

PHILCO SERVICE SUPERVISOR



AUGUST, 1954

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

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MECHANICAL PUSH-BUTTON PROBLEMS

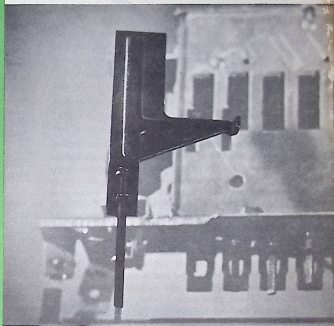


FIGURE 1

THE TUNER in an auto radio can be a source of mechanical trouble that often might entail considerable time to affect repairs. However, if a logical step by step procedure is followed, mechanical problems, can soon become a matter of routine repairs. This article will discuss the problem encountered with the manual tuning assembly.

The unit that will be under discussion here is the Philco mechanical push-button tuner part number 76-5275, used in Philco auto-radio model S-4927, code 121. This unit has seven push buttons, six of which are used for automatic station selection, and one for selecting manual tuning. The ganged tuning cores are mechanically actuated for either push button or manual operation.

(Continued on Next Page)

MECHANICAL PUSH-BUTTON PROBLEMS

(Continued from Front Cover)



FIGURE 2

Briefly the operation of the tuner is as follows: Pressing any one of the station selector push buttons moves the gear carriage a distance determined by the particular button adjustment. The gear carriage by means of a gear chain, moves the core-bar assembly on which are mounted the ganged antenna, r-f, and oscillator tuning cores. The cores in turn are driven into fixed antenna r-f, and oscillator coils to a position determined by the push button adjustment. The position of the cores within the coils determines the particular station frequency received. Pressing another push button releases the first button and repositions the cores according to the particular button adjustment. Pressing the manual tuning button engages the manual key and bar assembly and places the unit in manual control. In manual control the gear carriage is actuated by means of a worm gear. The operation of tuner #76-5275-1, used in radio model S-4924 is identical as described, except that this tuner has only five push buttons instead of seven.

If the unit operates on push buttons but does not operate on manual tuning, either the manual tuning key is binding or defective. Figure #1 shows the manual tuning key, part No. 76-5225. Several cases have been reported where the worm gear has been stripped, or the hole in the manual key has become enlarged. To facilitate repairs, Philco Accessories has available through your distributor a kit, part No. 45-3081, which substitutes the manual key assembly. The kit consists of a spring, pressure nut, "C" washer and the tuning shaft with worm gear but does not include a manual key, therefore the original key must be used. See figure #2. If the worm gear is stripped,

it is quite possible that the hole in the manual tuning key has been enlarged. If such is the case, before installing the new worm gear, place the manual tuning key in a vise, as shown in figure #3, apply only enough pressure to slightly close the hole in the manual tuning key. If too much pressure is applied the manual tuning key may be bent out of shape. If this should happen it can be straightened out with a hammer. Then the new tuning shaft with worm gear can be installed.

Listed below are various tuners used in Philco auto radios having this type of manual tuning and the kits that are available for making repairs to the manual tuning assemblies of these tuners. The procedure described above can, in most instances, be followed for the units listed.

MODEL	TUNER	KIT
S-4627	77-0588-1	45-1643
S-4824	77-0588-3	45-1643
S-4924	76-5275-1	45-3081-1
S-4927	76-5275	45-3081
P-4635	77-0891	45-1643
P-4735	77-0588-2	45-1642

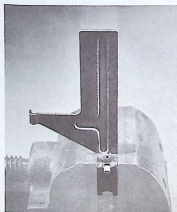


FIGURE 3

"The Old Order Changeth . . .

yielding place to new" Tennyson . .

These words were written in an age of progress much slower than ours. But, they reflect something that is, and always will be, true.

We see that truth about us every day. We think of it in terms of atomic bombs supplanting TNT, 3-D taking over the movies, or the new polio vaccine outmoding old treatments. It is also reflected in many things we fail to notice. Things that are a part of the daily routine. Changes that seem insignificant.

Right here in our own back yard we are part of a change. Truly an old order changing, yielding place to new. And what is this new change? The components program, of course. Real progress.

What is the hallmark of progress? Beneficial change.

And the components program qualifies as progress. But who and how, on the benefit side?

The answer to the "who" part is easy. Everyone.

But to understand why, we must answer the "how" part of the question.

With the advent of the sealed system, refrigeration repair took on an entirely different aspect.

The challenge was gone. No longer could a technician use his "savvy" to find the trouble. No longer could he set about repairing it with the least amount of fuss and bother.

With the advent of the sealed unit, unit failure meant virtually tearing the equipment apart to replace the entire unit. Certainly not the most pleasant type of work. But above all, it was terribly time-consuming. Six or more man-hours per change.

The sealed system certainly has played an important role in making refrigerating equipment as dependable as it is, but still there were those who wondered . . .

Was it really necessary to replace the entire unit just because some component was faulty?

Was it really necessary to maintain unwieldy stocks of units?

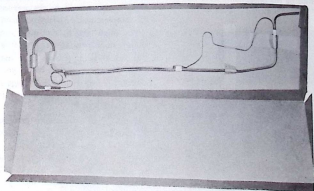
Was it really necessary to maintain the "sealed" condition of the units?

There were these and many more questions.

How about an answer?

The answer depended on still more questions:

Could the men in the field be trained to do repair work on sealed units?



Replacement tubing assembly kit



Replacement evaporator kit

Could Engineering produce the necessary equipment, components, and procedures?

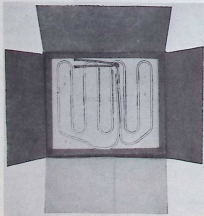
Service said the men in the field could be trained to do the job. Engineering said they could do their part. And from these decisions came the components program.

And now the components program is here, and with it one of the most unique changes in refrigeration for a long, long time.

So what?

So, we've got our hands a deal with a tremendous potential. A potential that can not be realized immediately. The new program will have growing pains (and what new idea doesn't), but once it is mastered, we will have the bull by the horns.

And why?



Well, one of the big answers is rapid, efficient service.

How?

There are two factors that determine the speed and efficiency of service. Availability of the necessary parts, and the job itself.

With the new program, inventories are cut down because of the interchangeability of parts. That is, one part may be used on many models.

This makes supply more reliable.

But, if the availability was equal, then what?

With the new program you are still way ahead of the game. A large percentage of the troubles with sealed units is motor compressor failure. Certainly a motor compressor can be changed in far less time than the complete unit. And by one man.

You might say, it takes quite a while to change a motor compressor. Longer than it is supposed to.

It would be surprising if it didn't the first few times. You have to walk before you can run.

Won't it take as long to change some of the components, such as evaporators, as it does to change the complete unit?

At first, it will be a long procedure, but with experience the time will drop considerably. Probably even more than can be imagined.

