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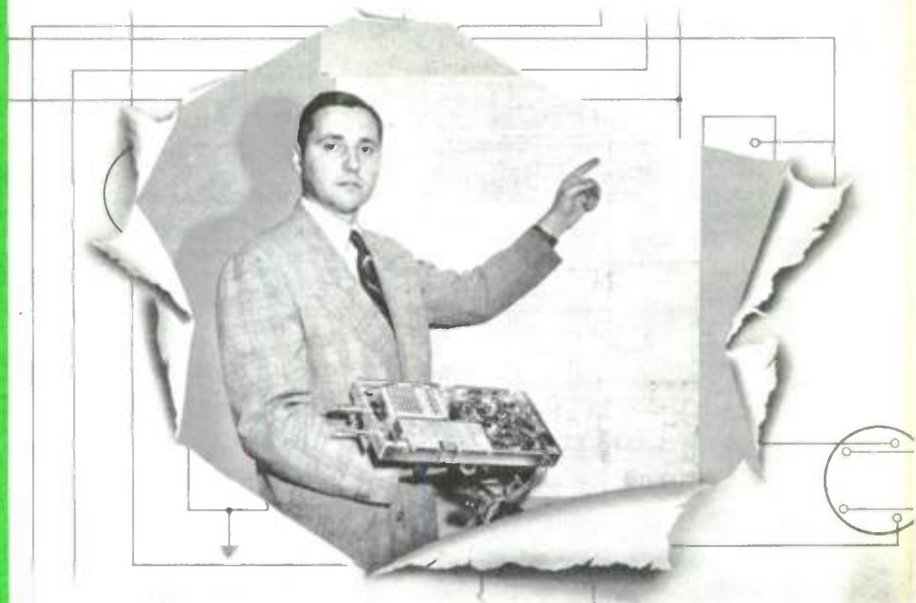
THE "B" LINE TELEVISION CHASSIS



THE Philco 1954 Television Receivers or the "B" line of receivers as they are more familiarly known have three basic chassis series, the TV-180, TV-190 and H. F. 200 series. In the TV-190 and HF-200 series, chassis are available with both a 3 watt audio output and a 5 watt audio output.

UHF tuners are available for the various chassis and the receivers may be obtained with the tuners factory installed or tuner kits may be obtained for later installation in the field. These tuners provide UHF reception on channels 14 through 83.

UHF tuner-adapter UT21D, part number 43-6778 is designed for the TV-180 series. The adapter consists of a UHF converter and preamplifier unit and converts the signals of the UHF band to a frequency selected within the VHF band, either channel 2 or channel 3, which is then fed to the VHF tuner.

UHF tuner-adapter UT22, part number 43-6703 will provide UHF reception on channels 14 through 83 for the TV-190 series chassis. The unit consists of a UHF tuner and preamplifier whose output is a 45.75 Mc. I. F. frequency which is fed into the Video I. F. stage of the receiver.

UHF tuner-adapter UT20B, part number 43-6701, provides for reception of UHF signals on television channels 14 through 83 and is designed for installation on the

(Continued on next page)

Description of the "B" Line Television Chassis

(Continued from front Cover)

HF-200 series chassis. The unit converts the UHF signals to the I. F. frequency of the receiver, 45.75 megacycles, which is fed to the VHF tuner whose RF and mixer stages act as I. F. amplifiers, when in UHF position.

Dual chassis are featured in all three series, consisting of an RF chassis on which the VHF tuner is mounted as a sub chassis and a deflection chassis on which is contained the power supply and the deflection circuits. The VHF tuner in the TV-190 and HF-200 series is tilted slightly for clearance of the picture tube.

The output of the VHF tuner in the TV-180 series is an I. F. frequency of 26.6 Mc. which is fed through 3 video I. F. stages, to the diode detector stage, a IN64 crystal. The VHF tuner is a 12 position incremental type, covering channels 2 through 13, with fine tuning of the local oscillator. The receiver employs 4.5 megacycle intercarrier sound which is taken from the plate circuit of the video output amplifier and fed through a single sound I. F. stage to the ratio detector.

The VHF tuner in the TV-190 series is a 12 position incremental tuner, covering channels 2 through 13, with fine tuning of the local oscillator. The output of the tuner, a 45.75 Mc. I. F. Frequency, is amplified by 3 video I. F. stages and fed to the IN64 crystal diode which is employed as the video detector in the TV-190, a 4.5 megacycle signal is used for intercarrier sound. The 4.5 megacycle signal is taken from the plate circuit of the first video amplifier stage, amplified by a single sound I. F. stage and fed to the ratio detector.

The VHF tuner, in the HF-200 series, is a twelve channel, 13-position incremental tuner, covering channels 2 through 13 with a position for UHF and including oscillator fine tuning adjustment. The tuner output is a 45.75 Mc. I. F. signal which is amplified by four video I. F. stages. The fourth video I. F. stage feeds into a IN64 crystal diode employed as a video detector. 4.5 megacycle intercarrier sound is taken from the grid circuit of the first video amplifier stage and fed through two sound I. F. stages to the ratio detector. Link coupling is used between the output of the VHF tuner and the I. F. stages in all series in view of the desirable characteristics of maximum signal transfer with low loss and negligible radiation, plus the minimum of interference signal injection.

	UHF TUNER	VHF TUNER	VIDEO IF	SOUND IF INTERCARRIER
TV-180 ➧	CONVERSION TO CHANNEL 2 OR 3 WITH PREAMPLIFIER	OUTPUT AT 26.6 MC. VIDEO 4.5 MC. SOUND I.C.	3 STAGES	1 STAGE
TV-190 ➧	CONVERSION TO 45.75 MC. I.F. FREQ. WITH PREAMPLIFIER	OUTPUT AT 45.75 MC. VIDEO 4.5 MC. SOUND I.C.	3 STAGES	1 STAGE
HF-200 ➧	CONVERSION TO 45.75 MC. I.F. FREQ.	OUTPUT AT 45.75 MC. VIDEO 4.5 MC. SOUND I.C.	4 STAGES	2 STAGES

FIGURE 1. R.F. and I.F. Characteristics of the "B" Line Television Chassis

The characteristics of the three chassis series discussed to this point are illustrated graphically in figure 1.

In the TV-180 series, the output of the video detector is fed through the video output amplifier to the cathode of the picture tube in view of the fact that the video signal from the plate of the single video amplifier is of positive polarity, see figures 2 and 3. The output of the ratio detector is fed through 2 audio amplifier stages to the speaker. AGC voltage is applied to the RF stages and to the first and second video IF stages.

The output of the video detector, in the TV-190 series, is fed through two video amplifier stages. Since the negative going video signal from the video detector output is subjected to a 360 degree phase shift through these two video amplifier stages, the output of the final video amplifier is a negative polarity signal which is therefore applied to the grid of the cathode ray tube.

The output of the ratio detector in the TV-190 is fed through two audio amplifier stages to the speaker. In this series both a 3 watt and a 5 watt audio output are featured, with a 6V6GT tube being used in the audio output stage of the 3 watt chassis and a 6L6GA tube in the audio output stage of the 5 watt chassis. AGC voltage is applied to the RF stages and to the first and second video IF stages.

The HF-200 chassis contains 2 video amplifier stages, through which the output of the video detector is fed. Since the negative going video signal from the video detector output is reversed in phase 360 degrees through the two amplifier stages, a negative going signal appears at the video output amplifier plate, which is fed to the cathode ray tube grid.

Two audio amplifier stages are employed in the HF-200 series with a 6V6GT tube being used in the audio output stage of the 3 watt chassis and a 6L6GA tube used in the audio output stage of the 5 watt chassis. AGC voltage is applied to the RF stage and to the first and second IF stages. Gated AGC is used in this chassis series. The differences of the three chassis series with respect to the audio and video amplifier stages, is shown in the chart in figure 4.

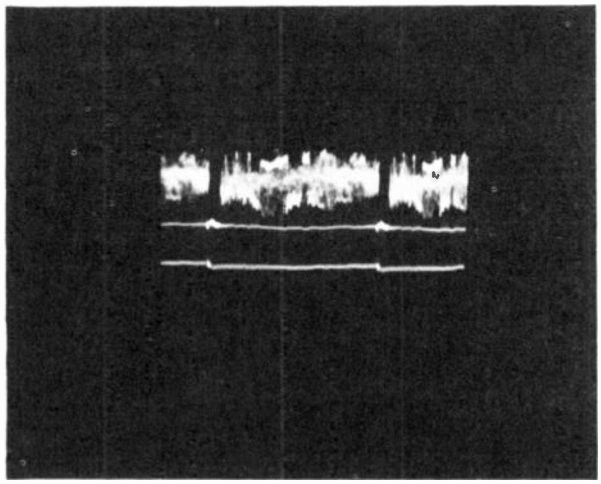


FIGURE 2. Video Detector Output, 30 Volts, 60 C.P.S.

