

PHILCO SERVICE SUPERVISOR



NOVEMBER, 1953

◆ REFRIGERATION

Replacement Unit Assemblies

Cover

◆ TELEVISION

Servicing UHF Tuners and Converters _____ 5

◆ ELECTRIC RANGE

Porcelain on Metal _____ 10

◆ HOME RADIO

Philco Printed Wiring _____ 14

◆ AUTO RADIO

Servicing the Power Supply in Auto Radio _____ 17

◆ AIR CONDITIONING

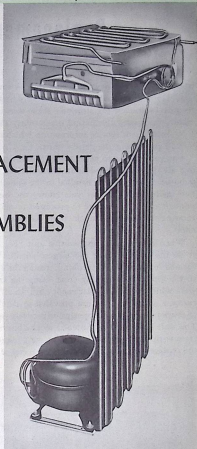
What is Air Conditioning? ____ 21

Published monthly by Service Headquarters of the Philco Corporation for independent service technicians who render high quality product service . . . the world over.

Copyright 1953, PHILCO CORPORATION
Reproduction of any material within this publication is prohibited without the written consent of the copyright owner, Philco Corporation.

Shop Practices • Service Techniques • New Product News

REPLACEMENT UNIT ASSEMBLIES



NOW that the cool weather is again upon us, we can sit back, relax and consider some of the problems we encountered in the past summer service season. One of the major procurement problems was that of refrigeration replacement unit assemblies. Delays in shipping replacement units to you were brought about through:

1. Defective units being held in storage too long prior to return to the factory.
2. Poor packing which caused damage and required investigation to determine if the unit was improperly packed or if it received excessively rough handling by the carrier.
3. Improperly filled out return tags which were in-

(Continued on next page)

Replacement Unit Assemblies

(Continued from Front Cover)

complete or had misinformation due to lost records.

4. Units returned under warranty when sales records (warranty registration) show that the refrigerator was passed the period of warranty claim.

5. Insufficient service information which caused delays in processing the repair units.

You can help us to help you by immediately returning all defective sealed unit assemblies to your distributor. They must be handled in the same manner as new merchandise for as you know, the major components of the system are re-processed to make up the rotating replacement stock your distributor has on hand.

When re-crating an inoperative unit (Fig. 1), place it in the crate so that the largest possible radius is formed in the refrigerant tubing. Fasten the evaporator to the top of the shipping crate, using the same hardware which held the replacement unit. In all shipping crates, a series of holes are provided so that any type of evaporator may be properly and securely positioned. The unit base must be fastened to the bottom of the crate with the nuts or screws which were removed from the replacement unit. Before the last panel of the crate

is secured, be sure that all evaporator bolts and unit base shipping bolts are installed and tightened. Check to make sure that the shipping angle, relay, circuit breaker and power cord are attached to the unit.

Fill in the necessary information on the return tag, PR-820, and affix the number six copy to the replacement unit.

When a dealer or serviceman has a defective unit assembly, a request for a replacement unit should be made to his distributor.

To receive credit for returning an inoperative unit to Philco, the following procedure should be followed:

Upon receipt of a replacement unit by the dealer, the dealer or his serviceman fills in the required information on the PR-820C and PR-820D tags, as illustrated in Fig. 2. The #6 copy (the cardboard section of PR-820D), is affixed to the replacement unit. The dealer then returns the defective unit to the distributor with the number 4 and 5 copies of the PR-820D tag. The number 1, 2, and 3 sections of the PR-820C tag should be enclosed in the envelope which is attached to the outside of the shipping crate.

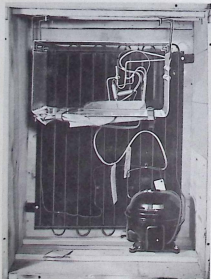


FIGURE 1

Correction—

OCTOBER Issue of the Supervisor
Page 12, 4th paragraph
Under "High Cabinet Temperatures"

Sentence should read:

"If the feeler tube of the plate regulator passes through a cold area (Fig. 7), such as immediately in back of the inner cover plate in close proximity to the evaporator where the surface temperature is lower than 38°, the control will close its contacts and the plate will not be refrigerated." The first *not* is eliminated.

however, the following is an explanation of the items on which a question may arise:

1. "Part Number of This Unit." This is the part number of replacement unit which is being installed in the refrigerator, freezer, or air conditioner.
2. "Serial Number." This is the serial number of the above mentioned unit as shown on the serial plate.
3. "Unit Model Number." This is the model number of the above unit as shown on the serial plate.
4. "Date of Installation of This Unit." This is the date this particular unit is installed.
5. "Date of Original Product Sale." This is the date the refrigerator, freezer, or air conditioner, in which this replacement is to be installed, was purchased by the original customer.

Replacement Units for "Out of Warranty" Refrigerators:

The warranty on the sealed unit mechanism expires five years after the date of sale of the refrigerator to the original consumer. Any replacement after this warranty period will be made at the consumer's expense.

All replacement units supplied by Philco for use in "out of warranty" refrigerators will carry a four-year warranty. This mechanism includes the sealed compressor unit, evaporator, condenser, and interconnecting tubing.

Philco will replace free of charge, at any time during the four-year warranty period, the complete sealed unit mechanism when examination by Philco discloses failures to have been caused, in Philco's judgment, by defects in material or workmanship under NORMAL USE AND SERVICE.

The procedure for replacing and returning these units for credit is the same as for units within the original five-year warranty.

Prior to March, 1950, all K, L, M, and R units supplied by Philco for use as replacements had attached a PR-1629 registration tag. This tag was used to register the unit under a new four-year warranty. Effective March 1, 1950, all units sold must be registered with our new PR-820D registration tag which is attached to all replacement units. If a distributor replaced a unit which has the old type PR-1629 registration tag attached and is within the four-year warranty, the PR-1629 tag should be shown as the registration number on the replacing PR-820C tag and the section of the PR-1629 tag which is attached to the defective unit should be returned to the factory with the PR-820C tag of the defective unit.

Relay Replacement:

Replacement units for refrigerators are shipped complete with relays and capacitors. These relays and capacitors may in some cases, be different from the ones originally installed in the refrigerator, freezer, or air conditioner. The original relay and capacitor should be returned with the inoperative unit. If the inspection at Philco discloses that the new relay and capacitor sent with the replacement was not installed when the unit was changed, the distributor becomes liable for damage resulting from defective relay and capacitor.

