090	306.0
17400	17,240	85.2	22800	13,160	146.3	34000	8,830	325.0
17500	17,140	86.2	23000	13,040	148.9	35000	8,570	345.0
17600	17,050	87.2	23200	12,930	151.5	36000	8,340	365.0
17700	16,950	88.2	23400	12,820	154.1	37000	8,110	385.0
17800	16,850	89.2	23600	12,710	156.8	38000	7,900	406.0
17900	16,760	90.2	23800	12,600	159.4	39000	7,690	428.0
18000	16,670	91.2	24000	12,500	162.1			
18100	16,570	92.2	24200	12,400	154.8			
18200	16,480	93.2	24400	12,290	167.6			
18300	16,390	94.3	24600	12,190	170.3			
18400	16,300	95.3	24800	12,100	173.1			
18500	16,220	96.3	25000	12,000	175.9			
18600	16,130	97.4	25200	11,900	178.7			
18700	16,040	98.4	25400	11,810	181.6			
18800	15,960	99.5	25600	11,720	184.5			
18900	15,870	100.5	25800	11,630	187.4			

TOOLS FOR RADIO SERVICE WORK

There are a number of tools which may be considered to be essential in radio service work. There are others which, though they are not absolutely necessary, are very useful occasionally and are well worth owning. The number of tools that a radio service man should possess in any case, depends largely upon the type or scope of work that he is in the habit of handling. For instance, if he does auto-radio work an electric drill and a heavy-duty electric soldering iron are essential; if he does not install these sets, he can do without these tools. While most service men will probably agree on the tools which are considered really essential in general service work, there are bound to be individual opinions regarding the so-called "extra" or "special" tools which it is desirable to have. However, a fairly complete list of tools (including such items as tape, solder, bolts and nuts, etc., which, although they are not strictly tools, are used so often that they may be considered as such) will be presented here for reference and check-up purposes, it being understood that it is subject to desirable changes to fit individual requirements.

diagonal side-cutting pliers (6" long)
long nose pliers (6" long)
linesman side-cutting pliers
1 set small "Hex" end wrenches
1 set Spintite wrenches
small screw driver for dial set-screws
small screw driver (4 inch)
large screw driver 6 inch—8 inch)
offset screw-driver
small hand drill with assorted drills and taps
soldering iron and rosin-core solder
can of soldering paste
neutralizing tool
tuning wand

bakelite insulated screw-driver
neutralizing adapters (UX, UY)
2 small files (breaker-point type, coarse)
small flashlight
steel wool and emery cloth
light hammer
dusting cloth
small camel's hair brush
roll of friction tape
small chisel
jack knife
pair of small high-resistance earphones

Although the tools listed above may seem at first glance to represent a rather formidable array, it will be found that each serves a definite purpose and will often be called into use. As is often the case, where an automobile is employed for service work, it may be well to include the following also: (*a*) brace and assorted bits; (*b*) extension bit; (*c*) hack-saw; (*d*) cold chisel, and reamer.

If auto-radio work is done the following tools will also be found useful:

electric drill (to take up to a ⅜- or ½-inch drill)
adjustable wrench to take up to ¾-inch nuts
center punch
set of "feeler" or "thickness" gauges for adjusting "breaker point" and "spark-plug" gaps (see table in Sec. 5 for correct gap values)

Besides the tool kit, every service man should carry with him sufficient tubes and repair parts to enable him to render rapid service. The number and types of tubes to carry depends upon the models and receivers or receiver that he encounters. In addition to the tubes, the service kit may contain the following parts and material supplies.