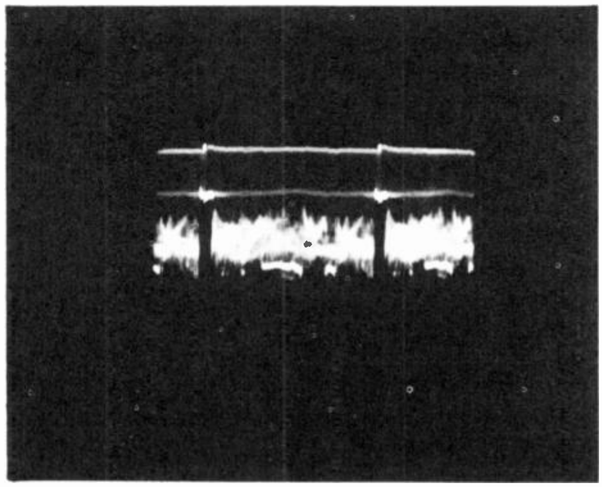


FIGURE 3. Video Amplifier Plate, 66 Volts, 60 C.P.S.

The sync take-off point in the TV-180 series is from the grid circuit of the video amplifier and the sync signals are then amplified by a sync amplifier stage. The output of this stage is then fed to the sync separator.

In the TV-190 and HF-200 series sync is taken from the plate circuit of the first video amplifier, and fed to the sync separator stage.

Included in the circuity of the HF-200 is a noise inverter stage which passes only noise signals which are present in the sync signals but changes their polarity 180 degrees. These signals are then mixed with the sync signals on the grid of the sync separator which also contain the noise pulses. However, since the

	VIDEO AMP	AUDIO AMP	AGC VOLTAGE
TV-180	1 STAGE	2 STAGES	TO 1ST AND 2ND VIDEO I.F. STAGES AND R.F. STAGE
TV-190	2 STAGES	2 STAGES	TO 1ST AND 2ND VIDEO I.F. STAGES AND R.F. STAGE
HF-200	2 STAGES	2 STAGES	TO 1ST AND 2ND VIDEO I.F. STAGES AND R.F. STAGE GATED A.G.C.

FIGURE 4. Comparison of Video and Audio Amplifier Stages

noise signals from the noise inverter are the same signals as the noise pulses in the sync signal but 180 degrees out of phase, a cancellation takes place. A gated leveler is employed with the noise inverter stage to clamp the sync pulses below conduction level of the noise inverter, thus preventing the noise inverter from conducting during the sync-pulse interval.

In figure 5, we see the signal on the noise inverter plate showing the noise pulses. Composite video appears on the plate from the first video amplifier stage due to the capacitive coupling, however, only noise pulses pass through the noise inverter stage.

The TV-180 and TV-190 series also incorporate a method of reducing the amount of noise pulses that may enter into the synchronizing stages and disrupt the action of the horizontal and vertical oscillators. This method is provided in the sync separator stage. Composite video of positive polarity is applied to grid number 3 of the sync separator stage. This grid is so biased as to permit only negative going sync pulses to appear at the sync separator plate.

At the same time a signal composed of composite video with negative going sync is applied to grid number one of the sync separator. The biasing of this grid is such as to permit plate current cut-off whenever the signal goes more negative than the sync pulses. Since any noise pulses present are in the form of sharp spikes in the negative direction, the plate current is cut off when the noise pulses are greater than the sync pulses. The circuit of this grid is so designed as to prevent the video components from appearing on the plate circuit.

AGC voltage is also developed in the sync separator stage of the TV-180 and TV-190 by utilizing the current flow on grid number 3 which occurs on the tips of the sync pulses and flows down through the accompanying R-C network providing negative signals proportional to the amount of peak signal applied to this grid. In order to prevent the AGC voltage, which is applied to the tuner, from lowering the tuner gain on weak signals a delay voltage is applied to the tuner AGC.

The horizontal synchronization takes place as follows. The output of the sync separator stage in the TV-190 and HF-200 series feeds into a phase splitter

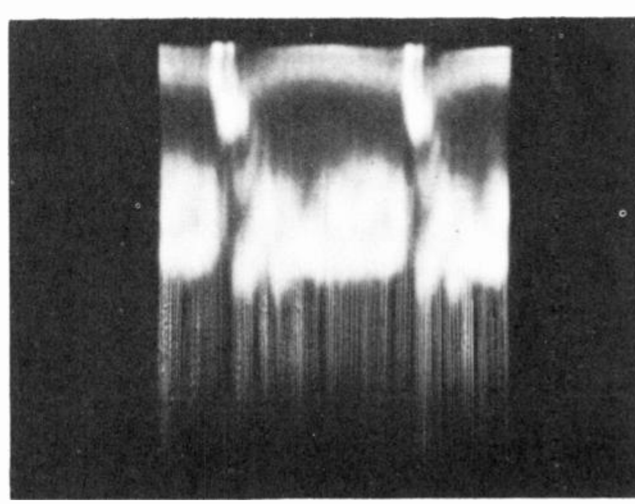


FIGURE 5. Signal at Noise Inverter Plate

stage, where positive sync signals are taken from the plate circuits and negative sync signals from the cathode. The TV-180 series employs a sync inverter whose action is similer to that of the phase splitter.

These signals, a positive and a negative sync pulse are fed to a phase comparer stage, a duo-diode tube, in all three series chassis, where they are compared, as to phase relationship, with a sawtooth shaped pulse taken from the horizontal output stage. Whether or not the sawtooth pulse will be in phase with the sync pulses at the phase comparer depends upon the frequency of the horizontal oscillator. If they are not in phase either a positive or negative voltage appears at the output of the phase comparer which is applied to the horizontal oscillator, a cathode coupled multivibrator in all three chassis series, and which either increases or decreases the frequency of the oscillator to the proper sync frequency. The horizontal hold control adjusts the oscillator frequency so that it is within the control range of the phase comparer. The output of the horizontal oscillator is fed to the horizontal output stage, which employs a 6BQ6GT tube. The horizontal output tube feeds the deflection coils through the horizontal transformer. A 6AX4GT tube is used as the horizontal damper. Picture tube second anode voltage is furnished by a high voltage winding from the horizontal output transformer, and is rectified by a 1B3GT high voltage rectifier tube.

The vertical oscillator stage in the TV-180 series employs a cathode coupled multivibrator. Proper triggering of this oscillator requires a negative sync pulse. Consequently, vertical sync pulses are separated through an integrator network from the horizontal sync signal in the cathode circuit of the sync inverter stage. The output of the vertical oscillator is amplified by a type 12B4 tube employed as the vertical output amplifier. The amplifier's output is applied to the vertical deflection coils through the vertical-output transformer.

In the TV-190 and HF-200 series vertical blocking oscillators are employed in the vertical oscillator stage. Proper triggering of the oscillator requires positive sync pulses, consequently the vertical sync signal is separated from the horizontal sync signals through an integrator network from the plate circuit of the phase splitter. The output of the vertical oscillator is fed to the vertical output stage, wherein a 12B4 tube is employed as the output amplifier. The output of the vertical amplifier is fed to the vertical deflection coils, through the vertical output transformer. The chart in figure 6 illustrates the oscillator types employed in the three chassis series in both the vertical and horizontal oscillator stages.

B-plus voltage for the receivers is supplied by two selenium rectifiers in a full-wave voltage doubler circuit, operating directly from the power line. In view of this, during servicing and alignment, it is recommended that an AC line isolation transformer be used since the chassis is not isolated from the power lines.