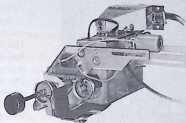
The solution to the paradox, which is a scourge to all concerned is to test units before you ship them to Philco. Look them over carefully. Check the electrical parts and wiring. Tie down all loose hardware. Crate the unit properly and ship it fast. Mail your tag order to the proper depot for a replacement shipment.

All that has been said on defective refrigerator returns cannot be stressed too often. It is a critical time for Engineering and the Replacement Unit Department during the introduction of a new line to the Field. Early failures are given special tests by the Engineering Department. Any defect, no matter how minor or commonplace it may appear, will lead to a fix in current production. This clearly indicates that the quick receipt of defective units for Engineering tests will improve the product.

Initial failures also give us a lead to the quantity of units that must be purchased from the Production people to handle our all time Field requirements. Pay particular stress to the defective unit and its importance. We have repair lines to feed; materials to schedule; units to schedule; schedules to be met; and men to keep busy.

Some returns from dealers are so tardy that both your stock and ours are depleted to a point that we have difficulty in filling an emergency order. The story is told that once an eagle lay dying on a rock and as its life blood ebbed away, it was saddened even more when he noticed that the feather that guided the arrow to his heart was one that had come from his own wing. The defective unit is the arrow that starts the unit cycle. Put wings on that unit and head it our way.

The failure of a refrigerant unit in a Philco customer's refrigerator is the beginning of the unit cycle that involves the Dealer, the Distributor, and the Unit Department with its widespread repair centers, Factories and warehouses. Of course, the main objective is to replace the unit in the customer's refrigerator in the shortest possible time.

*Servicing***UHF** TUNERS and
CONVERTERS

Servicing UHF tuners and converters requires greater knowledge and skill on the part of the service technician than has previously been required for the servicing of VHF equipment.

This requirement stems from the more critical specifications of the equipment plus the fact that certain electronic fundamentals which previously enjoyed a rather wide tolerance when applied to VHF television equipment now become of primary consideration, are critical in tolerance and must be considered as integral components in the design of UHF equipment.

UHF tuners and converters, however, perform the same basic function as the VHF tuner. Both types of units operate on the Superhetrodyne principle wherein the incoming television signal is selected, amplified, hetrodyne'd with an oscillator frequency and emerges from the output stage at a fixed frequency.

In view of the critical characteristics previously mentioned it becomes desirable to briefly review some basic electronic characteristics, since these characteristics are of utmost importance at the frequencies of the UHF television channels.

For example, in the study of basic electronics we learn of the effects of a current passing through a conductor around which a magnetic field builds up and an induced current of opposite polarity to the applied current results. This induced current is negligible with direct current or very low frequency alternating currents but becomes very pronounced as the frequency is increased until at UHF frequencies the conductor assumes all the characteristics of an inductance and may be considered as such. In view of this, lead length of components in R.F. circuits is very critical and may be considered as an integral portion of the R.F. circuit.



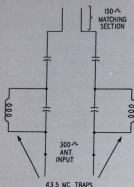


FIGURE 1. Antenna Terminal Board

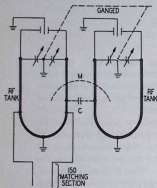
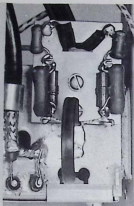


FIGURE 2. R.F. Tank Circuits

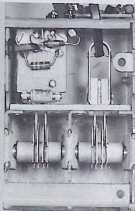
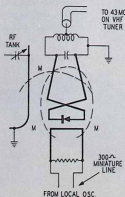


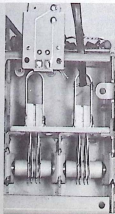
FIGURE 3. Crystal Mixer



Also of prime importance at UHF frequencies is the existence of capacity between a conductor and nearby objects such as the chassis. Since the wiring and the chassis are both conductors, capacitance exists between these components whose dielectric is air. The resultant capacity is small in view of the size of the wire and the distance between the wire and the chassis, however, at UHF frequencies this distributed capacity becomes an integral part of the circuits.

"Skin effect" is another important consideration at Ultra-high frequencies. This is the tendency for the current to flow on the outer surface of the conductor instead of through the mass of the conductor, and there is greater tendency for this surface conduction to take place as the frequency increases. Since the chassis itself is a path of current flow, it is necessary that its construction provide a low resistance path for these Ultra-high frequency currents. In view of this, copper plating is used and all seams are welded.

Two basic types of UHF units are employed in Philco receivers. One type is, in effect, a tuner, wherein the incoming UHF signal is changed in frequency to that of the I.F. frequency of the receiver, and consequently its action is basically the same as that of a VHF tuner.



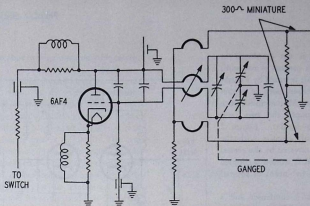


FIGURE 5. Tuner Oscillator Section

The method of feeding the output of the tuner to the receiver will vary depending upon the particular chassis. The tuner may be fed directly to the I.F. stages or to the VHF tuner which has a UHF position on the dial and a switching arrangement to make it operate as an I.F. stage. The UHF tuner contains an R.F. stage, oscillator stage, and mixer stage, and may have a preamplifier stage to amplify the output signal of the mixer stage, before feeding to the television receiver, for certain models.

The second type of UHF unit employed in Philco receivers is, in effect, a converter wherein the UHF incoming signal is converted or changed in frequency to that of one of the VHF channels, usually either channel 2 or 3. In view of this the output of the converter must be fed to the input of the VHF tuner for further conversion to the I.F. frequencies of the re-

ceiver. Therefore, whenever a converter is used, double conversion takes place, consequently, a preamplifier stage is necessary due to the need for added amplification. The converter therefore, consists of an R.F. stage, oscillator stage, mixer stage, and a preamplifier stage.

Basically the tuner and converter have similar requirements, except for different output frequencies and the addition of a preamplifier.

The UHF antenna signal feeds to the antenna terminal board on the side of the UHF tuner. The antenna board contains two 43.5 megacycle IF traps in series with each side of the antenna lead and two isolating condensers. A 150 ohm matching strip feeds the signal from the antenna terminal board to the R.F. section. Figure 1 shows the antenna terminal board both schematically and pictorially.