two 8 mfd. electrolytic condensers (1 dry, 1 wet)
three 0.1 mfd. by-pass condensers (1 dry, 1 wet)
three 0.05 mfd. by-pass condensers (tubular)
two 0.01 mfd. condensers (tubular)
one 0.001 mfd. condenser
one 0.0025 mfd. condenser
one 2- or 4-mfd. paper filter condenser, 400 V
one 0.5 mfd. by-pass condenser 200 V
20 carbon resistors (assorted sizes 500 ohms to 5 megohms)
two adjustable wire-wound resistors (1,000 and 15,000 ohms)

one 20-ohm center-tapped resistor
two lengths dial cable (phosphor bronze and string)
Two Edison base fuses (3A., 15A.)
six small cartridge fuses (3A)
two female plugs
two male plugs
one 3-way cube tap plug
assorted screws, nuts, washers
1 roll solid No. 18 push-back hookup wire
complete aerial kit
pilot lights, assorted sizes
5 standard mount sockets (4-prong, 5-prong, 6-prong and both sizes 7-prong)
small bottle Nujol
1 package pipe cleaners
small bottle walnut oil stain
small bottle furniture polish (with cloths)

DRILL AND TAP SIZES AND USES

In the construction of radio and electrical equipment it is neecssary to drill and tap holes in various kinds of metals and insulating materials for the machine screws which hold the parts together. Machine screws of various sizes are used in radio work, the most common being the 6 x 32 (number 6 screw with 32 threads per inch) and the 8 x 32. The tap and clearance drill table shows the screw numbers, the number of threads per inch, and the drills to be used in making holes either for threading (*tapping*) or for allowing the screw to slide through the hole freely (*clearance*). Thus, to tap a hole for a 6 x 32 screw, first drill the hole with a No. 36 drill, and then tap it with a 6 x 32 tap. To drill a clearance hole through which a 6 x 32 screw will slide freely, use the No. 28 clearance size drill.

In many cases it is desirable to know the diameter, in inches or thousandths of an inch, of a certain size drill. Many mechanical specifications are such that holes are sized in thousandths of an inch. To determine the size drill required to make the hole, merely consult the Drill Diameter Table given here. It will be found that. in general, standard sized holes will be specified.

All metal drilling should be done with round twist drills, which are obtainable in the sizes designated by numbers, as in the table. When drilling brass, aluminum and cast iron, no lubricant is used. When drilling steel, the drill should be lubricated with light machine oil as it enters the hole.

Insulating materials such as Bakelite, Formica, Celoron, hard rubber, fibre, etc., should be drilled with the point of the drill ground to the usual sixty degree angle but with the front edge of the cutting edge ground straight or flat to remove the hook. Speeds up to 1,500 r-p-m may be used, and the drill may be left

(*Text continued on Page 30-3*)

Sizes of Tap* and Clearance Drills

Screw No.	*Th'ds Per Inch*	*Tap Size*	*Drill Number For Tap*	*Drill Number Clearance*	*Screw No.*	*Th'ds Per Inch*	*Tap Size*	*Drill Number For Tap*	*Drill Number Clearance*
2	48	2x48	No. 50	No. 44	8	24	8x24	30	17
2	56	2x56	50	44	8	32	8x32	29	19
2	64	2x64	50	44	10	24	10x24	25	10
3	40	3x40	47	39	10	30	10x30	22	10
3	48	3x48	47	39	10	32	10x32	21	10
3	56	3x56	45	39	12	20	12x20	19	2
4	32	4x32	45	31	12	24	12x24	16	2
4	36	4x36	44	31	12	28	12x28	14	2
4	40	4x40	43	31	14	20	14x20	10	¼
6	32	6x32	36	28	14	24	14x24	7	¼
6	36	6x36	34	28					

*Note: These are the drill sizes for average use. The size drill to use really varies somewhat with the material being drilled. For tapping Bakelite or hard rubber use a drill one size larger than specified in this table.