Also, keep in mind that the new way is a more positive way. When the job is done and checked out, you can be sure the system will operate properly and there will be no call backs.

◀ Replacement cabinet plate kit

Replacement motor compressor kit ➡

Philco's engineers have devised the Restriction Tester to put the ultimate note of finality in your repair procedures.

The Tester checks to make sure the system is clear and ready to operate, and provides the means to assure proper charge in the system by its metering function.

Efficiency and profit go hand-in-hand. When this program is mastered by PFSS'ers, the greater speed, combined with the single man operation will make service more profitable.

Recall that the inventory situation has been bettered. Fewer and less bulky parts are required to repair all Philco refrigerating equipment. And certainly, space-saving and ease of handling reflects in the pocketbook.

To top it all off, this program will get into full swing very quickly. Philco has made arrangements for the usual thorough training PFSS is rightly famous for. And when the field gets into the swing of this program, the full impact of its practicability will be felt.

And while we're mulling this thing over, let's see what else makes this program a sure-fire bet.

Wait a minute.

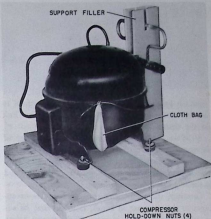
If this is such a good deal, why hasn't competition done it?

That is a difficult question to answer. We could do some surmising, however.

We could say the reason was expense, but that would only be part of the answer.

We might say they haven't got the men to devise and implement such a program.

We might guess they are afraid to start off such a



deal. And that is easy to understand. The problem of moisture is the big bugaboo. It takes very little moisture to restrict the system, and opening the sealed system makes it possible to introduce moisture. Philco has taken this into consideration and knows if the instructions it has put out are followed, and the capillary drier is installed when required, this problem will be minimized.

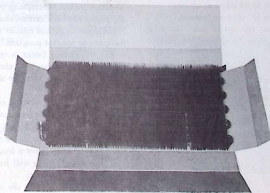
And, we might give other reasons for competition's not getting into the act. But, there is one answer we can be sure of. One reason Philco can embark on this program. Embark on its confidently.

PFSS is the answer.

That's right, PFSS. Philco has the personnel to make this program go.

None of the others has the force of trained and competent men Philco has.

The crux of the problem is not conceiving of grams. It is not the design of the component



Replacement evaporator kit

Manual Correction

PR-2595, page 82. Half shelf for models J-1147, J-1148, J-1149, and J-1248 should read: 6027-116 R. H. Shelf and 6027-117 L. H. Shelf.

tools. It lies in the ability of the men in the field to administer the program. They are the important link in the chain.

PFSS'ers have at their command a knowledge of refrigeration and refrigerating equipment second to none. They have the "savvy" and background. They can move into this program, master it quickly, and make it go smoothly.

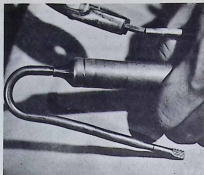
Certainly, the components program with its advantages to the customer in better, faster service; its advantages to the dealer in more efficiency and lower inventory; and its advantage to Philco in better public relations, can not fail because PFSS will make it go as predicted.

The overall impact of this program promises to change the thinking of the whole industry. And, being involved in the inception of such a unique deal means the burden of proof has been put on the shoulders of Philco and PFSS.

Certainly there is no question that the program will go. We have given reasons enough already. Thought we might point out a few more reasons, too.

In fact, we have pictured a few of the reasons. The components shown here are just a few of the ones available.

The components and the procedures used to install them are the results of a great deal of research by Engineering. Research through the files of the components used on Philco refrigerators in the past. And research in the best methods of installing the components.



Capillary drier kit

Of the components, the capillary drier kit is undoubtedly the most unique. This drier is the insurance component.

Why do we say that?

Well, as we said before, the biggest bugaboo in breaking into the sealed system is moisture. The capillary drier kit is designed to give the ultimate in protection against moisture. It is installed in the most strategic spot in the system, and has a capacity that assures its functioning with the utmost efficiency.

Almost all moisture restrictions occur at the outlet of the capillary tube. With the drier in the capillary tube itself, the chance that moisture could get to the critical point has been decreased to such an extent that that source of difficulty has been eliminated.

And, the manual that has been prepared to put this new program over outlines the proper procedures to be used, and outlines special precautions to be observed to assure proper functioning of the repaired unit after the repair has been carried out.

Let's not forget the special tool Philco Engineering has put out for this program.

The Restriction Tester is an important link in the chain. It is necessary for checking the system after repair, and metering for the adding and removing of refrigerant.

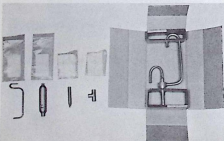
Yes, we have the winning combination.

All we have to do is master the new program.

And when we do, we'll rock the industry back on its collective heels, and make the wheels of progress turn faster than they have for a long, long time.

In a while, PFSS'ers will be echoing the words of Ibsen, the master writer:

"Oho! Original! Not the old-fashioned stuff that I am in the habit of turning out. . ."



Replacement parts for automatics

Doctor PFSS

"Hey, Doc, my ear hurts."

The Doc probes around for a while. Looks through a fancy instrument. Then he shakes his head and mutters, "Your tympanic membrane has become encrusted. Take this prescription and have it filled. The liquid you will get must be used to cleanse the ear thoroughly. Come back if the difficulty persists."

Often wonder . . . oh, yes, I'm the Doc's air conditioner . . . why he doesn't tell them to wash their ears more often. Guess that's the way the Doc does things. A little mumbo-jumbo. Lots of big words.

Now, I remember not too long ago when I needed a doctor. Didn't get one with an MD in back of his name. Got a PFSS man. He knew his job, and wasted no time with big words or fancy do-dads.

Got the full treatment. Seems like Mr. PFSS had an assistant with him. This assistant was learning the ropes, so the boss gave me a complete going over, and pointed out all the important things that needed to be done when servicing the electrical system of an air conditioner.

His spiel went like this:

"When giving the air conditioner the full going over, Joe, you got to check the line voltage to make sure it is within the operating ranges. For instance, if the job is rated at 115 volts, we're ok operating off voltages ranging from 106 to 125. 208-volt models should have 193 to 228 volts for operation. 230-volt jobs work off 208- to 250-volt lines.

When we're checking the voltage, we have to turn the switch to ON, and allow the job to run at least 10 minutes. Turn on all the other electrical appliances on the line, too. This will give a true indication of the line voltage the conditioner will be operating off.

Now, this conditioner has been running 10 minutes. We have the rest of the appliances turned on. Let's see what kind of voltage we get."

My voltage was a little low, but not enough to make any difference.

Joe piped up, "What would 'cause low line voltage?"

"Well, either the voltage supplied to the building by the power company is not correct, or poor wiring in the house could cause that trouble.