	VERT. OSC. TYPE	HORIZ. OSC. TYPE
TV-180	CATHODE COUPLED MULTIVIBRATOR	CATHODE COUPLED MULTIVIBRATOR
TV-190	BLOCKING OSCILLATOR	CATHODE COUPLED MULTIVIBRATOR
HF-200	BLOCKING OSCILLATOR	CATHODE COUPLED MULTIVIBRATOR

FIGURE 6. Vertical and Horizontal Oscillator Types

Conditioning the Air Conditioner

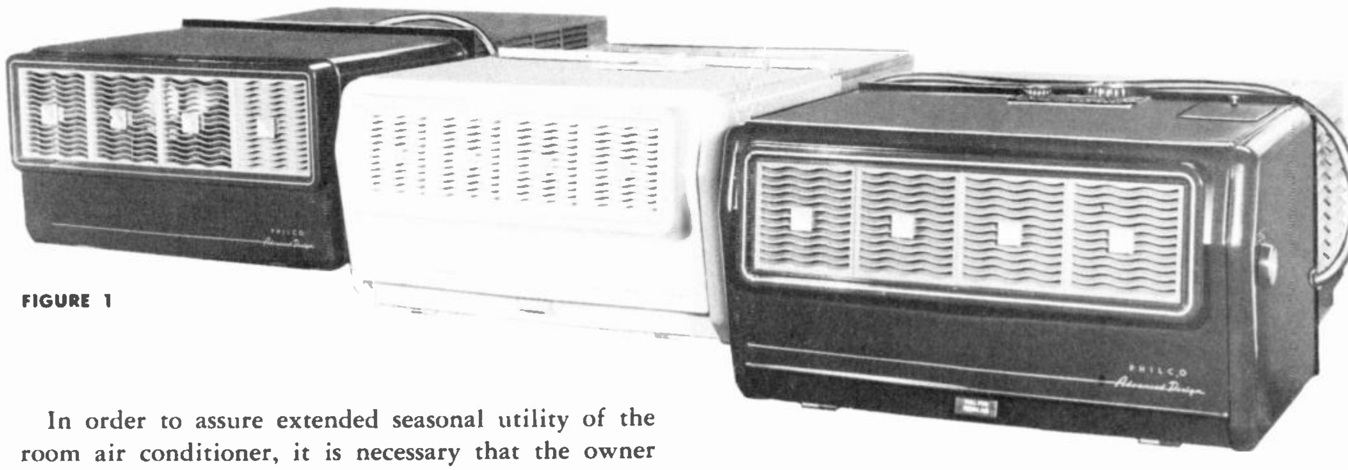


FIGURE 1

In order to assure extended seasonal utility of the room air conditioner, it is necessary that the owner make a small investment in service, which will assure him that the cooling cycle (or heating cycle in the Thermo-Cool air conditioner) will function with maximum efficiency whenever required.

There is only one way that maximum service life of an air conditioner may be achieved, and that is through periodic inspection of the appliance (at least once a year). A few pennies spent in preventative maintenance saves many dollars in repair bills. The wise owner will call the local service agency for preventative service. But the progressive serviceman will send out reminders to make the customer conscious of the advisability and the availability of this service.

The efficiency of an air conditioner's refrigeration system is dependent upon the proper function of the air flow and electrical systems. Trouble or abnormal conditions in either of these systems must be corrected prior to making performance checks to determine the efficiency of the air conditioner.

FILTERS

Air movement in a room or cooled area, is one of the important factors in comfort air conditioning.

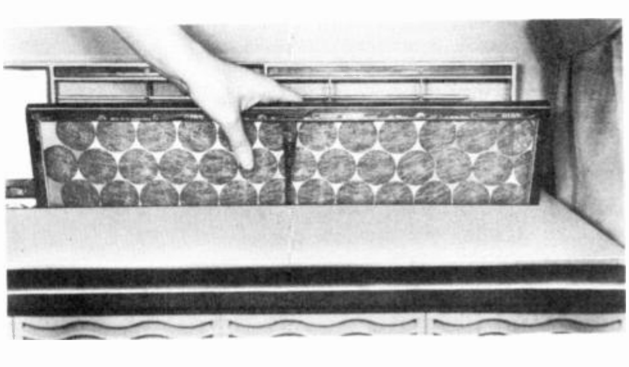


FIGURE 2

One of the greatest offenders which causes a reduction of ventilation and cooling effect is a dirty or clogged air filter. Shown in figure 2, the serviceman is checking the air filter in a one-horse power unit. A visual inspection is made to determine if the filter pores are clogged or dirty to such a degree as to restrict air passage through it.

All current Philco Air Conditioners of the one-horse power type have their filter installed before the evaporator, and are accessible after opening the fresh air inlet grille on top of the cabinet, as shown in Fig. 2. The ¾ and ½ H. P. units have the filter installed in the recessed fresh air damper at the bottom front of the cabinet, Fig. 1.

With the ⅓ H. P. and 50J models it is necessary to remove the decorative cabinet to gain access to the air filter which is mounted in front of the evaporator.

FILTER SCREENS

Philco Air Conditioners are equipped with a screen in the outside air path which serves to prevent the entrance of insects and lint from entering the room through the air conditioner.

The outside air screen may be cleaned with a stiff brush and/or a vacuum cleaner.

The one-horse power units have two screens. One covers the fresh air damper, and the other is located behind the pump-out damper on the cabinet.

The ¾ H. P. units have a fresh air screen in the fresh air damper vent under the evaporator, as indicated in Fig. 3. There is an additional filter screen under the pump-out damper on the cabinet.

The 1/3 H. P. Air Conditioner has one air screen, which is located behind the fresh air damper. It is readily accessible for cleaning after the cabinet is removed.

When checking the air conditioner, a thorough inspection should be made of the insulating boards and pads which are secured to the air plenum walls. A piece of this insulation if loose may easily be drawn over the fan port or air outlet grilles to reduce the efficiency of air movement.

If it becomes necessary to re-affix the insulation to the plenum walls, use a good odor-free glue or patching cement.

FANS AND FAN MOTORS

Check for dirt encrusted fan blades. Fan blades that have a layer of dirt and scale on them offer more resistance to the air movement. This causes a restriction of the air flow path.

To clean the fan blades, a light wire brush and steel wool should be used to restore a clean, smooth surface to the blades.

Care should be observed in cleaning the fan blades so that their pitch is not changed.

The fan motor armature should be checked for freedom of rotation and a good grade of oil should be used to lubricate the motor. A number of the fan motors used in Philco Air Conditioners are of the oil-less bearing type.

CONDENSER AND EVAPORATOR

Check the condenser and evaporator for dust and lint imbedded between the tubes and fins. Any obstruction in these components will cause a loss of refrigerating effect due to the reduced air flow and, therefore, it must be removed. The condenser and evaporator should be thoroughly cleaned, preferably by using compressed air or a blower type vacuum cleaner. All bent fins should be straightened to expose a maximum cooling surface to the movement of the air stream.

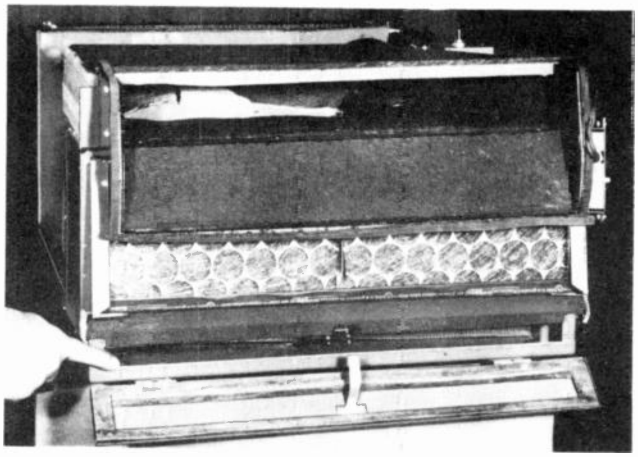


FIGURE 3

A dirty condenser not only causes a loss of refrigeration, but also causes the motor compressor to consume more power.

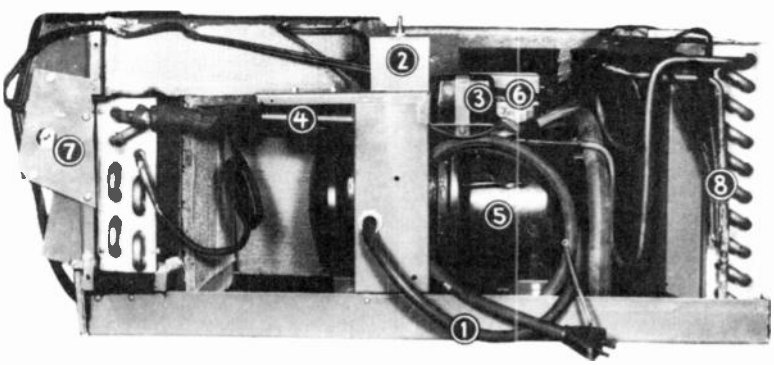
BASE PAN

During the inspection, be sure to check for restrictions to the flow of condensate moisture through the rubber drain tube which connects the evaporator and the condenser.

After continued usage of the air conditioner, dust and dirt may accumulate as sludge in bottom pan. To insure proper condensate disposal and avoid the possibility of damage due to overflow of water on the floor, the bottom pan should be thoroughly cleaned.