Drill Diameter Table

Drill No.	*Dia. (Mils)*	*Drill No.*	*Dia. (Mils)*
1	228.	28	140.5
2	221.	29	136.
3	213.	30	128.5
4	209.	31	120.
5	205.5	32	116.
6	204.	33	113.
7	201.	34	111.
8	199.	35	110.
9	196.	36	106.5
10	193.5	37	104.
11	191.	38	101.5
12	189.	39	099.5
13	185.	40	098.0
14	182.	41	096.0
15	180.	42	093.5
16	177.	43	089.0
17	173.	44	086.0
18	169.5	45	082.0
19	166.	46	081.0
20	161.	47	078.5
21	159.	48	076.0
22	157.	49	073.0
23	154.	50	070.0
24	152.	51	067.0
25	149.5	52	063.5
26	147.	53	059.5
27	144.	54	055.0

Note: Diameters are specified in "thousandths" of an inch (*mils*). To change to *inches*, divide the diameter in *mils* by 1,000.

dry or else lubricated with lard oil or light machine oil. Insulating materials of this kind are rather hard on the drills and dull the point quickly. When the drill comes through the hole in the back, it is advisable to hold a block of scrap wood solidly against the back surface to prevent the material from chipping or breaking through around the edges.

Taps are used for cutting threads on the inside of holes. *Dies* are for threading the outside of rods. The first part of each tap or die number indicates the gauge number of the rod stock from which the screws were cut, or the gauge number of the rod to be threaded, respectively; the second part of each number indicates the number of threads per inch, which should correspond to the number of threads per inch on the screw or nut to be used.

COMMON FRACTIONS AND THEIR DECIMAL EQUIVALENTS

The following table gives the decimal equivalents of some of the commonly used fractions. The table lists the fractions in 64ths of an inch, starting with 1/64 and increasing 1/64 inch at a time. In all cases, the fractions have been reduced to the lowest denominator. Thus, the second fraction should be 2/64, but it is shown as 1/32 because it has been reduced.

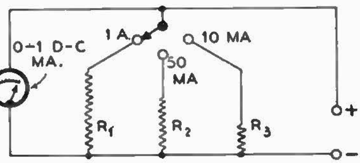
COMMON FRACTIONS AND THEIR DECIMAL EQUIVALENTS

Fraction	*Decimal*	*Fraction*	*Decimal*	*Fraction*	*Decimal*	*Fraction*	*Decimal*
1/64	.0156	**1/4**	**.2500**	**1/2**	**.5000**	**3/4**	**.7500**
1/32	.0313	17/64	.2656	33/64	.5156	49/64	.7656
3/64	.0469	9/32	.2813	17/32	.5313	25/32	.7813
1/16	.0625	19/64	.2969	35/64	.5469	51/64	.7969
5/64	.0781	5/16	.3125	9/16	.5625	13/16	.8125
3/32	.0938	21/64	.3281	37/64	.5781	53/64	.8281
7/64	.1094	11/32	.3438	19/32	.5938	27/32	.8438
		23/64	.3594	39/64	.6094	55/64	.8594
1/8	**.1250**	**3/8**	**.3750**	**5/8**	**.6250**	**7/8**	**.8750**
9/64	.1406	25/64	.3906	41/64	.6506	57/64	.8906
5/32	.1563	13/32	.4063	21/32	.6563	29/32	.9063
11/64	.1719	27/64	.4219	43/64	.6719	59/64	.9219
3/16	.1875	7/16	.4375	11/16	.6875	15/16	.9375
13/64	.2031	29/64	.4531	45/64	.7031	61/64	.9531
7/32	.2188	15/32	.4688	23/32	.7188	31/32	.9688
		31/64	.4844	47/64	.7344	63/64	.9844
15/64	.2344					**1**	**1.0000**

ANSWERS TO NUMERICAL PROBLEMS IN *MODERN RADIO SERVICING**

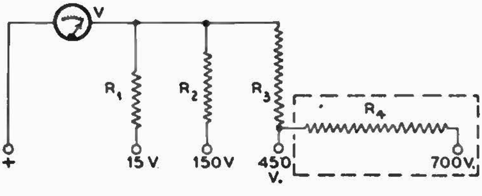
(First Edition, Third Printing Dated June, 1936)

Pages 57-58-59.—Prob. 7: sensitivity is 1 ma. Prob. 13: (*a*) 5.6 ohms; (*b*) 1.02 ohms; (*c*) 0.05 ohm; (circuit arrangement shown below).