Usually low voltage is caused by poor wiring in the house. We can remedy that by wiring the conditioner on a separate line, or changing the wiring in the house so that the lines will be able to carry the current without too much drop.

Ok, Joe?"

Joe nodded assent.

Then they started checking my motor and starting assembly.

PFSS took some complicated gizmo out of his tool box. He said he'd made it himself. Showed Joe a drawing of it. (Figure 1 is the drawing.)

"This rig can be used to check the operation of all the compressors, regardless of voltage. And indirectly checks the operation of the relay and the starting capacitor, as well.

If the compressor motor is inoperative, the air conditioner wiring should be removed from terminals 1, 2, and 3 in the compressor motor-terminal box. (See figure 2.)

Connect the spring clips from the test set to these terminals. Then, insert the plug into the nearest receptacle, and immediately depress the momentary contact switch."

For a minute I was afraid PFSS wouldn't remind Joe about not holding the momentary contact switch down too long. If it is held down longer than three seconds, they could do an awful lot of damage to my motor.

PFSS resumed his talk. "If the motor runs normally with the test set-up, the capacitor, relay, circuit breaker, or power switch is probably defective. If the

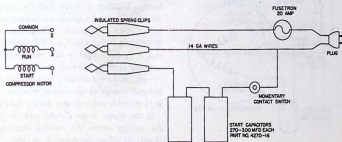


FIGURE 1

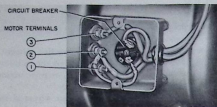


FIGURE 2

motor does not run when this test set is used, there is a defect in the motor.

Let's assume the motor ran with the test hook up. We replace the components in order and test after each replacement. And, if after all the parts have been replaced, the motor still refuses to run, check for a defect in the wiring."

Joe looked a little puzzled. He scratched his head. Then he asked, "somebody was saying the other day that there are two types of starting relays. Series-shunt and current-voltage, or something like that."

Crazy, mixed up kid. But PFSS handled it very well.

"That's right, Joe, there are two types of starting relays.

They are the current or series coil type, and the voltage or shunt coil type.

Maybe I'd better explain them to you so you'll have them straight in your mind.

The current or series coil type may be used on straight split-phase or capacitor type motors. The switch contacts are normally open (as shown in figure 3) and the current that passes through the running winding also passes through the series relay coil.

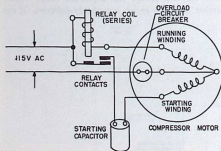


FIGURE 3

When current is first applied to a motor, the running winding draws a starting current which is three or four times as much as running current. This heavy starting current passes through the coil and causes the relay contacts to close. This connects the starting winding into the circuit.

As the motor begins to wind up, the current falls off. When the motor gets up to about 80 per cent of running speed, the current through the coil is not strong enough to produce enough magnetism to hold the contacts close. The contacts open, the starting coil drops out of the circuit.

You with me, Joe?"

Joe shook his head and I shook my ATC knob. It was fun learning all about me.

"As I said, the other type relay is the voltage or shunt coil type. This relay, used with capacitor type motors only, has contacts which are normally closed.

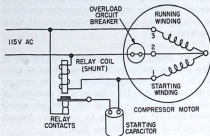


FIGURE 4

(See figure 4.) The relay coil is connected in parallel with the motor starting winding. When current is applied to the motor, both windings are energized, but the voltage across the starting winding and the relay coil is considerable less than the line voltage, because both are in series with the starting capacitor. As the motor gains speed, the voltage across the starting winding and the relay coil increases until, at about 80 per cent of full speed, the force exerted by the relay coil is great enough to open the contacts and disconnect the starting winding and the capacitor from the circuit. After the starting circuit is disconnected, the induced voltage in the starting winding is sufficient to hold the relay contacts open during the running period.

If the motor is overloaded and its speed reduced, the voltage across the starting winding drops sufficiently to allow the contacts to close. This connects the starting winding back into the circuit. If the load

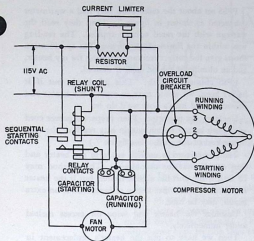


FIGURE 5

is not too great, the increased torque obtained by using both windings will bring the motor up to speed again. You still with me, Joe?"

Joe shook his head yes. I thought I heard something rattle. Then he asked, "What is the difference in which type motor you use. Is there any advantage of one over the other?"

"Hmmm. Now let me see." PFSS wrinkled his forehead. A sure sign of concentration. Then he started, "the use of the voltage relays for capacitor motors offers certain advantages. An important factor is that the voltage relays of identical characteristics can be used with a variety of motors, regardless of the horsepower and motor speed. Of course, the relay contacts must be large enough to carry the starting current.

With current relays, the current coil must correspond to the current rating of the motor. This necessitates the use of a definite size relay for each motor.

Philco air conditioners using a current limiter are with voltage relay which provides a means of starting the fan motor a short time after the compressor motor is started.

The two motors are started in the following sequence: the relay disconnects the compressor motor. As the contacts move to disconnect the starting winding, the contacts to the fan motor are closed and the fan starts. (See figure 5.)"

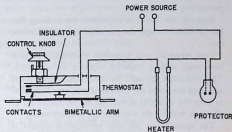


FIGURE 6

Joe seemed slightly dazed. Guess all those new terms shook him up. He was an eager beaver, however, and came back with a question. "What is this ATC deal? How does it work?"

"Some of the '54 Philco air conditioners are equipped with an automatic temperature control . . . that's what ATC stands for . . . to prevent overcooling.

Since power companies in certain areas will not allow the use of a thermostatic control to start or stop the motor-compressor, in units not equipped with

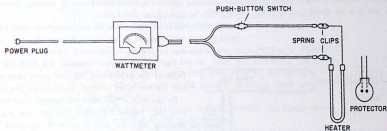


FIGURE 7

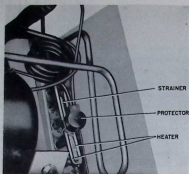


FIGURE 8

ATC, the practice is to turn the unit off manually when overcooling has occurred.

Stopping the motor will prevent overcooling, but has the disadvantage that, it stops dehumidification, too.

Units equipped with automatic temperature control have their cooling capacity adjusted automatically. This eliminates the need for motor compressor starts and stops to control the amount of cooling. They tend to keep the humidity down, and supply cooled air at all times without the disadvantage of overcooling.

The operation of the new temperature control is entirely automatic. The setting of the ATC knob determines at what room temperature the automatic control is to start functioning. When the room air temperature reaches the temperature determined by the setting of the ATC control, the thermostat contacts close.

The closing of the contacts energizes a heater that is soldered to the strainer. This strainer is on the refrigerant line, and the added heat causes bubbles to form in the liquid refrigerant. This bubbling effect reduces the relative amount of liquid refrigerant, and thus reduces the relative cooling capacity.