After completely cleaning the air conditioner, all parts and panel mounting hardware should be checked

FIGURE 4



1. Power cord
2. Power switch
3. Starting relay
4. Starting capacitor
5. Motor compressor
6. Motor compressor terminal box
7. A. T. C. thermostat
8. A. T. C. heater & protector

The ninth item which cannot be seen here is the fan motor.

to eliminate any possibility of rattles and vibration due to loose components. The fan blade and plenum housing should be checked for ⅛ of an inch clearance between the tips of the blade and the housing.

ELECTRICAL SYSTEM

The electrical components of a Philco Air Conditioner may vary in size and shape, but their function and operation is the same in all units. As an example, shown in Fig. 4, is the model 76-H which utilizes automatic temperature control.

An overall wattage check of the electrical system will be of assistance in determining the component that is causing malfunction. The power cord of the air conditioner is inserted into the receptacle of the wattmeter, (Fig. 5), and the power cord from the meter is plugged into the wall receptacle for the air conditioner. Allow the air conditioner to operate for a few minutes, read the total power consumption. If the power reading is low, that is between 100 and 200 watts, with the power switch in the COOL position, it would indicate that only the fan motor was drawing current and the power cord is not the cause of malfunction. Therefore, it will be necessary to make individual checks of the electrical components.

With the power cord disconnected from the source voltage and the cabinet removed, the switch may be dismounted. The switch can then be isolated so that a continuity check may be made by disconnecting the common motor compressor lead and one of the fan motor leads. A point-by-point check with the switch first in the FAN position and then in the COOL position will determine if the switch is operating properly.

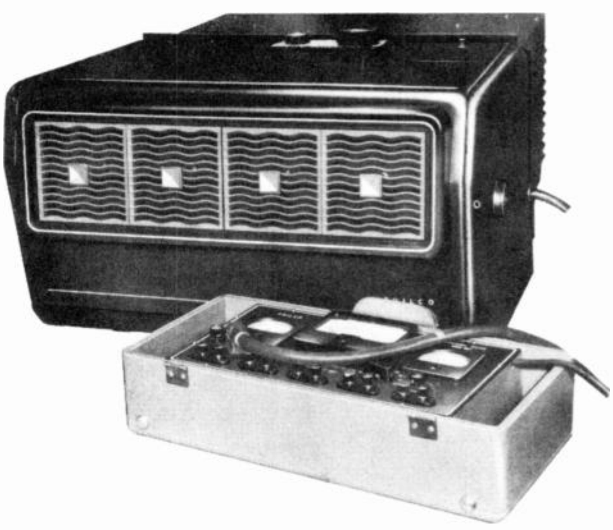


FIGURE 5

To check the starting relay, plug the power cord in the A. C. supply and use a test jumper to by-pass the contacts between terminals #1 and #2 for a type "G" unit, and terminals "L" and "S" for a type "W" unit. The test jumper should not be held on the terminals for more than three seconds. If the motor compressor starts, the relay must be replaced.

If the motor compressor does not start, the defect is in either the starting capacitor or the motor.

If the starting capacitor for the motor compressor is suspected of being faulty, the best check is to replace it with one of the same rating and type that is known to be good. If the motor compressor starts, the original capacitor is defective.

A resistance check of a capacitor will show a reading of two to three megohms; a leaky capacitor will read between zero and twenty thousand ohms.

The running capacitor may be checked by substituting one known to be good. A wattmeter check of the power consumption of the unit before and after replacement will show a very definite decrease in power when a defective running capacitor is replaced.

MOTOR COMPRESSOR

If a motor compressor is inoperative, the air conditioner wiring should be removed from terminals #1, #2, and #3 in the motor compressor terminal, Fig. 6.

Using a refrigeration test cord, connect the spring clips from the test set to the motor terminals. Insert the test cord power plug into the power receptacle and immediately depress the momentary contact switch to start the motor. Do not hold the momentary contact switch closed for a period of more than three seconds. If the motor runs when the test set is used, the trouble is in the control circuit or wiring harness. If the motor does not run, there is a defect in the motor compressor.

The compressor motor is constructed in such a manner that its field winding is isolated from the compressor shell and frame. If there is any electrical leakage between the windings and the air conditioner

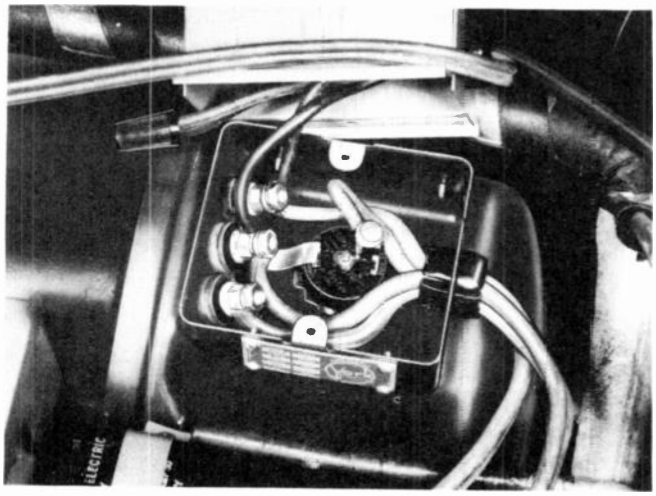


FIGURE 6

frame, the compressor should be replaced. A resistance check between the frame and the motor terminals will show an open circuit for a good motor compressor.

AUTOMATIC TEMPERATURE CONTROL

All Philco Air Conditioners produced in the last two years with model numbers in which the final digit is #4 or #6, are equipped with an automatic temperature control.

The operation of the temperature control is entirely automatic; however, the temperature of the room air at which it starts to function is determined by the setting of the A. T. C. knob on the thermostat. The thermostat is located in the duct that returns the room air to the air conditioner. When the air in the room reaches a definite temperature, depending upon the control setting, the thermostat contacts close. The closing of the contacts energizes a heater that is soldered to the strainer on the liquid line. The added heat causes bubbles to form in the liquid refrigerant, and thus reduces the amount of liquid refrigerant entering the evaporator. A protector (thermostat) is

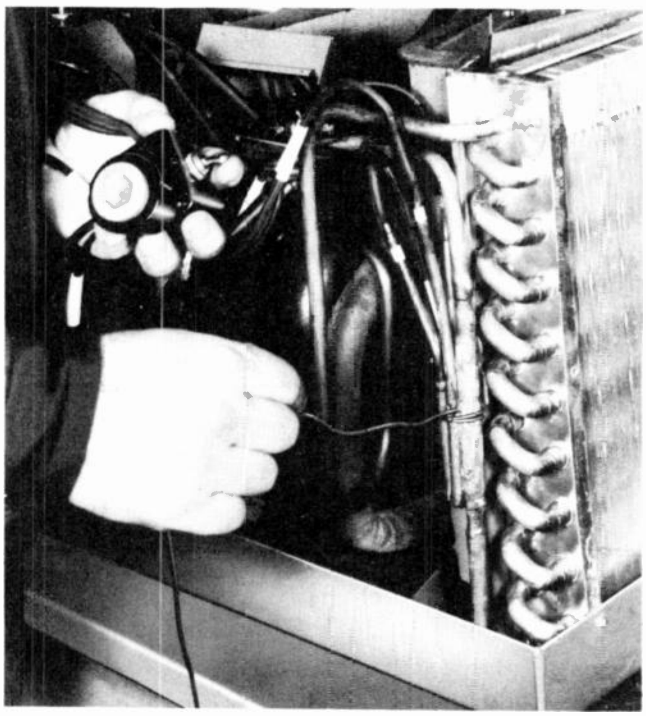


FIGURE 7

placed in series with the heater circuit, to open the circuit in case of excessive heater temperatures.

A.T.C. HEATER AND PROTECTOR

To check the heater and protector for operation, use a test cord in place of the wiring harness, Fig. 7, and plug it into a wattmeter. Heat the assembly slowly by turning the switch on and off. If the wattmeter cuts off before the solder begins to melt, the protector and heater are good.

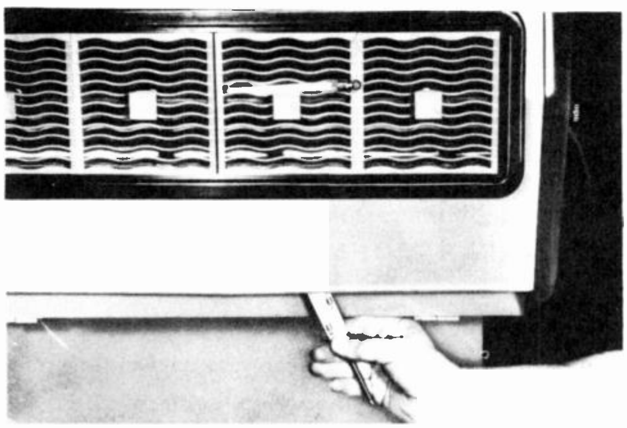


FIGURE 8

If the heater does not warm up, a resistance check of the heater and the protector should be made individually. A defective heater or protector will show an open circuit when checked with an ohmmeter.