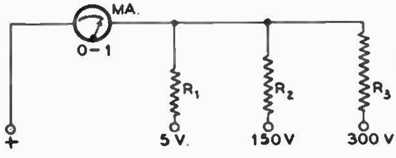
Problem 13, Page 58

Prob. 14: 15,000 ohms for the 15-volt range, 150,000 ohms for the 150 volt range, and 450,000 ohms for the 450-volt range, 0.001 ampere through the movable coil, (same circuit arrangement) as shown in Fig. 2-21 on page 29 of Modern Radio Servicing. Prob. 15: (*a*) Connect a 250,000-ohm multiplier resistor between the 450-volt terminal and the new 700-volt terminal, thus putting this resistor, R_4 in series with multiplier R_3 for the 700-volt range, as shown in the illustration below; (*b*) 250,000-ohm multiplier resistor R_4; (*c*) diagram shown below.



Problem 15, Page 58

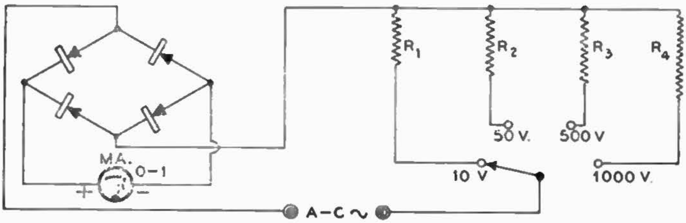
Prob. 16: (*a*) a multiplier resistor of 5,000 ohms, one of 150,000-ohms and one of 300,000 ohms; (*b*) circuit diagram is shown below.



Problem 16, Page 58

**Modern Radio Servicing* by Alfred A. Ghirardi, Radio & Technical Publishing Co.

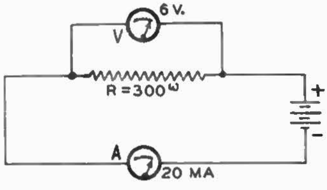
Prob. 27: (*a*) "average" value is 190.5 volts; (*b*) "effective" value is 212.1 volts. Prob. 28: (*a*) "effective" value is 11.1 amps; (*b*) the pointer "deflects" according to the *average* value of the current but the scale is calibrated to indicate the "*effective*" value directly. Prob. 29: circuit arrangement is shown in the diagram below (R_1 = 10,000 ohms; R_2 = 50,000 ohms; R_3 = 500,000 ohms; R_4 = 1,000,000 ohms).



Problem 29, Page 59

Prob. 31: (*a*) 20 volts ±; (*b*) 20 volts ±; (*c*) 4 per cent at half-scale reading, 8 per-cent at quarter-scale reading; (*d*) same as for the 100-division 1,000-volt scale. Prob. 34: The meter having the 10-volt range has the greater sensitivity.

Pages 84 and 85.—Prob. 2: 12 ohms. Prob. 3: (*a*) circuit diagram shown below; (*b*) 300 ohms.



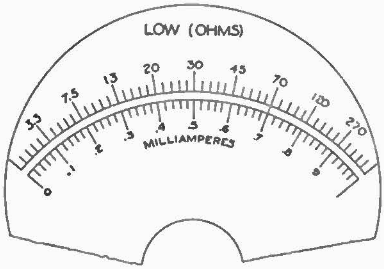
Problem 3, Page 84

Prob. 5: 66,666 ohms. Prob. 11: 14,250 ohms. Prob. 17: use a battery having a voltage ten times as high, and a current-limiting resistor having ten times as much resistance.