FIGURE 4
Tuner Oscillator Section

A vacuum tube is not employed in the R.F. stage which consists of two tank circuits. Each circuit is tuned by a push-pull variable condenser, both of which are ganged together. Mutual inductance and capacitance couple the two tank circuits which are similar. Figure 2 shows the R.F. tank circuits with the second tank circuit covered by the crystal mixer panel. The R.F. section is coupled to the mixer stage by means of mutual inductance.

Two inductances, a condenser and a crystal, mounted on a panel, form the mixer stage, part of which is a printed circuit on the panel. A crystal is employed in the mixer stage in view of its extreme low noise factor. A 300 ohm miniature line couples the oscillator to the mixer stage and terminates in a printed inductance located on the mixer panel. In figure 3, the schematic diagram illustrates the mutual inductance coupling of the R.F. stage to the crystal mixer stage, while in the photograph the mixer panel is raised exposing the printed inductance and also the second R.F. tank circuit.

The oscillator stage utilizes a 6AF4 tube employed as a modified colpitts oscillator. Partially printed circuits form the inductances. The oscillator stage is tuned by a push-pull variable condenser ganged with the tuning condensers in the R.F. tank circuits thereby providing a common tuning shaft. The printed inductance on the under side of the wafer terminates the oscillator end of the 300 miniature line. In figure 4A, the oscillator section is shown with the wafer removed, exposing the inductances which constitute the oscillator tank, and in figure 4B with the panel in place, showing the miniature 300 ohm line emerging from the wafer terminals. Figure 5 illustrates schematically the oscillator section. The R.F., mixer and

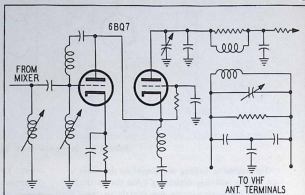
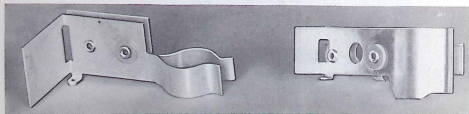


FIGURE 7

oscillator stages of the UHF converter are identical to the UHF tuner with the following exceptions. The oscillator tank circuit of the converter differs physically from that in the tuner in comparative size. The converter oscillator also differs from the tuner oscillator in that it produces an output from the mixer at a VHF channel frequency of either channel 2 or 3. In figure 6 the physical differences of the two oscillator tanks are shown.

In the physical construction of the two tanks, small bushings with porcelain spacers are used to fasten the two halves of the oscillator tank together. In the UHF converter the bushing is so constructed as to form a condenser. In the tuner the bushings are not condensers, however, a ceramic type is connected across the top of the tank.

The UHF converter further differs from the UHF tuner in that a preamplifier stage is necessary while



CONVERTER

FIGURE 6

TUNER

a preamplifier is necessary with a tuner only for certain chassis.

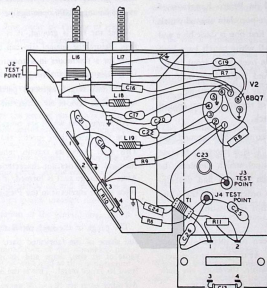
A 6BQ7 duo-triode tube is employed in the preamplifier and the output of the mixer is condenser coupled to the grid of the first triode section. This grid is double tuned by variable inductances before and after the coupling condenser, while L-C neutralization from the plate to grid is employed. The first triode plate is directly coupled to the second triode cathode. The second triode output is transformer coupled to the VHF tuner antenna terminals with both the primary and secondary of the transformer loaded with low-value resistors for wide Band-Pass characteristics. The Secondary Circuit of the transformer presents a 300 ohm impedance match to the VHF tuner antenna terminals, see figure 7.

The variable grid inductances for the first triode stage of the preamplifier are mounted with the adjusting screws easily accessible from the outside of the sub-assembly, see figure 8. As previously stated the UHF tuner when used with certain chassis will require a preamplifier unit. Basically there is no difference between the tuner and converter preamplifier units with the exception of the output frequencies. The tuner preamplifier output is an I.F. frequency while that of the converter preamplifier is either channel 2 or 3 frequency.

Next Month...

This article will be continued and will cover the necessary test equipment and preliminary steps for testing UHF tuners and converters.

FIGURE 8



Porcelain on Metal

The word "porcelain" when used in reference to the finish of an electric range can sometimes be misleading. Most ranges have porcelain insulators and some Philco models have a porcelain refractory brick for the deep well cooker, both of which are actually ceramics. When describing the finish used on Philco electric ranges, it is most accurately described as oitreons porcelain enamel, however, in order to shorten the term, it is acceptable to use the simple term "porcelain enamel." This also distinguishes it from the ordinary lacquer synthetic enamel commonly used on the exterior of refrigerators, cabinets, etc.

Porcelain enamel is fused to our metal range panels as a homogeneous unit. It is the most ideal finish yet devised for an electric range. Its surface is hard, glossy, non-porous and lasting. It will resist discoloration caused by spilled acids, alcohol, alkalies and the common chemicals used around the home. It is easily cleaned, requiring only soap and water and is also the housewife's pride and joy from a beauty standpoint.

Ground Coat

Porcelain enamel as used on Philco Ranges is of two different types. All white porcelain enamel panels have two coats applied, the first one is dark blue and is called the ground coat. All white panels have both coats, while parts such as the oven liner, front frame, inner doors, broiler pans and baffle, have only the ground coat with an over spray of black enamel. The over spray deepens the color of the ground coat enamel to a more pleasing blue black.

As noted above we at Philco use a blue ground coat as a first coat on all panels. This is necessary because the ground coat is the enamel which develops the adherence to the steel. Much research and development has been carried out in order to apply the white enamel direct to the steel, thus eliminating the dark colored ground coat enamel.

Such a process has not been too successful except where special steels are used. At the present time very little of these steels are available, therefore, the dark colored ground coat enamels are in general use.

The blue ground coat is made from the following minerals: Feldspar, Silica, Borax, Fluorspar, Cryolite, Cobalt and Nickel oxides.

The Cobalt and Nickel oxides cause the enamel to be blue in color, however, their main function is to promote the adherence between the ground coat enamel and the steel. These materials are pre-mixed and smelted and the result is a vitreous compound which is called frit.