To check the A. T. C. thermostat isolate the circuit by removing the thermostat lead from #3 binding post of the motor compressor. Expose the other lead by removing the wire nut from it. Connect an ohmmeter from the wire nut to the exposed lead.

Turn the A. T. C. knob all the way clockwise. The thermostat contacts should close and indicate a completed circuit on the meter. Next turn the knob all the way counterclockwise. The contacts should now be open. If the control does not operate in this manner, it should be replaced.

If the room temperature is above 75 degrees it will be necessary to dismount the control and pre-cool it prior to making this check.

If it becomes necessary to replace the protector or remove a defective heater, an extra heater may be strapped over the assembly and energized through a test cord to remove the assembly.

To install the new heater and protector, strap the heater and protector to the condenser strainer and energize the heater with a test cord, as shown in Fig. 7. When the heater is sufficiently hot to permit the solder to flow, solder the heater to the strainer and the bottom tip of the protector to the heater.

Having checked and/or repaired any defect in the electrical and air flow system, a performance check may be made to determine the efficiency of the refrigeration system.

COOLING PERFORMANCE CHECKS

With the air conditioner in the installed position, operate the unit with the power switch in the COOL position.

Check the temperature at the evaporator air inlet, Fig. 8. Prepare a psychrometer by thoroughly wetting the wick that covers the bulb. To obtain correct readings, it will be necessary to place the bulb in the air inlet stream and record the lowest wet bulb readings before the wick dries.

When taking the dry bulb readings of the evaporator, Fig. 8, the temperature should be checked at several places in the evaporator conditioned air streams.

When a wattage check is to be made, the following temperature check must be performed first:

Read the condenser air-inlet (outside air) temperature, locate the bulb of the dry-bulb thermometer outdoors near the condenser air inlet louvers at either side of the air conditioner, but not closer than six inches to the unit. Be sure that the bulb is securely fastened, that it is shielded from the direct rays of the sun, and that it is not in contact with any metal parts. There must be no obstruction to the flow of air across the bulb of the thermometer. If the air conditioner is installed at a casement window, or if the above suggestion cannot be followed, place the thermometer outside the nearest window, on the same wall.

With the wattage and temperature readings obtained, reference can now be made to the cooling range and wattage tables for the particular model under test. The efficiency of the refrigeration assembly may then be determined.

Automatic Refrigerator Controls

In previous publications, the Automatic Refrigerator has been discussed quite extensively. In the August edition of the Service Supervisor, Thermo-Regulation was discussed. It is felt that this information, even though complete in itself, is of such importance that a review of it with appropriate illustrations is warranted.

The Automatic Refrigerator utilizes an entirely new design for the refrigeration system which makes the refrigerator fully automatic. Control for this refrigerator is maintained through the use of three temperature-regulating devices, which are an evaporator thermal regulator, a plate thermal regulator, and a solenoid-operated refrigerant valve.

EVAPORATOR THERMAL REGULATOR

The freezer compartment temperature is governed solely by the evaporator thermal regulator, and since the function of this regulator is to control the unit assembly to maintain the freezer compartment at a low enough temperature for the safe storage of frozen foods, it is not necessary that it essentially be a variable control as in the standard refrigerator. Therefore, this control has been designed to operate most efficiently at two pre-set positions, an "ON" and a "SHARP FREEZE" point with an "OFF" position at the lower point of the counterclockwise swing of the control.

The evaporator thermal regulator opens and closes the unit control circuit to start and stop the unit, thus controlling the actual running time of the motor compressor. Assuming that the thermal regulator is properly installed, the only adjustment the serviceman can make on this control is that of altitude correction.

PLATE REGULATOR

The plate thermal regulator controls the temperature of the food storage compartment by controlling the solenoid valve which in turn controls the flow of refrigerant through the True Zone plate to maintain the correct temperature for storing fresh foods. The thermal regulator is electrically connected in series with the solenoid valve, figure 1, which is an electromagnetic valve that controls the flow of refrigerant through the plate.

The plate thermal regulator, as shown in figure 2 is mounted in the inner portion of the food compartment liner left wall, with the control feeler tube passing through the side wall and cabinet back insulation. It is routed through the inner cover plate with the end of the feeler tube placed in the feeler tube well, which is mounted on the left-hand side of the True Zone plate, (figure 3). With this type of mounting, the control feeler tube senses both air and plate temperatures and in this way causes the thermal regulator to activate the solenoid valve which cuts the plate in and out of the refrigerant circuit, thus maintaining the desired food compartment temperatures.

THE SOLENOID VALVE

The solenoid valve, shown in figure 1, is an electrically operated valve that controls the flow of refrigerant through the True Zone plate to maintain desired food compartment temperatures. The valve coil (electromagnet) is wired in series with the plate thermostat (True Zone thermal regulator). When the plate has been cooled sufficiently by the flow of refrigerant through it, the plate thermal regulator closes its contacts, energizes the solenoid which opens the refrigerant valve. This valve, when in the open position, by-passes the refrigerant around the plate. The flow of refrigerant at this time is directly to the freezer compartment evaporator. This condition prevails until the plate control calls for refrigerant, whereupon the plate thermal regulator contacts open de-energizing the solenoid coil allowing the valve to close, thus restoring the flow of refrigerant through the plate.

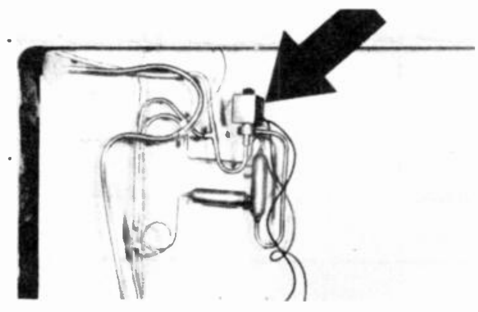


FIGURE 1

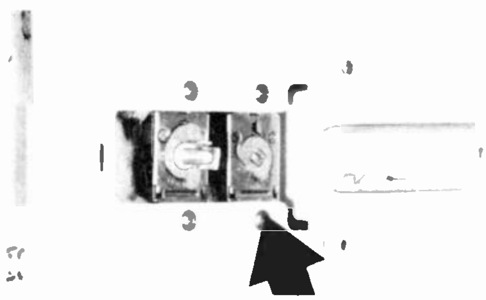


FIGURE 2

It may be seen from the foregoing paragraphs that cooling of the food storage compartment by the True Zone plate is wholly dependent on the valve action, which in turn is controlled by the thermal regulator. The importance of the positioning of the control feeler tube and well assembly cannot be stressed too much, for any deviation from the recommended installation position will affect cabinet temperatures.

Figure 3 illustrates proper positioning of the true zone control feeler tube and well. The well is mounted in the cut-out portion of the left-hand flange of the True Zone plate. It is tightly secured and parallel to the plate with 1/8" clearance between the well and plate. The control feeler tube is inserted into the well in such a manner as to have the end of the feeler tube extending beyond the bottom opening of the well 3/8 of an inch and not more than 3/4 of an inch. The feeler tube passes through the rubber grommet which isolates it from the tank and inner cover plate, it then passes through the center of the cabinet insulation below the area of the evaporator. Illustration "C" of figure 4 shows a view of the routing of the control feeler tube in the insulation. It must be remembered that the True Zone control feeler tube reacts to the coldest point on its surface area, therefore, to have the control function properly only that area of the tube that is in the inner portion of the food compartment should be exposed to cold temperatures.

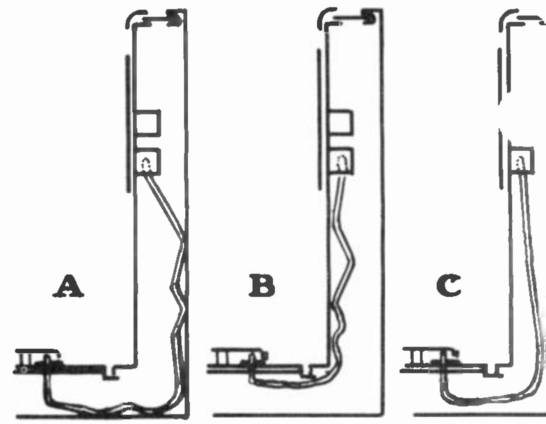


FIGURE 4

HIGH CABINET TEMPERATURES

In diagnosing malfunction of the Automatic Refrigerator, there are numerous conditions that may cause high cabinet temperatures:

If the feeler tube well is bent in such a manner as to touch the True Zone plate, (Fig. 5), the feeler tube will sense only the temperature of the plate, since the plate temperature is quickly reduced when refrigerant flows through its coils, the control will sense a false cabinet temperature and cause the refrigerant to be cut off prematurely.