A protector is placed in series with the heater circuit to open the circuit in case of excessive heater temperatures. (Figure 6 shows the ATC circuit.)

"Show me how to check that circuit," came Joe's request.

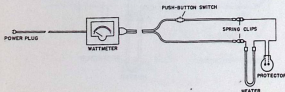


FIGURE 9

PFSS set about the task. Soon they had a wattmeter connected as shown in figure 7. Then they read the wattage with the rated voltage applied. The reading was within the limits given for me. The specification sheets give the correct resistance reading for my heater, and an ohmmeter can be used, if desired.

PFSS chimed in with: "This job is ok, but if it hadn't been, we would have to replace the heater and protector, and here's how we'd do it:

Unclamp the protector. Then prepare a power cord with push-button switch within easy reach of the connector end of the cord. (See figure 7.)

The power cord is used to energize the heater and thus supply heat for unsoldering. This method may be used if the unit has a good heater; but if the heater is defective, some other source of heat, such as an extra heater, may be used.

Unsolder the heater and wipe off excess melted solder immediately.

Then we have to put the heater's replacement in the circuit.

Fasten the heater to the strainer with wire. Tie it in the original position. (Figure 8 shows the proper positioning.)

Don't connect the protector to the heater until the soldering has been completed.

Solder the heater to the strainer.

Then, clamp the protector to the heater, and connect the newly mounted heater into the circuit as shown in the wiring diagram for the model under repair.

Reconnect all wiring."

"Interesting," said Joe.

"Interesting, but incomplete," added PFSS. "We have to check the heater protector for correct operation before we call it a day.

Plug the prepared power cord into the wattmeter (see figure 9), and test the heater and protector by connecting the heater to the proper operating voltage for the conditioner.

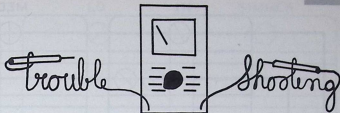
Heat the assembly slowly by turning the switch on and off, as required.

If the wattmeter reading drops to zero before the solder begins to melt, the protector is good. If it does not, replace both heater and protector."

Just then the Doc returned. He held his hand in front of the grilles and felt that good stream of cool air. He was quite pleased. He thanked Joe and PFSS.

By the way, if you were wondering what was wrong with me, maybe I'd better tell you the truth. The cleaning lady got mixed up with my plug and disconnected me from the wall outlet.

Simple, Eh?



We got the word that PFSS'ers wanted some drawings of the electrical system of Philco ranges. Drawings that were made to show voltage and test lamp indications around the circuits.

We've whopped up a few and hope they will serve the purpose. Any other drawings you might like to have will be yours for the asking. Drop us a line and let us know what you might want.

Before we get into the trouble shooting end of the deal, let's take a look at some background material that might be helpful.

Electricity is convenient to supply because it can be readily transmitted over long distances. The voltage is stepped up and transmitted over high tension lines to the locale in which it is to be used.

This stepping up is done to cut to a minimum the power losses. The higher the voltage, the lower the losses.

Locally the voltage is stepped down for transmission over local power lines.

When the power is to be used in a home, it is taken from the local power lines, and is fed through a transformer that reduces the voltage to a level suitable for use with home appliances. It is passed through a meter which measures the exact amount of power that is used. From there it is sent to the main junction box of the house. In this junction box are several heavy-duty fuses. These fuses are usually rated at from 35 to 50 amperes.

From this box the power is distributed by service lines to various appliances throughout the home. For the electric range, however, the power is taken directly from the junction box.

The power is carried from the main junction box to the electric range by means of suitable conductors. These conductors are attached to the terminal block on the back of the range.

The two outside terminals of the block are at a potential of 115 volts with respect to the center terminal. This center terminal is usually grounded.

Between the two outside terminals, 230 volts will be found. This is the sum of the two 115-volt potentials mentioned above.

This particular arrangement of the voltages makes it possible to get the different degrees of temperature needed for cooking.

That brings us up to the business at hand.

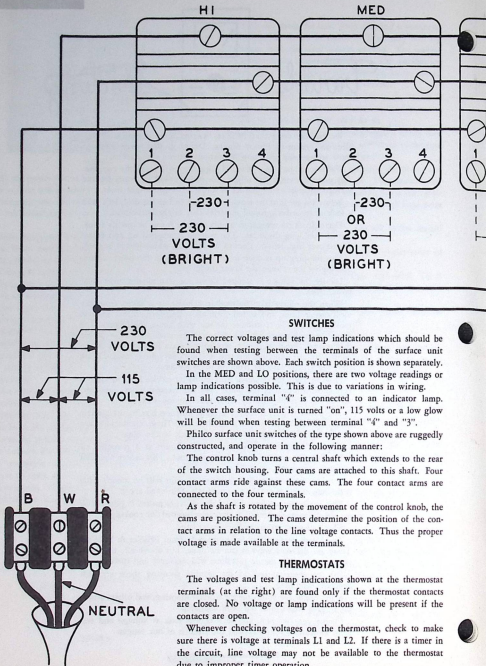
Trouble shooting varies technique-wise from PFSS'er to PFSS'er. There are different ways it can be done, but above all, the most important thing is that it gets done with accuracy and speed.

For the electrical end of the trouble shooting there are two generally used tools.

Many prefer the voltmeter for trouble shooting, and others attack the trouble armed with the neon test lamp.

Choose your weapon, and let's take a look at voltage and test lamp indications found around the circuits of our ranges.





SWITCHES

The correct voltages and test lamp indications which should be found when testing between the terminals of the surface unit switches are shown above. Each switch position is shown separately.

In the MED and LO positions, there are two voltage readings or lamp indications possible. This is due to variations in wiring.

In all cases, terminal "4" is connected to an indicator lamp. Whenever the surface unit is turned "on", 115 volts or a low glow will be found when testing between terminal "4" and "3".

Philco surface unit switches of the type shown above are ruggedly constructed, and operate in the following manner:

The control knob turns a central shaft which extends to the rear of the switch housing. Four cams are attached to this shaft. Four contact arms ride against these cams. The four contact arms are connected to the four terminals.

As the shaft is rotated by the movement of the control knob, the cams are positioned. The cams determine the position of the contact arms in relation to the line voltage contacts. Thus the proper voltage is made available at the terminals.

THERMOSTATS

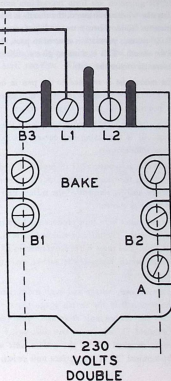
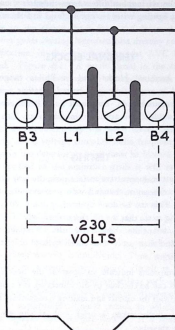
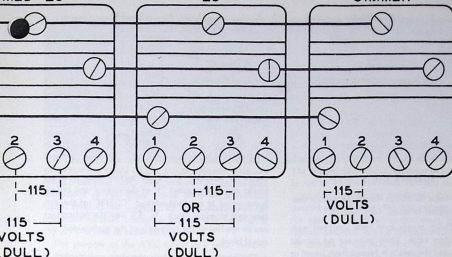
The voltages and test lamp indications shown at the thermostat terminals (at the right) are found only if the thermostat contacts are closed. No voltage or lamp indications will be present if the contacts are open.