The frit is purchased and comes to us from the smelter in a coarse granular form. It must be ground and mixed with water in our own milling department. This grinding and mixing preparation is done in revolving drums, approximately half full of hard porcelain grinding balls. A spray of water is played on the outside of the drum to dissipate the generated heat.

The milling operation reduces the size of the frit particle so that only 1 to 8 per cent (depending on the type of enamel) is retained on a 200 mesh screen. In order to have a more comprehensive idea of the fineness or particle size, we can describe a 200 mesh screen as one having 40,000 openings per square inch.

After the frit is ground, it is then called enamel slip. Before the enamel slip can be used it must be aged for a few hours in automatically agitated vats. It is then screened through an 80 mesh screen to remove any large unground particles and magnetic separated to remove all adulterant iron particles.

All range parts which are porcelain enameled have to be fabricated from special enameling sheet steel. This steel embodies certain inherent physical and chemical properties not characteristic of other steels. After the range part is formed, it is placed on a conveyor which carries it to the Pickling Department for cleaning.

The gauge of the steel varies according to the size and shape of the fabricated part. The table top because of its size, shape and its importance is made from 16 gauge metal. This is the heaviest gauge used. All other parts are 18 and 20 gauge.

The parts to be porcelainized must be of special design with respect to the radii and strength of flanges. All radii when possible, are not less than $\frac{1}{4}$ ". The larger radii tend to minimize the spalling tendency of the enamel. The wide flanges strengthen the part and reduce warpage during firing of the part.

One of the most important operations of good enameling is cleaning the parts. All dirt, grit, grime and grease must be thoroughly removed before a panel can be successfully enameled. Different sized conveyor baskets to hold the various shaped parts carry them through a series of alkali, acid, water and neutralizer sprays. This is known as the pickling operation. Upon emerging from the pickling and washing department the parts are then carried in the same conveyor baskets through a drying oven. The parts being thoroughly dry are ready to be enameled.

Most of the ground coat enamel is applied by dipping. The part is completely submerged by hand into the ground coat slip and immediately hung on a conveyor rack maintained at a predetermined slope. The slope of the rack allows the enamel to flow off the part at just the right speed in order to maintain a constant thickness of enamel. A thickness of from .0035 to .004 of an inch is proper for ground coat enamels. The enamel slip is also adjusted to a definite specific gravity and flow value by the use of special ingredients. This also aids in maintaining uniform enamel thickness.

Such parts as table tops and control panels, have the ground coat sprayed on rather than dipped. This eliminates all dip drain lines which is characteristic of dipped parts. After the ground coat slip is applied, the part is immediately passed through a drying oven at 250° F. This removes practically all the water from the mixture and leaves the enamel frit adhering to the part in a dry bisque form. At the end of this conveyor line the parts are picked off and transferred to the conveyor line which passes through the furnace. This is the final operation of the ground coat, and is known as the "firing" of the enamel.

In "firing" the temperature of the enameled part is brought up to 1550° F. and held at this temperature for approximately 3 minutes. During this time the

enamel actually becomes a molten mass and is fused to the metal. As the part cools it becomes a smooth glossy surface.

After the "firing" operation all Ground Coated parts, including those parts which are to receive the finish white coat, are inspected. All marred, and parts having burned off spots are rerouted to be processed.

Finish Coat

In general this white finish enamel frit is made from the same minerals as the Ground Coat frit, however, the metal oxides of Cobalt and Nickel are eliminated. In their place the oxide of Titanium is added. This oxide imparts the whiteness or the opacity to the frit. The frit is purchased and milled fine in the same manner as the ground coat enamel.

In our process all the finish white enamel is applied by spraying. The parts to be sprayed are loaded flat on a conveyor which passes under four reciprocating spray guns which operate automatically. The parts continue through a drying oven, which removes the water and leaves a bisque coating of dried enamel similar to the dried ground coat described in the foregoing. This coat is also "fired" at 1550° F. and the resultant finish is a white smooth surface, much superior to the ground coat in gloss, hardness and smoothness of surface.

The white Titanium enamel is resistant to the ordinary acid and juices used in cooking which makes it easy to maintain the high glossy finish. This characteristic is not true of the ground coat enamel and all ground coat liner parts may etch badly if spillage is not quickly removed.

The thickness of the white coat of enamel is very important and an attempt is made to hold it to .0045 to .005 of an inch. The thickness is controlled by:

1. Specific gravity and flow value of the enamel.
2. Air spray pressure.
3. Size of the spray gun orifice.
4. Speed of the conveyor.

At a thickness of .005 of white enamel there is very little danger of chippage under ordinary conditions. When it becomes necessary to reprocess a part because of some enamel defect the possibility of chip-

page rapidly increases and a color variation sometimes results.

Because of the greater tendency for heavier coated enameled parts to chip, it is better to maintain a reasonable commercial standard of acceptance than to attempt to produce an enameled part completely free of defects. A reasonable acceptable level may permit the presence of black spots which are not too prominent in appearance.

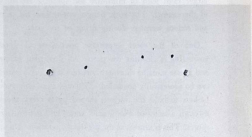
It is not always possible to design the perfect part for good porcelain enamel practices. Therefore, some parts may have localized areas where chippage of the white coat cannot be controlled. If this occurs, the white enamel can be brushed away before the part is "fired." This reduces the possibility of local chippage, and in most cases entirely eliminates it.

Some enamel defects are of such a nature that they are impossible to hide by applying subsequent coats of white enamel. It is, therefore, necessary to set up limits of thickness which will permit safe handling. This limit ranges between .018 to .025 (including ground coat thickness) depending upon the shape, size and gauge of steel in the part.

See the following photos and notes for different types of damage and defects.

Each part receives an inspection as it leaves the furnace conveyor line before being assembled into the range. All parts which do not pass the acceptable standard are rejected for reprocessing. Under usual enameling conditions, exterior parts such as are used in our range, have an acceptance value of from 75 to 85 per cent. This means that the greater percentage of range parts are finished with less than .010 inches (ground coat and white combined) of vitreous porcelain enamel.

A follow up inspection is made for both enamel defects and chipped enamel during the assembling of the range. All parts finished in white, which are chipped or show indications of possible later chippage are removed and replaced. Slight chips which occur in the parts finished in ground coat only, are sometimes touched up with a black heat resisting lacquer enamel.