Page 98.—Prob. 7: "low-range" scale values are as follows:

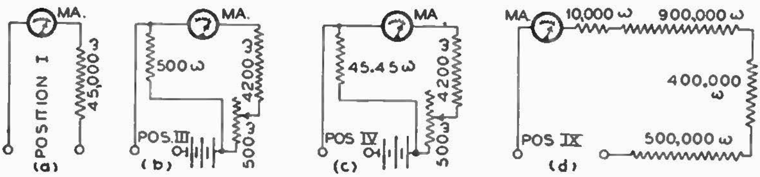
I	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
R_x	3⅓	7½	13	20	30	45	70	120	270	X

Prob. 9: The complete current and low range "ohms" scale for the meter is shown herewith:



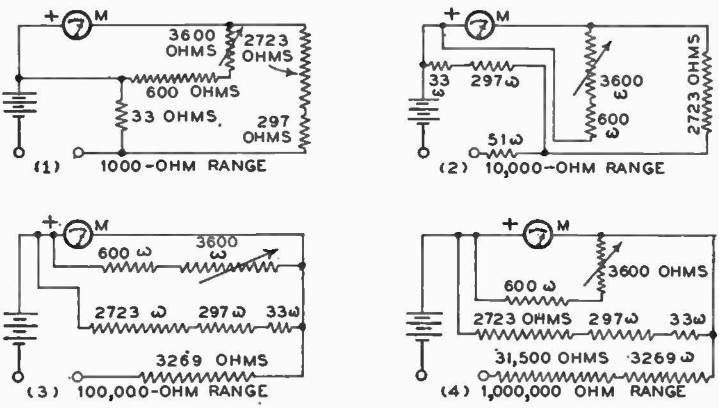
Problem 9, Page 98

Page 119.—Prob. 3: The various "breakdown" circuit diagrams are shown herewith:



Problem 3, Page 119

Prob. 5: The various "breakdown" circuit diagrams are shown here:



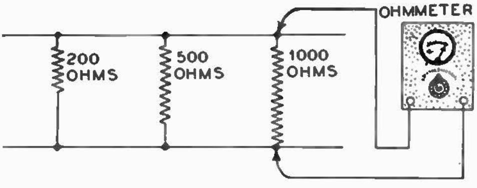
Problem 5, Page 119

Page 331.—Prob. 6: 0.0075 mfd. **Prob. 7:** 11 ohms.

Pages 374 and 375.—Prob. 4: 5.5 watts signal output. Prob. 11: The table of frequency values is shown here:

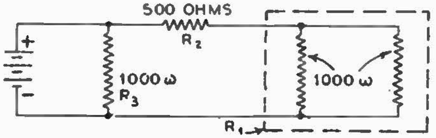
Fund. Freq.	*2nd Harmonic*	*3rd Harmonic*	*4th Harmonic*	*5th Harmonic*	*6th Harmonic*
175	350	525	700	875	1,050
275	550	825	1,100	1,375	1,650
425	850	1,275	1,700	2,125	2,550
600	1,200	1,800	2,400	3,000	3,600

Page 550.—Prob. 1: 163 ohms. Prob. 2: 3.3 ohms. Prob. 3: 2,800 ohms. Prob. 4: 125 ohms. (The circuit diagram is shown herewith.)



Problem 4, Page 550

Prob. 5: 1.5 amps. (The circuit diagram is shown herewith):



Problem 5, Page 550

Page 598.—Prob. 18: Some value between 1,800 and 2,200 ohms.

Page 791.—Prob. 22: The i-f is 465 kc.

Pages 1020 and 1021.—Prob. 4: 12,912 kc. Prob. 5: Total width, 20 kc. Prob. 6: 12,920 kc. Prob. 19: Frequency ratio about 3½ to 1. Prob. 20: 3 bands are necessary to cover the all-wave frequency range from 540 to 18,000 kc.

Pages 1159-1162-1164.—Prob. 12: 2.5 times less objectionable. Prob. 13: The signal-to-noise ratio is 2. Prob. 14: The signal-to-noise ratio is 4. Prob. 59: Length should be approximately 495 feet. Prob. 60: The length of each horizontal section should be approximately 74.3 feet. Prob. 81: The overall length of the doublet for 6 mc. reception should be about 82.5 feet. The one for 15 mc. reception should be 33 feet long overall.

Page 1203.—Prob. 24: Per cent distortion is 7.5.

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