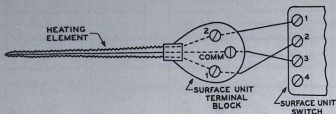
Whenever checking voltages on the thermostat, check to make sure there is voltage at terminals L1 and L2. If there is a timer in the circuit, line voltage may not be available to the thermostat due to improper timer operation.

MED-LO

LO

SIMMER





SURFACE UNITS

The surface units on Philco electric ranges are controlled by individual switches. (See page 13.)

Since '51, Philco ranges have been equipped with mono-tube surface units. These units are the tubular enclosed type, and the sheath is formed from Inconel or T-K alloy.

After the wires are inserted, the sheath is filled with magnesium oxide. Then a tremendous force of up to 2,000,000 pounds pressure is exerted to pack the oxide into the sheath. This is done to give rigidity, and to permanently secure the coils.

The mono-tube is attached to the pan in only one place, and can be lifted on its swivel arm into an upright position. This makes cleaning easier.

No anchorage weld is required to keep the unit in position. It is free-acting and returns to its proper position automatically.

The units are constructed to provide five different temperatures for cooking, when used as shown above. Inside the heating element of the surface unit are the three wires as shown.

The two outer wire coils produce the high temperatures necessary. The third or middle lead is in a heavy return wire. The three wires are connected to the surface unit switch through the surface unit terminal block, as shown.

As can be seen, voltage and lamp indications found on the terminals of the switch (page 13) can be applied to the surface unit terminals. Just remember that terminal "1" on the surface unit switch is connected to terminal "2" of the surface unit terminal block; terminal "2" of the surface unit switch is con-

nected to terminal "1" of the surface unit terminal block; and that terminal "3" of the surface unit switch is connected to terminal marked "COMM" of the surface unit terminal block. In this way the indications can be applied to the terminals of the surface unit terminal block.

The heating coil used in the deep-well cooker is similar in wiring, but differs from the surface units in that the heating wires are not enclosed in a sheath, but exposed.

TERMINAL BLOCKS

The terminal blocks used in Philco ranges are molded in two halves, and bolted together over the three terminal leads. Each unit has a grounding terminal welded to the unit frame about an inch from the block.

TESTING

To test an inoperative surface unit, the first thing to do is to determine that full voltage is available to the range. This can be done by turning the oven on and checking to see that the unit glows brightly. If it does, we can assume that there is full voltage available to the range and then proceed to check voltage or test lamp indications.

If symptoms indicate an open in the heating element, it can be checked by disconnecting the suspected heater from the circuit and making a continuity check.

Well, we've taken a brief look at the electrical trouble shooting.

Any other drawing you may want, let us know. We'll try to send them your way, pronto.

Understanding and Servicing AGC Circuits

PART I

Due to variations of signal strength from a television station at the receiver it becomes desirable to have AGC action in the receiver. A strong signal received in the antenna stage is proportionately stronger after being amplified in the RF and IF stages. Without AGC action this would tend to overload the signal, thereby causing distortion. A very weak signal, even after amplification, would still be proportionately weak and could cause poor sync. AGC will tend to balance these conditions so that there would be a fairly constant signal level at the output. To better understand the operation of AGC circuits it may be wise to refer to the AVC action in radio receivers.

The purpose of the AVC action in a radio receiver is to maintain a constant level at the second detector irrespective of the variance of the input signal. This is accomplished by feeding a negative voltage proportionate to the signal, back from the detector to the amplifier grids causing increased bias thereby reducing amplification in the stages where the AVC bias is applied. Figure #1. A weak signal in the antenna circuit will cause less negative voltage feedback allowing weak signals to receive a greater degree of amplification in the RF and IF stages. In this manner both weak and strong signals will be reproduced in the speaker at approximately the same level. However, since the AVC voltage contains audio frequency modulation in the detector stage, it must be filtered so that when applied to the amplifier grids it will not vary with the signal voltage. An important factor in AVC filters is the time constant of the resistor and condenser values. The time constant of a filter network can be determined by the formula $T = RC$.

In a long-time constant AGC circuit, the control voltage does not respond to short-time variations in the overall video waveform amplitude. Thus, a great disadvantage of a long time constant circuit is that it does not respond to the rapid variations such as those produced by airplane flutter. Another disadvantage is that it is susceptible to noise pulses, to which it responds rapidly but recovers slowly. If a short-time constant were used, the gain would be lowered during each vertical sync pulse, depressing the sync pulses and thus the vertical sync would be unstable. From this

it can be seen that an average time constant must be chosen with care so as to obtain optimum performance.

An AGC system in a television receiver operates in much the same manner as AVC. Various methods of AGC action have been designed, however, the methods discussed here will be delayed AGC and gated AGC. The delayed AGC action can either be fixed or variable. In earlier Philco television receivers the variable delayed AGC system was employed. Figure #2. The contrast control served the dual purpose of controlling the gain of the video output stage by varying its cathode bias, and varying the positive delay voltage to the cathode of the AGC rectifier. This delay voltage is applied to the AGC rectifier cathode to keep the diode from conduction until the incoming signal on the plate overcomes the positive delay voltage. In weak signal areas the contrast control will normally be operated near maximum clockwise position. This means maximum delay voltage is fed to the cathode of the AGC rectifier. Thus, no sensitivity reducing

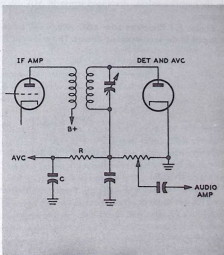


FIGURE 1

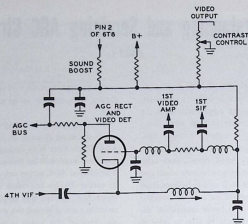


FIGURE 2

AGC voltage is developed, and the entire RF-IF sensitivity is available. An additional voltage developed by the sound signal is fed from the FM detector to help overcome the positive delay voltage. Thus, the AGC action is relatively flat over a wide range of input signals. The original AGC voltage due to the picture signal is developed across the AGC diode load resistor. This negative signal from the sound circuit opposes the positive voltage from the contrast control and adds to the negative voltage developed across the AGC diode resistor.