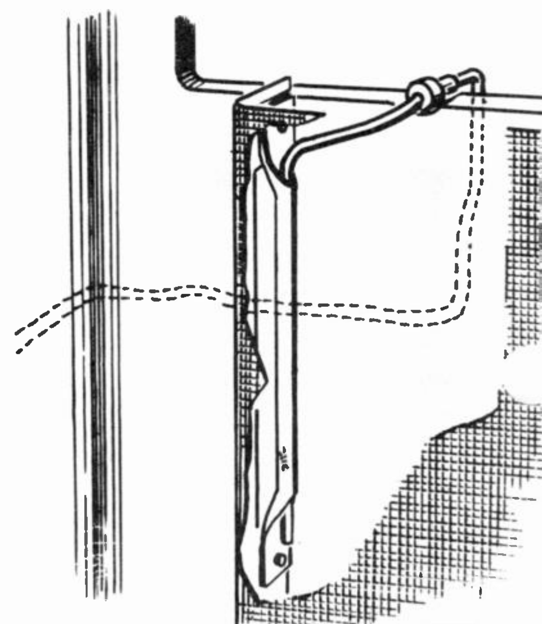


FIGURE 3 CORRECT

If the end of the feeler tube extends below the well, (Fig. 6), and touches either the plate or the refrigerant tubing, the control will be activated prematurely causing the valve to be opened and cease plate cooling, thus causing high food compartment temperatures.

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 not close its contacts and the plate will not be refrigerated. This condition would also occur if the feeler tube were in close proximity to or touching the side of the food liner tank in the area of the freezer evaporator.

The altitude settings of the thermal regulators are set for 1,000 feet at the factory. If the refrigerator is to be used below 1,000 feet, it is necessary that the control's altitude adjustment be properly positioned or warm cabinet and freezer temperatures will prevail.

If the solenoid valve (Fig. 1) is energized through improper wiring, or if the valve is stuck in the open position, the plate will not be refrigerated and thus extremely high food compartment temperatures will prevail. To check solenoid action, expose the control terminals and remove one lead from the control. When the refrigeration unit is operating, by

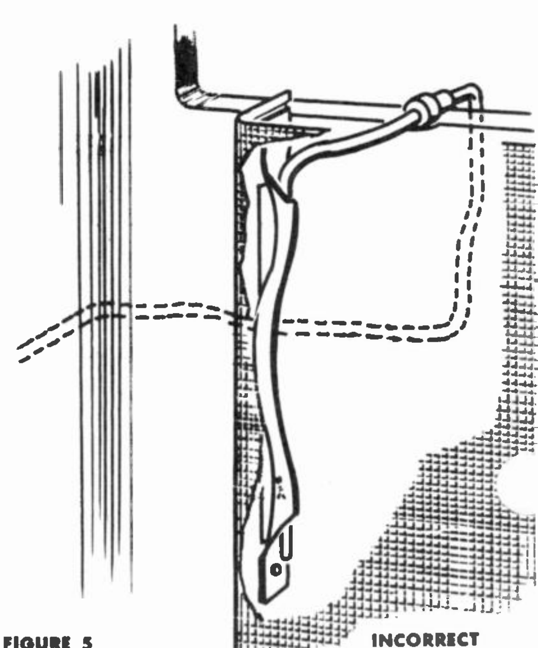


FIGURE 5 INCORRECT

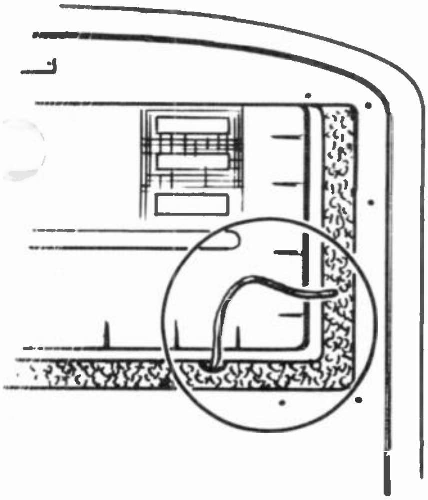
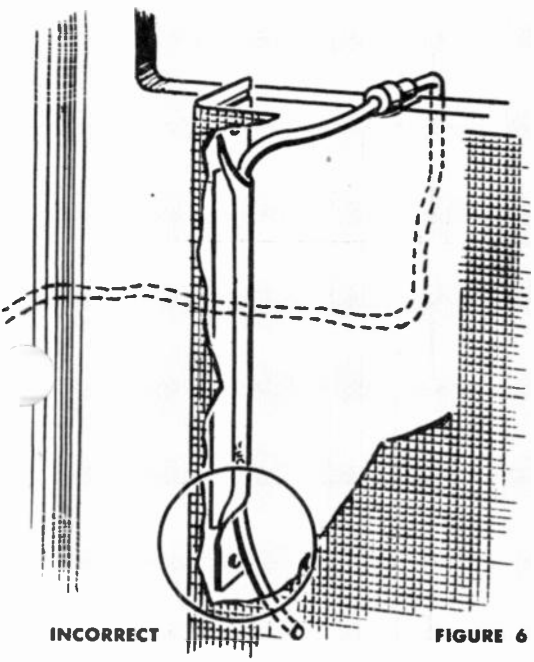
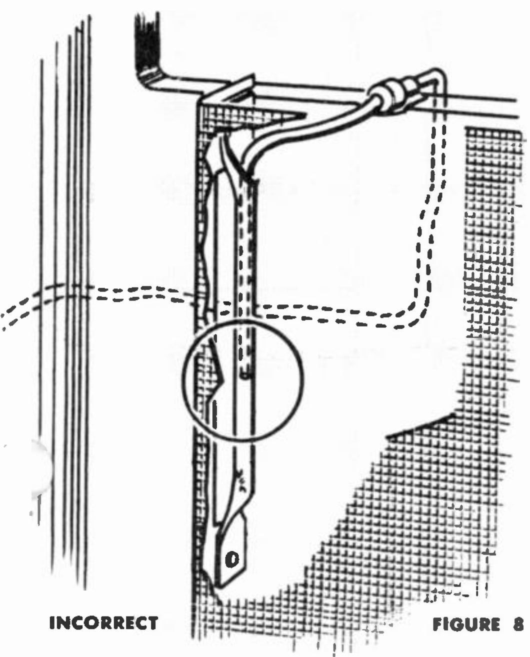


FIGURE 7



INCORRECT FIGURE 6



INCORRECT FIGURE 8

touching the disconnected lead to its terminal or the other terminal of the control, the solenoid valve will be opened and a click will be heard from the valve. When the lead is removed from the terminal, a spark will be visible when the circuit is broken, thus indicating proper control and valve action.

CABINET TEMPERATURES TOO COLD

Conversely, if the solenoid coil is open or the valve is stuck in the closed position, the True Zone plate will be refrigerated all of the time that the unit is operating, thus creating extremely cold temperatures in the refrigerator compartment with no defrosting of the True Zone plate. The failure of the click test previously outlined would show an open coil. If the valve were frozen in the closed position, defrosting of the system would remedy this condition.

If the feeler tube well mounting bolts are loose, or the plate mounting lips are bent in such a manner as to change the plate to feeler tube well positioning, the feeler tube well senses a false high cabinet temperature due to poor conductivity, therefore, the plate will be refrigerated for a longer period which will cause low food compartment temperatures.

If as in figure 6 the feeler tube is touching the food tank, the control will receive a false indication of high cabinet temperatures and cause the plate to reduce the cabinet to a much lower temperature than normal.

Under the conditions where the mounting flange for the feeler tube well touches the food liner tank, the control will feel a false high cabinet temperature and thus cause the plate to reduce the cabinet temperature to a lower than normal condition.

The plate should be straightened or shimmed up on its spacers to establish an 1/8″ clearance between the tank and the edge of the plate.

If the control feeler tube is not inserted completely into the well (Fig. 8), the feeler tube will have a reduced surface area exposed, therefore, the control will sense a false warm temperature in the refrigerator compartment and cause the plate to overcool the food compartment. The feeler tube must be re-inserted into the well so that the tube extends 3/8 to 3/4 of an inch below the bottom of the well. When the refrigerator is operated in an area that is more than 1,000 feet above sea level, it is essential that the controls be adjusted to its proper altitude setting. Improper altitude correction will cause the freezer and the food comment to become too cold. The plate may not defrost automatically and unit running time may be excessive.