1

FIGURE 1. Bubbles or Blisters. These are due to impurities of the steel boiling through the enamel.

FIGURE 2. Split due to a crack in the metal panel.

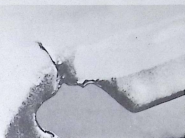
FIGURE 3. Chips caused by flexing or bending panel. It is very wise to uncrate each range exactly along edges.

FIGURE 4. Chip caused by a sharp blow.

FIGURE 5. Scuff or scratch.

NOTE: This condition can occur if the crate is allowed to rub against the porcelain when uncrating, according to instructions.

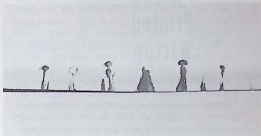




2

FIGURE 6. Mar. (Caused by disturbing dry bisque coating before firing.)

FIGURE 7. Fish Scale. This condition occurs because of poor adherence of the enamel to the steel. Generally this condition occurs during or shortly after the firing operation. Delayed fish scale may also occur days later so that the range may have been shipped from the factory. This is not too common but such a defect should be replaced.



3



4

6



5



PHILCO Printed Wiring

Since the first radio receivers were produced by production methods, Philco has constantly searched for and tried various methods of wiring, installing components, and shaping sub bases, that would ultimately result in complete uniformity of a given model regardless of quantity produced. As a result of this research, approximately five years ago, our Engineers decided that the greatest advance toward this goal would be achieved if placement and length of connecting conductors between components could be exactly the same for each chassis of any given model. This would mean that "stray" capacities and inductances between and contained in conductors could become fixed figures for each chassis and would no longer be "strays." They would be known and could be included in the engineers design.

Working toward this end the "printed circuit" panel was developed and a short run of production samples was made at Sandusky in June of 1950 for test purposes. These sets proved that large quantities could be produced and would perform more uniformly than previous models. However, the engineers were not happy with the service handling as both top and bottom of the panel carried the circuit and it was decided that improvements would have to be developed so that the set could be more easily serviced. The result of these improvements is the "printed panel" shown to your distributors Service Managers at the recent Atlantic City Philco Service Conference. The receivers, in which this panel will be used, are more easily serviced than the hand wired sets of the same model and we think you will agree that Philco has made a great step forward in the building and serviceability of small sets.

We felt that you would be interested in how the panel is produced and the following amounts to a quick trip through the factory on paper.

Your distributor will shortly receive a visual training forum covering this and service methods recommended.



FIGURE 1

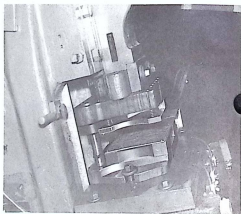


FIGURE 2

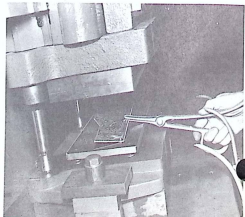


FIGURE 3

November, 1953

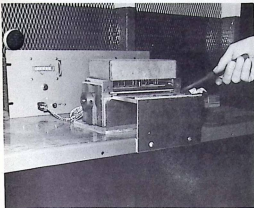


FIGURE 4

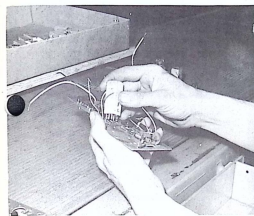


FIGURE 5

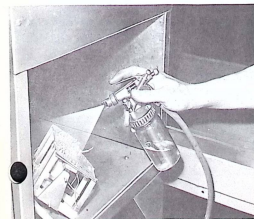


FIGURE 6

The production cycle starts with a bakelite panel large enough to form several completed circuits. It has, bonded to one surface, a sheet of copper foil. This sheet is placed in a frame, copper side up. A resist type of paint is then processed onto its surface through a silk screen which accurately paints complete circuits. (Fig. 1.) The panel is then allowed to dry. Next, the silk screened panel is sent to the developing or etching machine. Here the panel is exposed to a bath which etches or dissolves the exposed copper and leaves only the desired circuit which has been protected by the paint. Following this operation the panel is washed to remove any remaining etching solution and then goes through a degreaser which removes the paint from the panel.

The next step takes the panel to a cutting machine (Fig. 2). This divides the panel into the individual printed circuit panels. From here the panel goes to the punch press which punches the various component holes (Fig. 3), to admit the I.F. transformer lugs, condenser, and resistor leads, sockets, etc. At this point we have an almost completely wired chassis, less components.

Each panel now goes to a tester that makes continuity tests and short tests all in one operation (Fig. 4). The connections are made to various points of the wiring circuit by spring loaded needle points and a bad panel causes a reject light to show on the front of the tester.

The OK panel is now ready for the production belt (Fig. 5).

After all components have been installed on the panel, a mask is placed over the bottom side. This mask is fabricated to expose all of the connections. The mask with the assembled panel is placed in a frame and a flux is sprayed onto the panel (Fig. 6).

Now comes the soldering process. The above assembly is placed into an automatically timed soldering machine. This machine, in ONLY seconds, will perfectly solder more than one hundred connections.

The panel is now very nearly a complete radio, but still another test is made before the condenser gang, loop, speaker, and volume control are added. This machine most any serviceman would be happy to own, if it were adaptable to just anyone's radio chassis (Fig. 7).

It makes thirty-two point to point circuit checks in just ten seconds.

It amounts to a resistance bridge with a stepper assembly added and a series of lights to indicate out of tolerance parts or circuitry.

A factory standard chassis is chosen as the one side of the bridge and the wired and soldered production

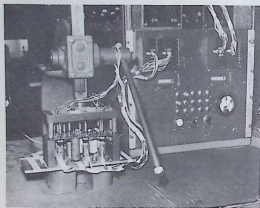


FIGURE 7

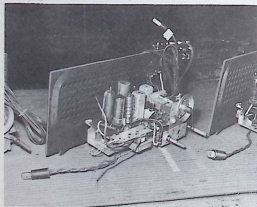


FIGURE 8

panel is compared to this standard or balanced against the standard. Should any one of the thirty-two circuits under test be out of tolerance the stepper will stop at this circuit and the light indicating where the trouble exists stays lit. The panel can, then be given to service with definite information of what to look for. Ten seconds to locate and isolate the trouble and a few minutes to remedy it. A very neat device.