Figure #3 illustrates how AGC voltage can be developed in the sync separator circuit. The grid (pin 7)

of the 6BE6 tube draws current on the positive going tips of the sync pulses, which flows through the network composed of R-1, R-2, R-3, L-1 and R-4, causing capacitor, C-1, C-2, and C-3 to assume negative charges that are proportionate to the amount of peak signal applied to the grid (pin 7). The tuner AGC voltage is delayed by means of a resistor divider network, which applies a small positive voltage to the tuner AGC circuit. This positive voltage prevents AGC action from lowering the tuner gain on weak signals. To prevent the delay voltage from driving the tuner AGC voltage positive on weak signals, a diode clamp is connected to the tuner AGC buss. Thus, when in-

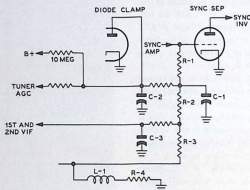


FIGURE 3

sufficient negative AGC voltage is developed to cancel the positive voltage applied to the AGC buss, the plate of the diode clamp is positive compared to the cathode which is grounded. The diode will conduct and since the conducting resistance of a diode is very low, the plate will effectively be shorted to ground and the positive voltage will not appear on the AGC line.

Assume that 5 volts positive is being applied to the AGC line. The plate of the diode will be 5 volts positive with respect to the cathode and the diode will conduct thus, effectively shorting the 5 volts positive to ground leaving the AGC buss at zero potential. As AGC voltage is developed it must first overcome or cancel the 5 volts positive before it appears as a negative voltage on the AGC line. If sufficient signal were being received by the receiver to develop -3 volts of AGC voltage, the minus 3 volts would cancel or neutralize three of the five positive volts but would leave still 2 volts positive on the AGC buss which would

video amplifier and the AGC gate tube. Referring to figure #4. The output of the video detector is direct coupled to the video amplifier, the polarity of the crystal is such that it presents a signal with negative going sync to the grid of the video amplifier. The amplitude of this signal, negative going, determines the amount of conduction through the video amplifier.

A large amplitude of signal applied to the grid of the video amplifier tube will drive the grid very negative at the signal's greatest extremity, thus causing a very small amount of conduction in the video amplifier tube. The small current flow through this tube will result in a small voltage drop across the video amplifier plate load resistor, R1 and R2. Since the plate load resistor is split and part of it is placed between the grid and cathode of the gate tube, this results in a small bias being applied between the grid and cathode of the AGC gate tube and consequently heavy conduction in the gate tube when the gate pulse, which is

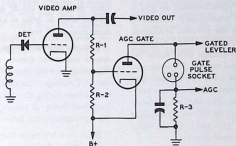


FIGURE 4

cause the diode clamper to conduct and the voltage on the AGC line would remain zero. The AGC voltage that would appear on the AGC buss would remain at zero until the developed AGC voltage exceeded the positive 5 volts applied to the AGC buss. Therefore, no negative voltage will be applied to the amplifiers as bias until sufficient signal is received by the TV receiver to develop more than -5 volts AGC. Minus 5.1 volts developed AGC voltage would result in -1 volts of bias being fed back to the amplifier tube.

In late model Philco receivers gated AGC action is used. The amount of AGC bias developed is largely dependent upon the amount of conduction through the

obtained from the horizontal output transformer, is applied to the plate of the gate tube. This results in heavy current flow through the plate load resistor of the gate tube and a subsequent high voltage drop. The AGC gate plate load resistor is the resistor across which the AGC voltage derived. Due to the direction of electron flow through the plate circuit of the AGC gate tube, the voltage drop across this resistor, R3, is negative with respect to ground and since the above conditions exist (heavy conduction) a high negative AGC voltage will be developed and when applied to the RF and IF amplifiers will reduce their gain proportionately. Conversely, when a low amplitude signal

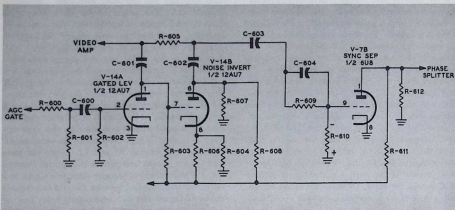


FIGURE 5

is applied to the grid of the video amplifier the grid is not driven as negative and consequently, conduction is much greater than under the previous conditions. This greater conduction through the video amplifier tube will result in a larger voltage drop across the lower portion of the plate load resistor, R2, which supplies bias, for the AGC gate tube. This higher bias will prevent the gate tube from conducting very heavily with a consequence of very little AGC voltage being developed. This will permit the RF and IF amplifier tubes to operate at a higher gain and bring the signal level up to normal at the second detector.

Remember the bias to the AGC gate tube (voltage drop across R2) determines how much the gate tube will conduct and the gate pulse on the plate determines when the gate tube will conduct.

By the use of this method of AGC development, AGC is determined by a fixed factor, the sync pulse amplitude pre-set at the transmitter, and variations in picture content will not affect AGC. In either of the above instances, the action continues until a balance point is reached. The level at which this balance is attained is fixed by the circuit constants. These constants are chosen in the design of the receiver to give a practically constant signal output at the video detector over a wide range of signal input voltages.

The tuner AGC voltage is delayed by taking it from a more negative point of the AGC divider network. This is done to prevent AGC action from lowering the

tuner gain before the IF gain is lowered beyond a certain value, in order to maintain the best signal to noise ratio at all times.

Thus, the chief advantage of the gated type of AGC system over other systems is that noise disturbances that occur between sync pulse intervals cannot affect the AGC voltage. Conduction in the AGC tube can only occur during the gating pulse, and when the horizontal sweep is properly "locked-in" this occurs during the sync pulse interval.

Noise in a television receiver is a problem that requires serious thinking not only by the service technician but the design engineer as well. The performance of a television receiver is limited by the amount of noise it rejects or suppresses.

First let us consider the sync separator circuit of a television receiver that does not have noise suppression and follow the signal through the circuit. Figure #5. The signal arriving at the sync separator would appear as shown in figure #6. Grid current will be drawn each time the positive sync pulses appear at the grid. This grid current will develop a voltage across R-610 which is negative at the grid end, and will charge C-603, so that the grid side will be negative. The time constant of C-603 and R-610 is much longer than the time between the sync pulses, and therefore, a definite value of charge will be established. This change will hold the grid negative with respect to the cathode, thus biasing the tube beyond cutoff. The circuit values are

so chosen that the composite video signal will appear at the grid of the sync separator as in figure #7 with only the sync pulses rising above the cutoff level of the tube.