When installing a new control or when checking the control positioning, pay particular attention to the feeler tube well mounting. The feeler tube should be inserted into the well and the well should then be crimped approximately 1½″ from the bottom to secure the feeler tube in the well. Tighten the well mounting bolts securely to insure good heat transfer.

Any excess length of the feeler tube should be drawn through the inner cover plate grommet into the insulation area below the inner cover plate cut-out. It is imperative that the excess length of the control feeler tube does not contact the refrigerated lines or cabinet surfaces.

Vibrator Development and Operation

The vibrator in one form or another is the most common present-day method of changing high current, low voltage, direct current to alternating current which can then be transformed to a higher voltage. Most of us know the basic principle, which is a vibrating reed but, to many, the vibrator and its particular circuit requirements are somewhat hazy. We felt that a fuller understanding of this inverter, as it is called, would be of assistance and interest to auto radio and mobile equipment servicemen.

The fundamental purpose of a vibrator is to open and close a circuit so that we may change our current from unvarying D. C. to pulsating D. C. and from that, by the use of an inductance, to A. C. (Fig. 1).

The fundamental action of an iron core choke when D. C. is impressed on it is shown in Figure 2. The large negative voltage is the inductive kick which results right after the key is opened. This kick has its uses, but not in an auto radio, as it may result in a voltage hundreds of times larger than the battery voltage. By placing a condenser across the choke we can dampen the kick without affecting the action of the choke at all (Fig. 3). This condenser, because of its action on the voltage is called a buffer condenser.

If we add a secondary winding having, say ten times as many turns as the iron core choke and couple the two coils magnetically we have obtained a step up transformer whose voltage output has the same characteristics as the voltage impressed on the primary except that it is ten times greater. Now if we add an electromagnet and spring to the key we will have made it an automatic circuit "maker and breaker" (Fig. 4). You will also note that we have moved the buffer from the primary to the secondary. It may be used in either position but, since the secondary voltage is higher, a smaller capacitor may be used with the same effect. The components of the circuit are chosen so that the vibrator points open before the primary starts to saturate, and the buffer capacity is kept low so that the voltage remaining in the inductive kick is about equal to the positive voltage delivered by the primary. If we now add a rectifier and filter we have what is shown in Figure 5.

There are three disadvantages to this circuit. As the vibrator coil is in series with the load as reflected

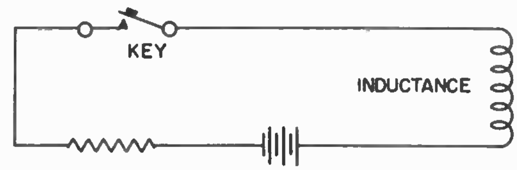


FIGURE 1

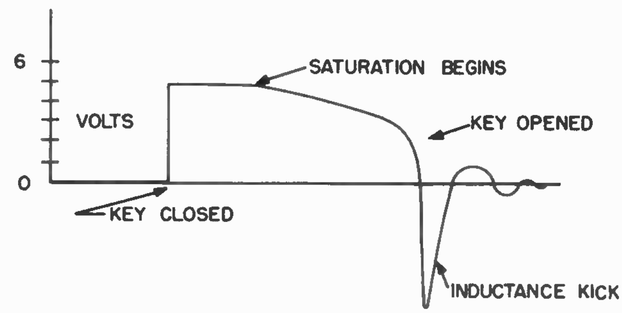


FIGURE 2

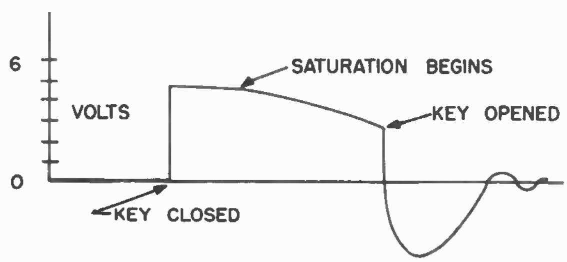
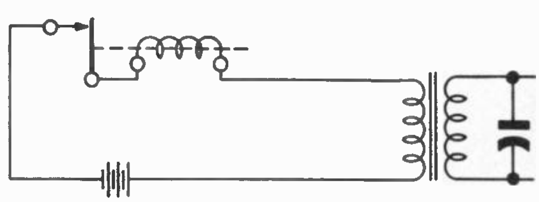


FIGURE 3



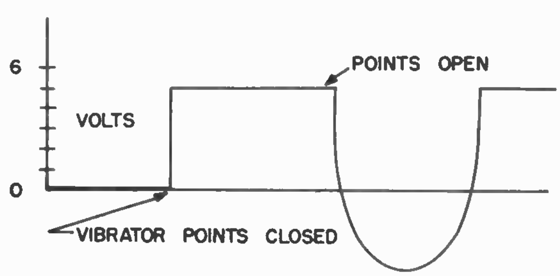


FIGURE 4

from the secondary; it depends upon that load for its magnetic strength. If the load is too light for the design of the coil, the vibrator reed would not make a full swing and would flutter lightly and erratically away from the contact. This would result in an over-extended closed period and the transformer would saturate causing sparking at the contact points. If the current drawn is heavier than the rating of the vibrator coil, the vibrator would be driven too hard which would probably cause early failure.

The second disadvantage is with the secondary of the transformer. Although there is a form of A. C. in the winding (see Fig. 4) the rectifier tube will pass current only with voltage of one polarity and we would effectively be trying to pass D. C. pulses through the inductance of the secondary. This would cause the secondary to act as a choke which would limit the output power to a certain absolute value which would quite probably be insufficient to operate the radio.

The third drawback is the imbalance of A. C. voltage. If the rectifier is so wired that the square topped wave is applied to the plate, energy is delivered directly from the battery through the closed contacts to the transformer and load, and the efficiency is fairly good. If, however, the rectifier is connected in the opposite fashion, the positive pulse applied to the plate is the one obtained from the energy stored in the inductance of the primary which is released when the vibrator points are open. This, as you can see from Fig. 4 again, does not contain nearly as much average power as does the square wave at the top, and the output is correspondingly low. Actually, of course the polarity used is determined by the polarity of the automobile battery. Some cars use a grounded positive and some a grounded negative so we would need a switching device to provide for proper operation in all cases.

The disadvantage of the vibrator coil limiting the amount of load was readily overcome by placing the coil across the contacts instead of in series with them. Now the coil is shorted out when the contacts are closed and only draws power when they are open. The strength of the coil is now only dependent on the current from the battery and will run about the same regardless of the load placed on it (Fig. 6).

Overcoming the inductance of the primary was accomplished by merely taking two half wave circuits and placing them back to back with a full wave rectifier. This required another set of contacts and replaced the useless lower half of the wave form with a duplicate of the upper half (Fig. 7).