The panel now goes to still another spray booth and receives a spray of electrical varnish to protect the circuits from moisture absorption. Then the variable condenser is added, the volume control, the antennae and the sub chassis which carries the output transformer. The wiring to the antenna, volume control, and gang are hand soldered.

And now a finishel PW set is ready to be aligned and put into a cabinet (Fig 8).

The AC cord is an interlock and is fastened to the masonite back on which the loop is mounted.

Servicing the POWER SUPPLY in Auto Radios

In the last issue of the Supervisor we covered basic vibrator theory and operation. This issue will be devoted to checking the vibrator, power transformer and buffer condenser.

The power supply of the modern auto radio is the only section that differs basically from the home radio and, because of this, many servicemen tend to shy away from vibrators. Radio schools generally gloss over this portion of radios but there are not really many problems if a few procedures are followed.

First remember that the buffer condenser is subjected to twice the voltage of any other condenser in the radio as it is placed across the complete secondary of the power transformer. Thus the voltage may range as high as 700 volts. If the buffer fails it may well ruin the vibrator points or burn out the transformer. Upon checking, the serviceman may detect the vibrator or transformer and replace it only. The set will operate properly while in the shop, but after a period of time, the defective buffer will again destroy it.

It is possible that the vibrator failure was caused by neither its age nor the buffer but by some other irregularity within the set. Check the current drain of the set against the manufacturer's value. (The Philco models P5206, O5207 and C5209 are rated at 8.6 amps—6.6 volts; and the S5327 at 7.2 amps; the S5323 at 6.8 amps; and the models C5211 and C5212 at 4.3 amps—13.2 volts.) If the normal current is not known, check the vibrator current by measuring the current with the vibrator in and with it removed. The difference is the current passing through the vibrator. This value is seldom given by the manufacturer but is roughly 2 amperes for each power output tube, ½ ampere for the converter and ¼ ampere for each of the other tubes excluding the rectifier which draws no current of its own.

Using the P5206 as an example we have:

	6BE6	½ amp
(2)	6BA6	½ "
	6C4	¼ "
	6X4	0 "
	6AV6	¼ "
(2)	6AQ5	4 "
		—
		5½ amps

If we add to this the filament currents we have a total of 8.35 amps. This with the current drawn by the vibrator coil and pilot lights gives us the rated current of 8.6 amps.

If the current is much over the value as computed, something is probably not as it should be. First check the rectifier tube and the filter condensers. Electrolytic condensers have a relatively high leakage rate and, as they age, the rate may become high enough to overload the vibrator. It is also possible that an output tube is drawing too much plate current because of a defective bias resistor or by-pass condenser.

If these check O.K. and the current is still high, remove the rectifier tube. The vibrator current should be less than 1 ampere. If this current is exceeded, and replacing the vibrator and buffer does not bring it down, the power transformer should be replaced.

If there is any question as to whether the vibrator is still in good shape, the following procedure will give a good indication.

Operate the set on 6 volts and check the B+ with no signal. The voltage should be within 10% of the specifications with a variation of not more than 4%.

Drop the supply voltage to 4 volts, turn the set off and then on to see whether the vibrator starts at this

voltage. If it does start, check the B+. It should read $\frac{3}{4}$ of the value it had with a 6 volt supply but the vibrator is still good if it reads $\frac{1}{2}$ of that value. If the vibrator will not start every time with a four volt supply it should be replaced as it will soon give trouble in the car.

If a closer check is desired because of recurrent trouble, the oscilloscope can give a more detailed story and pin down the trouble more accurately. The procedure for this was given in detail in the May and June 1952 issues of the "Supervisor" but, for those who may have missed these publications, we will briefly go over it again.

The voltage waveform of the vibrator tells whether the vibrator is in good condition and electrically matched to the circuit, and the current waveform tells whether the circuit is correct and the vibrator is properly connected to it.

The best place to check the voltage is between the top and bottom of the power transformer primary where they are connected to the vibrator. The current is best checked between the primary center tap (or any convenient "A" point before the vibrator) and ground. Each time a pair of the vibrator contacts close, a current is drawn from the battery causing a voltage

drop in the A line which corresponds to the current through the vibrator.

The vibrator should run smoothly from the instant it starts and should not change much as the set warms up. Fig. 1 shows a normal voltage curve and Fig. 2 shows allowable chatter which may result from minor variations in contact resistance. Quite frequently this chatter will almost disappear after running a short while. The period of closure is the contact break period or length of time that the contacts are open and the voltage is falling through the normal action of the induction of the power transformer primary. Fig. 3 shows the maximum allowable closure and Fig 4 the minimum. It is also permissible to have 25% closure on one set of contacts and 100% on the other.

Fig. 5 shows insufficient buffing which is the result of too small a value in the buffer condenser. In a case such as this the probability is either that the vibrator does not have mechanically the same period as the manufacturer called for in the original equipment or the buffer has been replaced by a different value.

Sometimes, because of excessive wear or faulty construction, the contacts are late in making. This results in "over closure" as illustrated in Fig. 6 and is cause for rejection. The "V's" such as shown in Fig. 7 indi-

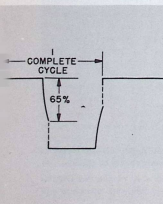


FIGURE 1

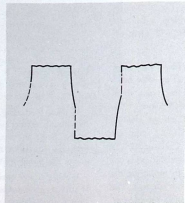


FIGURE 2

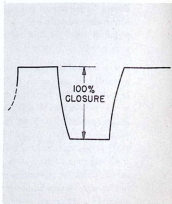


FIGURE 3

cate "contact bounce" and are cause for rejection if they persist after a few minutes running.

We have now checked the voltage waveforms and, so far, everything seems to be in order. Let's suppose the customer complains that this is the third vibrator he has had in six months. This would suggest a check of the current wave form and we hook the scope between "A" and ground. If the vibrator, power transformer, buffer and rectifier are operating properly the current wave should look like Fig. 8. Each set of vibrator contacts indirectly feeds one plate of the rectifier and the load should be balanced about evenly between each half cycle. The short spaces of no current are the periods when both sets of contacts are open. It was this period of time which determined the percentage of closure on the voltage waveform.

If either half of the vibrator-transformer primary is open there would be a no-current period where there should be a pulse. This is illustrated in Fig. 9 which shows that one-half of the vibrator cycle is not conducting. Such a condition can be identified by the long no-current period between pulses. Although the output voltages will be very nearly normal, the vibrator life will be shortened considerably.