The sync separator is operated with a low value of plate voltage. This permits the tube to be driven to saturation very rapidly, thus limiting the upper portion of the sync pulses. Figure #7 shows the operating curve of the sync separator with the input and output signals as they appear in relation to the curve. The input signal is applied to the tube so that only the sync pulses cause plate current to flow, thus eliminating the video components of the signal in the output as the sync pulses drive the grid beyond plate current saturation the upper portions of the sync pulses, with any noise above the sync tip level removed. However, noise pulses that occur between the cutoff and saturation levels in the input signals (see figure #6) will be passed by the sync separator. It is these noise pulses that are detrimental to the maximum efficiency of a television receiver. To remove these noise pulses, the noise inverter V14B, and the gated leveler, V14A, are employed. Figure #5. The noise inverter is biased beyond cut-off, and therefore, will pass only the positive portions of the signal which are above the sync tip level. In passing through the noise inverter the polarity of the noise is reversed. Figure #8 part B

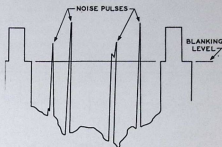


FIGURE 6

shows the output of the noise inverter with the gated leveler in use.

The gated leveler prevents the sync pulse from passing through the noise inverter. This is done to prevent cancellation of the sync pulse when the output of the noise inverter is mixed with the composite video at the sync separator. The gated leveler plate circuit is connected to the grid of the noise inverter, thus placing the plate resistance of the gated leveler from grid to ground. The plate resistance of the gated

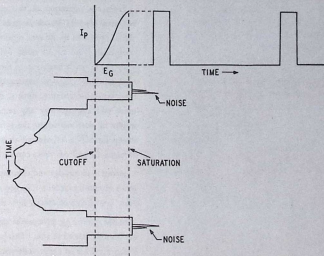


FIGURE 7

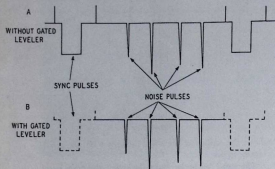


FIGURE 8

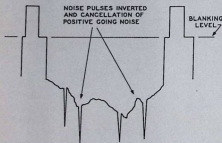


FIGURE 9

leveler is controlled by the gate pulse signal applied to the grid. The gate pulse is obtained from the horizontal output transformer, and this pulse occurs in time with the sync pulse of the composite video signal when the receiver is operating normally.

The positive gate pulse causes grid current to flow in the gated leveler. This current flows through R-602 and charges C-600 so that the tube is biased beyond cutoff. Only the positive pulse of the gate pulse signal drives the tube into conduction. Thus the gate pulse signal causes the gated leveler to present a high plate resistance during sync pulse time. The plate resistance of the gated leveler is in series with R-603 to B+ and these two resistances form a voltage divider. This divided voltage, which is proportional to the plate resistance of the gated leveler, is applied to the grid of the noise inverter. Between gate pulses the divided voltage will be more positive than when the gate pulse is present, thus the grid voltage at the noise inverter is controlled by the gated leveler. Figure #6 shows a composite video signal with the noise pulse present. Figure #9 shows the same signal after the inverted noise from the noise inverter is mixed with this signal.

From the operation of this circuit (noise inverter/gated leveler) it can be seen that the composite signal presented to the sync separator circuits is almost completely void of all noise which would interfere with stable synchronization of the horizontal and vertical circuits. As was illustrated in figure #7, the sync separator circuits, have a certain immunity to noise and consequently any remaining noise which might be detrimental to the synchronization of the sweep circuits is eliminated thus providing sync information free from noise contamination.

In order to rapidly and effectively service AGC and noise immunity circuits it is necessary to have a good basic knowledge of exactly how they function.

In the preceding paragraphs this basic information has been presented to you. This provides the technical background for an easier understanding of the methods employed in servicing these circuits which will be the subject of next month's article.

Loudspeaker Design

PART I

The loudspeaker employed in a radio or television receiver is one of the most important components of the overall audio amplifier section. The speaker is the final stage through which the audio intelligence in its electrical energy form passes, and is then converted to mechanical energy. Thus, the primary purpose of the speaker is to convert the audio electrical energy into mechanical energy which can be detected by the human ear. Figure #1.

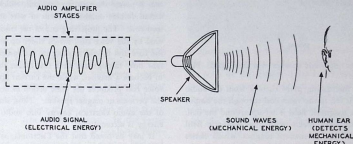


FIGURE 1

There is one basic type of speaker employed in today's receivers and it is known as the dynamic speaker. The dynamic speaker, however, is subdivided into two general classes, the permanent magnet dynamic speaker and the electro-magnetic dynamic speaker, generally referred to as the PM speaker or EM speaker respectively.

The very early type speakers consisted of a paper cone fastened to a diaphragm. This speaker type did not prove very satisfactory since under strong current signals being fed to the speaker coil, the diaphragm

was pulled against the magnet and a speaker rattle with accompanying sound distortion would result. Figure #2.

To overcome this problem the dynamic speaker was developed, which incorporated a voice coil. The voice coil is a small coil wound on a tube of bakelite or fiber material and was so mounted that the tube could slide back and forth on the permanent magnet. The voice coil tube is held in place by a very flexible or springy material called a spider, and the voice coil is further attached directly to the paper cone. Thus, the per-

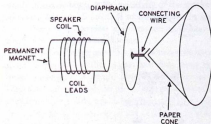


FIGURE 2

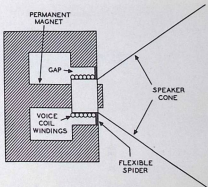


FIGURE 3

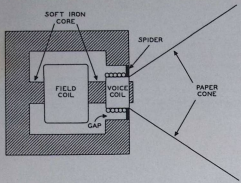


FIGURE 4

manent magnet dynamic speaker was developed. Figure #3.

When the fluctuating plate current from the audio output stage is fed to the voice coil through the output transformer a magnetic field is set up around the coil. This magnetic field reacts with the magnetic field existing around the permanent magnet, which causes the voice coil to move up and down the permanent magnet. A greater amount of current through the voice coil will cause a greater motion of the voice coil on the magnet. Due to the action of the spider and its flexible properties, the voice coil is permitted to move during current flow, but is returned to its normal position when the current drops off or ceases. Since the paper cone is directly connected to the voice coil, its motion corresponds to the motion of the voice coil. Further, since the paper cone will therefore have a motion which corresponds to the audio signal fed from the audio output stage, the cone vibrations or movements will disturb the air and produce sound waves

directly related to the variations of the audio signal. This therefore is the basic operation of the Permanent Magnet Dynamic Speaker converting the audio electrical energy to audio mechanical energy.

The basic design of the electromagnetic dynamic speaker is very similar with respect to the voice coil, cone, etc. The electro-magnetic type differs, however, in that a field coil, forming an electromagnet, replaces the permanent magnet. Figure #4.

In the electromagnetic dynamic speaker a direct current is passed through the field coil, which consists of a considerable number of turns of wire around a soft iron core. The projecting end of the iron core is covered by the voice coil, which slides up and down on the core and is held in place by the spider. The current flow through the field coil causes the iron core to become a magnet, while the current applied to the voice coil produces the same action as occurred with the permanent magnet speaker. Thus, the conversion of the audio electrical energy into audio mechanical energy is accomplished.

It may be noted that the Electromagnet employs a soft iron core while the permanent magnet employs a hard metal core. From basic physics and the study of magnetism, it may be remembered that hard steel retains its magnetic properties for a considerable period, while the soft iron will lose its magnetism as soon as the current through the field coil is removed. In the manufacture of magnets for speakers, a standardization program has been adopted by the industry. Further, in designing speakers, the type and choice of magnets is considerably effected by the cost factor, and the speaker manufacturer therefore must decide whether the increased magnet cost and the accompanying improvements in performance are more desirable

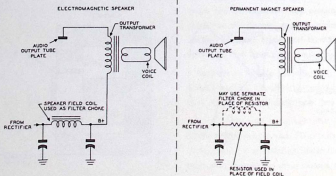


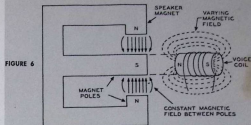
FIGURE 5

than increasing the performance factor of some other part of the amplifier section. The model receiver, the price range of the receiver into which the speaker will be installed and the expected performance range for which the receiver is being designed are the factors which will influence the manufacturer's decision.

The design of the field coils will vary in accordance with requirements. One of the advantages of the electromagnetic speaker is the fact that the field coil can serve two purposes, that of providing the magnet necessary for the speaker's operation and also as a choke in the filter circuits of the power supply rectifier stage. Therefore, the design engineer has two factors in mind, designing a field coil sufficiently heavy enough to handle the power requirements of the receiver and also providing sufficient magnetism for the required speaker performance. The schematic diagram of the electromagnetic speaker and the permanent magnet speaker in the output stage of the audio amplifier circuit is illustrated. See figure #5. Note that a resistor is used in place of the field coil when a permanent magnet type speaker is used. In the better filter circuits a separate choke may be employed, rather than a resistor, as a substitute for the missing field coil.

In general the field coil is designed for a dissipation approximately equal to the electrical power output of the receiver. The design engineer must also consider the ampere-turns in the field which is governed by the wire size. A further factor which the design engineer must take into consideration, when selecting the wire size for the field winding, is the temperature rise in the winding. This factor is ordinarily checked under actual operation. It is also necessary when designing the speaker to provide sufficient flux in the gap otherwise the low frequency resonance of the voice-coil cone may be overpronounced. A certain amount of overemphasis in low frequency resonance is desirable in some cases and consequently, may be deliberately incorporated into the speaker design. A small air gap would of course improve the sensitivity of the speaker, however, there are limitations to the decrease in gap size, otherwise mechanical problems are encountered which tend to introduce distortion.

The voice coil must provide a field which will interact with the field of the magnet and thus cause the voice coil to move a desired distance on the magnet. Therefore, the physical design of the voice coil dictates that it be small both in wire size and in overall size. Due to the diameter of the magnet pole piece employed in the standard radio and television speakers, which varies from one half inch to one inch, the voice coil impedance is usually 3.2 ohms. This impedance will of course vary as the speaker is designed



for heavy output wattage, however, a 3.2 ohm voice coil can be found on speakers capable of 12 to 15 watts.

The actual operation of the voice coil as previously described depends upon the variations in the voice coil magnetic field caused by the varying electron flow through the coil. Figure #6.

From basic physics and the study of magnetism we learned that like poles repel and opposite poles attract. The position of the voice coil is directly over one of the poles on the speaker magnet. Figure #7. From the study of electromagnetism we know that by applying the left hand rule to the voice coil we can determine the pole positions. Regardless of which direction the voice coil current flows through the coil, two magnetic lines of force will exist, that produced by the coil and that existing around the magnet. If the voice coil field is such that its north pole is in the same direction as the north pole of the magnetic field, a repelling action would take place and the voice coil cone would be pushed forward. Figure #8. If either the poles of the magnet or the voice coil were reversed so that the opposite poles were adjacent, north to south, the voice coil direction would be backward and the cone would naturally move in the same direction. The reason for this action, of course, would be due to the tendency for the magnets to center or align the poles as closely as possible. Movement of the cone in either direction will create the necessary sound waves.

Part #2 to be continued in next issue.

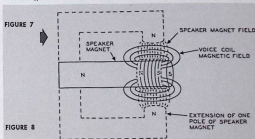
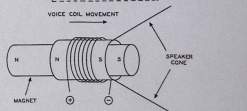


FIGURE 8





This month . . .

EDWIN E. KNIPPER, General Service Manager of Benarr Distributors, Inc. of Toledo, Ohio, gives us words of wisdom about service advertising. Ed has had fourteen years' experience in electronics . . . in Distributor Service administration and, from 1942 to 1945, as a Civilian Technician with the Naval Research Laboratories at Washington, D. C. He has held his present important post since 1949 and has made notable contributions to Service in the Toledo area.

Your Service Manager says . . .

. . . today, service is a highly competitive business. You already know that! The question is, what are you doing to beat competition?

Every self-employed service technician—every service “independent”—can benefit from service business advertising. We can assume that the man who works for a servicing agency or a servicing dealer is already benefiting from the advertising activities of these firms, so my ideas will not be news to him.

Direct mail advertising is the most favored medium among service people. Telephone directory advertising, small classified ads in newspapers, small newspaper display ads and radio spot announcements can also be used effectively. “Service” is basically unglamorous, in comparison with product advertising. Therefore, the primary consideration in planning service advertising is to indelibly register your name, your phone number and some illustrative spot or slogan that will have a high rate of reader-memory value.

Equally important is frequency. One or two ads inserted in newspapers irregularly will not do the job and your budget should allow a consistent advertising schedule so that your name and phone number will be remembered when people want service.

Confucius said, “One picture is worth 10,000 words.” An advertisement carrying some type of illustration demands far more attention than an ad which is straight wording. Much imagination and ingenuity are required to make a small ad stand out. Most newspapers offer assistance in the design and preparation of attention-getting ads. This service is usually offered free. Likewise, most printers are in a position to develop some attention-getting design when it comes to direct mail. Your Philco Distributor's Service Manager, too, is in a position to help and can offer advertising mats for the purpose.

Advertising takes still other forms: There is the appearance of your service shop, how it is identified, the courteous attitude of your personnel and the appearance of the transportation facilities they use. Yes, you and your services are being advertised at every point of contact with the public. That is why you should put to full use the decalcomanias, signs, plaques and other items that give you proper identification and prestige in the eyes of your service customers.

And that brings us to the most important advertising medium of all . . . word-of-mouth advertising! Your courteous, straight forward contact with the customer, your competence on the job, customer satisfaction with what you do, and your willingness to answer complaints and make redress even when it is only slightly justified . . . all this represents your finest form of personal advertising. Word-of-mouth advertising costs you nothing if you are sincerely interested in customer satisfaction. If you are not, it will eventually cost you your reputation.

Remember—your Philco Distributor and Philco Factory-Supervised Service are ready to help you secure good advertising, whether it be in newspapers or over the backyard fence.