FIGURE 7

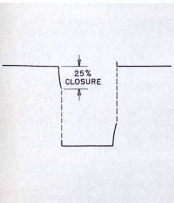
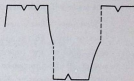


FIGURE 4

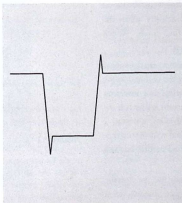


FIGURE 5

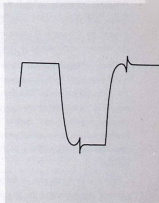


FIGURE 6

If one plate of the rectifier tube is weak or non-operative or if half of the transformer secondary is open, the current wave will indicate a load on one set of points but the other set will only be carrying the current resulting from the collapsing inductive field or back E. M. F. This is shown in Fig. 10. The peaks at the beginning of each current pulse are the result of the charging of the buffer condenser. The average height of those peaks should be no more than 2 or 3 times the height of the current pulses and need not be all equal in height but should be nearly so. If the peaks resemble these in Fig. 11 it indicates over-buffing which generally causes early deterioration of the contact points.

If a vibrator of too low frequency is used the current wave will look something like Fig. 12.

Sometimes, when a new vibrator is installed, it refuses to start. This is usually the result of a slight oxide film on the contacts which developed from storage. If the film can be removed the vibrator will then operate properly. There are several methods of removing the film:

First—Turn on the set for about 30 seconds or until the tubes warm up. Then turn the set on and off rapidly several times.

Second—If the above does not work remove the vibrator and apply 6 or 7 volts DC directly across the magnet or driving coil three or four times. When the vibrator starts you're in business.

Third—If neither of the above have worked, connect a 100 watt light bulb in series with the coil and apply 110 volts A. C. to it. The fluctuating and reversing magnetic field of the alternating current will scrub the contacts together and remove the film. About 2 minutes operation in the set afterward will thoroughly clean the contacts and there will be no further starting trouble.

When a new vibrator is installed, use the specific vibrator recommended by the service manual or at least be sure that it has sufficient current capacity and is the correct frequency. When the above checks are made you can be practically certain that the vibrator will give good service which will reduce call-backs and improve your reputation as a service agency.

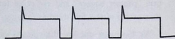


FIGURE 8

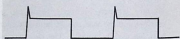


FIGURE 9

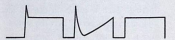


FIGURE 10



FIGURE 11

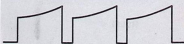


FIGURE 12

what IS AIR CONDITIONING?



Air Conditioning

Air conditioning may be defined as the mechanical treatment of air—whereby it is cooled or heated, filtered and cleaned, moisture removed or added, and a circulation of air maintained to give comfortable conditions. Summer air conditioning only, includes all of the above with the exception of heating and the adding of moisture.

Our Most Vital Needs

To maintain life, we must have food, water and air. During each day, the average man will require:

- 3 to 4 lbs. of food
- 4 to 8 lbs. of water
- 34 lbs. of air, about 460 cubic feet.

60% of the human energy is obtained from the air we breathe.

Man can go for days, or even months without food—or many hours without water—but deprived of air for only a few minutes, death would become a certainty.

Air—this vitally important item of our daily existence is colorless and odorless—around us at all times, and due to its being so readily available, we are inclined to give it no serious consideration. Since we cannot see the cleanliness and quality of the air we must breathe, it is necessary to take proper means of conditioning the air which is so important to our body health. Modern education and research have taught us the importance of selecting and preparing the food which we eat—now we are also learning to prepare the air which we breathe.

Man's Body, the Automatic Control Device

To maintain life and give us energy, our bodies act as a human heat machine. The fuel and air which are fed to the human body, likewise produce heat within the body. In each case the oxygen in the air serves to oxidize or burn the fuel or food, thereby producing heat.

During the summer months, the body obtains heat from the burning of food and also absorbs heat from surrounding objects and the sun. Both types of heat must be removed from the body to maintain comfortable conditions.

The body automatically attempts to control temperature by the following methods:

1. Increased blood at the skin surfaces.
2. Decreased food burning.
3. Evaporation of moisture from the skin.
4. Increased breathing rate which increases evaporation from the lungs.

The normal body temperature during periods of good health is 98.6°F. Fortunately, nature has provided the body with an automatic temperature regulator—our nervous system—which attempts to maintain our proper body temperature.

In order for our bodies to feel comfortable and maintain the temperature of 98.6°F., it is necessary for the air surrounding the human body to be below body temperature. Heat flows from a higher to a lower temperature level, and thus the air must be several degrees below blood temperature in order to remove excess body heat and maintain comfort.

As the surrounding air approaches blood temperature, the nervous system automatically indicates that the conditions are not comfortable and that the blood temperature is increasing. To offset this rise in body temperature, the nervous system opens the surface capillaries in the skin and more blood flows to the surface of the body where it is partially cooled by exposure to the air. If this does not have sufficient cooling effect, the sweat glands open and deposit moisture on the outside of the skin surface, perspiration starts and the latent heat necessary to evaporate this moisture is absorbed from the excess heat in the body, thus maintaining the normal blood temperature.

Body temperature is regulated by heat lost through:

1. Radiation—losses from body to surrounding walls or objects.
2. Convection—losses from body to surrounding air.
3. Evaporation of perspiration.

Effect of Overheating

1. Increased blood flow to the skin surfaces.
2. Increased rate of heart beats.
3. Increased respiration. (Breathing)
4. Increased perspiration with possible attack of cramps.
5. Increased body temperature.
6. General lassitude, laziness, decreased mental alertness, lack of appetite.

The flow of blood to the skin's capillary surface, in an attempt to cool the body, robs the supply of blood to the brain, decreases mental ability, causes a shortage of blood circulation to the vital organs, affects the secretion of gastric juices in the stomach with resulting delay in digestion. Then, too, it causes diminished secretion in the intestinal tract and loss of antifermentative action, which permits the growth of bacteria in these portions. The prevalence of summer ailments due to gastro-intestinal disorders is no doubt largely due to this diminished blood circulation through the inner parts of the body.

Overheating in the summer causes the victim to suffer general enervation, headaches, loss of appetite, distress from indigestion, and similar effects which eventually lead or contribute to premature old age.

The amount of heat given off by a person varies with the degree of activity and with the conditions by which he is surrounded. The fact that this total heat load of sensible heat from the body and latent heat from evaporation of perspiration must be removed for comfort, makes air conditioning necessary.

Fresh Air and Ventilation

Man breathes about 17 times every minute, during which he inhales air containing about 21% of oxygen and .04% carbon dioxide, the remainder being mostly nitrogen together with bacteria, pollen, dust, dirt and other air impurities. The air exhaled from the lungs contains about 15% of oxygen and about 4% of carbon dioxide. Until recent years, it was considered that the increased concentration of carbon dioxide within a room was the cause of the discomfort, general fatigue, and dullness which are frequently experienced by people in tightly closed rooms which contain "stagnant" air. Experiments have proved no harmful effects are caused by the carbon dioxide in the air, provided the temperature and humidity of the air are not allowed to increase above a certain point. A slight air motion in the room is also effective in increasing the comfort of the occupant.

Temperature, humidity and air motion are fundamental in air conditioning which must be balanced to the requirements of human comfort.

The introduction of fresh air will displace other room air which has accumulated objectionable odors, smoke, and vapors that cause a "stagnant" smell in the conditioned area.

Clean Filtered Air

The dirt and dust that are drawn in with the air we breathe, accumulate in the lungs to form coatings which decrease the lung capacity and are latent points of disease infection.

The dust and other particles in the air are bearers of bacteria which cause colds and many nasal, sinus, tonsil, lung and other ailments. The filtering of air in a conditioning system is one highly important contributing factor in safeguarding health.

Cooling and Dehumidifying

During the warm summer months it is necessary to cool and dehumidify the air in order that the human body can give off the heat generated and still be comfortable.

The proper design of air conditioning equipment takes into consideration the three methods of heat removal from the body; first, radiation; second, convection; third, evaporation. Satisfactory air conditioning carefully balances the combination of these three cooling effects to avoid any sensation of body shock caused by exposure to indoor and outdoor conditions. Proper air conditioning should provide



human comfort without any temperature shock to the body.

In the Philco Air Conditioner, the air is cooled and dehumidified by passing over a surface chilled by mechanical refrigeration. When the air comes in contact with the cold surfaces, heat is removed which thereby lowers its "Dry Bulb" temperature. If the air is cooled below its "dew point" during this chilling process, it is not only reduced in temperature but the humidity is also reduced, and moisture is condensed from the air.

Comfort Zone

Air conditioning for comfort cooling is a combination of the proper air temperature and moisture content, to produce a cooling effect. The most effective combination varies with the outside conditions, so that air conditioning is not accomplished merely by the reduction of temperature to a constant point, say 70°, as many people believe. For example, if air temperature is 85° outside, with high relative humidity, and our conditioner cooled that air to 80° and removed sufficient moisture to give a moderate humidity, the air would have capacity to evaporate more perspiration from our body which gives a cooling effect and we would be comfortable.

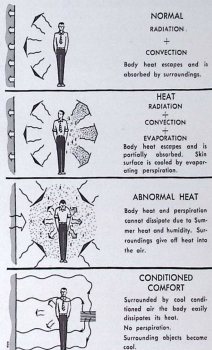
If, on the following day, the outside temperature went up to 100° and we still maintained 80° in our room from the outside, it would be a definite shock and would upset the nervous system. One would feel more comfortable and avoid the shock on the real hot day when the room temperature is held at possibly 85° to 90°, which would only be about 10° to 15° below outside air temperature.

Research has established the relationship of inside conditions to outside conditions for maximum comfort to the average person. There is a range of temperature and humidity conditions which will produce the greatest summer or winter comfort and these relationships are known as Comfort Zones. The exact conditions will vary according to the individual person, activity in the room, air circulation, time spent in the room, and local climatic conditions to which the person is accustomed.

Cycle of Refrigeration

The cycle of refrigeration is based upon the natural tendency of heat to flow always from a higher to a lower temperature object.

In the refrigerating system, heat is absorbed by a cooling surface which is colder in temperature than its surroundings. The heat is then transferred from the cooling surface to the refrigerant, which absorbs the heat and changes from a liquid to a vapor.



The vapor, laden with its heat, is pumped back into the refrigerating machine and passed to the condenser under pressure. There it comes in contact with the condenser-cooling air. By this process the vapor changes back to a liquid, and re-enters the cooling surface, ready to repeat its work again.

The refrigerating machine and condenser are simply a combination of equipment which eliminates heat absorbed by the cooling surface and changes the refrigerant gas back into its original liquid form.



This month . . .

WALTER H. KEMBEL, Philco Service District Representative for the Pacific Mountain Division, brings us his views on the necessity for good service technician-customer relations. Walt has been a Philco man since 1944—first as a Contract Field Engineer for the TechRep Division and then as a Service Representative in various sections of the country. His present territorial assignment became effective in May, 1953.

In my opinion . . .

. . . serviceman — customer relations are a very vital part of the successful operation of all service organizations. The tremendous dollar volume of business that flows and will continually increase from service, need not and must not be jeopardized by poor customer relations. Good customer relations stem from rendering service to your customer promptly, courteously and efficiently.

It should be remembered that the serviceman is the one man who is most often invited into the customer's home after the purchase of a product used in the home. For this reason he is the key to good customer relations which will benefit his service organization in many unseen ways.

Good customer relations start at the time the telephone call is received to render service. Courteous telephone conversation in making arrangements for service is essential. At the home, your appearance and attitude toward your job and your customer are the first things your customer will notice about you. What you say and do on your first call to a new customer's home will determine whether or not you will receive another call for service at a later date. For example—do not make statements against the product you have been asked to service because your customer has paid his money for a product of his choice and considers it the very best. You will only be harming yourself by further discouraging the customer at a time when he may already be annoyed. To your customer, a breakdown of the radio, television receiver, refrigerator or electric range is an unjustifiable cost and inconvenience to him. You as a serviceman can explain in simple terms the reason for a technical breakdown and restore customer confidence by your reassuring and sympathetic attitude.

There is no simple magic formula to establish good customer relations. But if you sincerely strive to serve your customer promptly, courteously and efficiently he will remember you as "a man who knows his business" and will recommend you highly to his friends.

Remember, to start your customer relations off right!—identify yourself with your Philco Factory Supervised Service identification card.