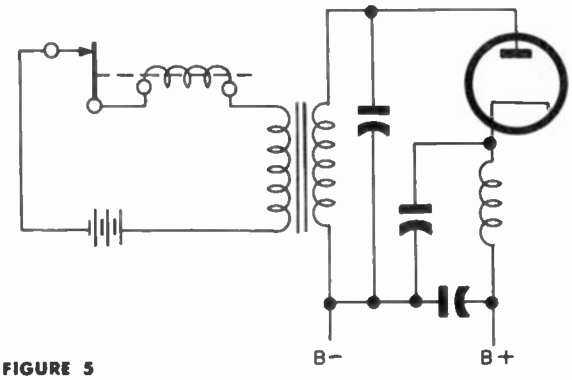


FIGURE 5

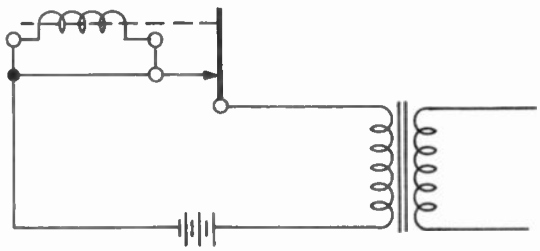


FIGURE 6

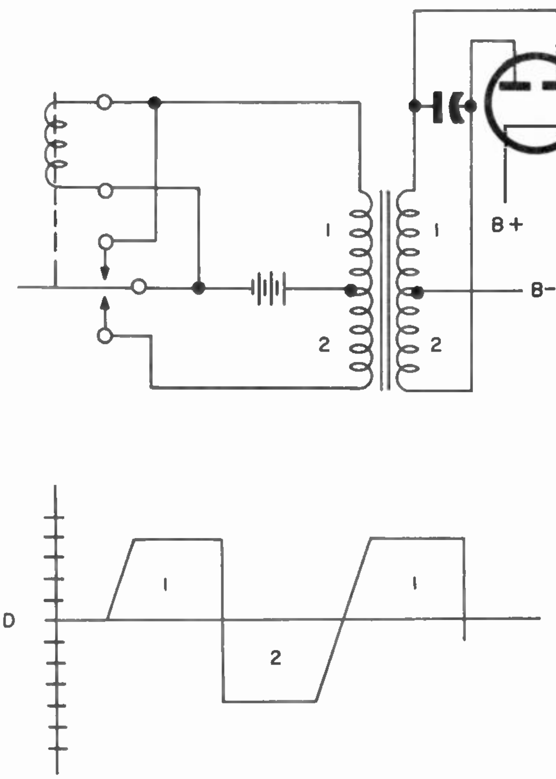
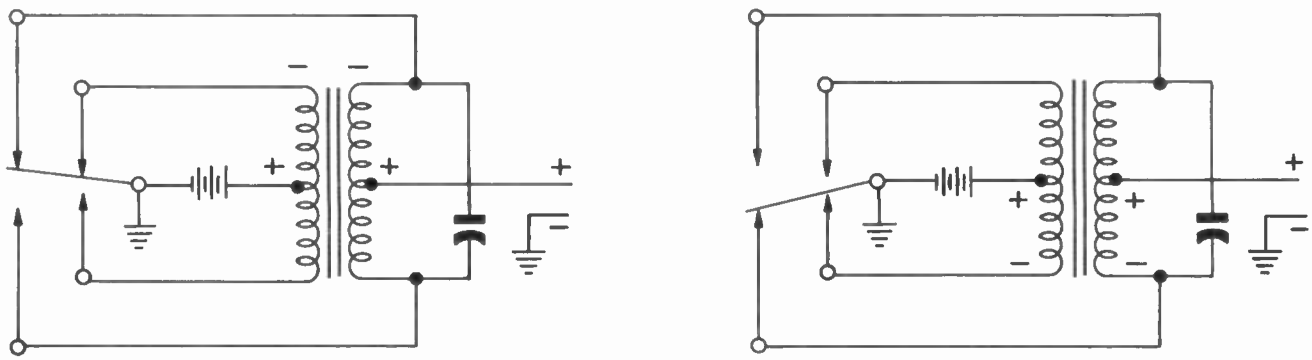


FIGURE 7



A FIGURE 8 B

With this circuit it can easily be seen that one of the two rectifier plates will always have a positive voltage on it and there is no longer any problem of battery polarity. We no longer have any blocking of the D. C. pulses by the primary inductance because each half of the coil is operating in opposite directions and thus each half balances or neutralizes the inductance of the other half. The above set up is the full wave non-synchronous vibrator circuit or primary interrupter and is used on millions of present day auto radios.

Sometime during or after this tinkering around with vibrators someone got the idea of getting rid of the rectifier tube by adding two more pairs of contacts to the reed so that the output of the power transformer would always have the same polarity. This is called the synchronous vibrator which operates electrically in a somewhat different manner from the non-synchronous type so let's take a look at a cycle of its performance (Fig. 8).

In position A, above, the upper half of the primary is connected directly across the battery. With the polarity as indicated the center tap is positive and the upper tap is negative with a return through the vibrator. A voltage of the same polarity is induced in the upper half of the secondary and the negative return is through the contacts to ground. This puts a positive pulse at the center tap of the secondary. In position B the reed has swung down to the other two contacts and, again, the center tap of each winding is positive with negative at the outside or lower tap. The negative return is still through the reed to ground for both secondary and primary. Thus we see that, in both positions of the reed, a positive pulse is delivered to the center tap of the secondary and this only needs filtering to be usable on the plates of the tubes in the radio. Let's suppose, however, that this radio is installed in a car whose electrical system uses a grounded positive as do a great many of the present-day cars (Fig. 9).

This looks very much as though we have a negative voltage to apply to our plates and a setup like that

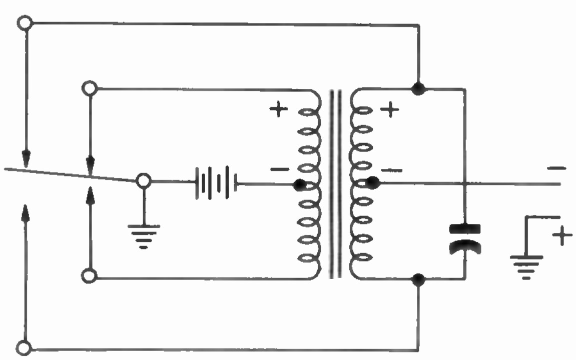


FIGURE 9

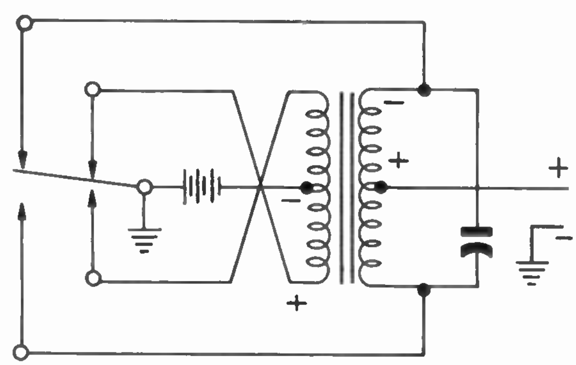


FIGURE 10

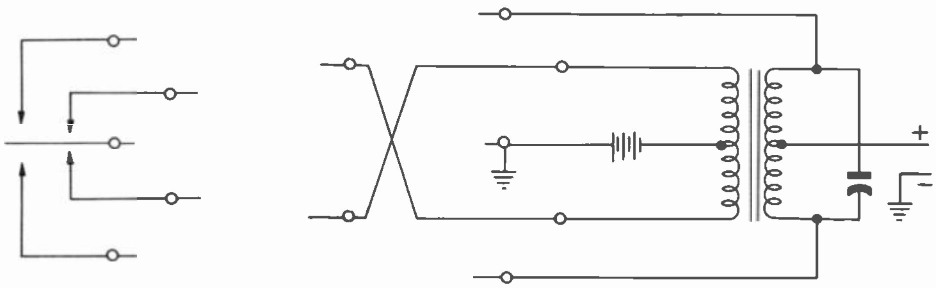


FIGURE 11

usually makes the electron tube very unhappy. To say the least, their operation under these conditions leaves something to be desired. If the set is built for cars with either polarity, a special switching device must be incorporated to reverse the primary of the transformer (Fig. 10).

Of course the simplest method is to merely exchange the leads of the primary but this meant opening the set and altering it until they came up with another method (Fig. 11).

If we could use a three-dimensional drawing the above circuit would be quite simple as is the actual mechanics of the switching. The socket and vibrator are designed so that the vibrator can be inserted in either of two ways. Actually this type of circuit reverses the secondary which is effectively the same as in the previous figure where the primary was reversed.

Although the synchronous vibrator does not require a rectifier it has been found that the requirements and specifications make its final cost higher than using a "non-sync" and rectifier. First, if the "sync" and "non-sync" vibrators are to be equal in operation, a great deal more care must be taken in adjusting four sets of contacts than in setting only two pairs; especially as all four are mechanically linked together. Size for size the "sync" cannot carry as much power and to equal the "non-sync" capabilities the surface size of the contacts must be increased, using more tungsten. The average life of the "sync" is only about half of the "non-sync" due to greater internal heat and greater wear on the contacts as a mechanical result of its construction. Add to this the necessity of a polarity switch and it is understandable that almost all present day manufacturers use the non-synchronous type unless space and weight are at an absolute premium.

The vibrator is the heart of the auto radio and as soon as it stops running everything stops. It is the only mechanico-electric item in the basic radio and is therefore more subject to wear than other parts. A standard vibrator cycles at a rate of 115 times *per second.* If the radio is used for two hours each day for one year it must complete 302,220,000 cycles and, during each cycle, parts of the reed are subjected to an acceleration of more than 150 Gs. Many times customers feel that they have been sold short when their vibrator fails after eight or ten months of service. If they realize what the poor thing had to go through they might feel better about the cost of its retirement.

Servicing Philco Printed Circuit Radios

Various brands of "Printed Circuit" Radio receivers are beginning to turn up in your shops for repair.

Recently Philco announced to its distributors a complete new line of Home Radios and in this line there is, of course, some printed circuitry.

The following article, we believe, will give you the necessary knowledge to properly handle and service Philco Printed Wiring when you are called upon to do so.

Figure 1 is a complete set less the speaker and cabinet. It looks much the same as Philcos you have been seeing for some time but there is a difference. Actually servicing has been made easier.

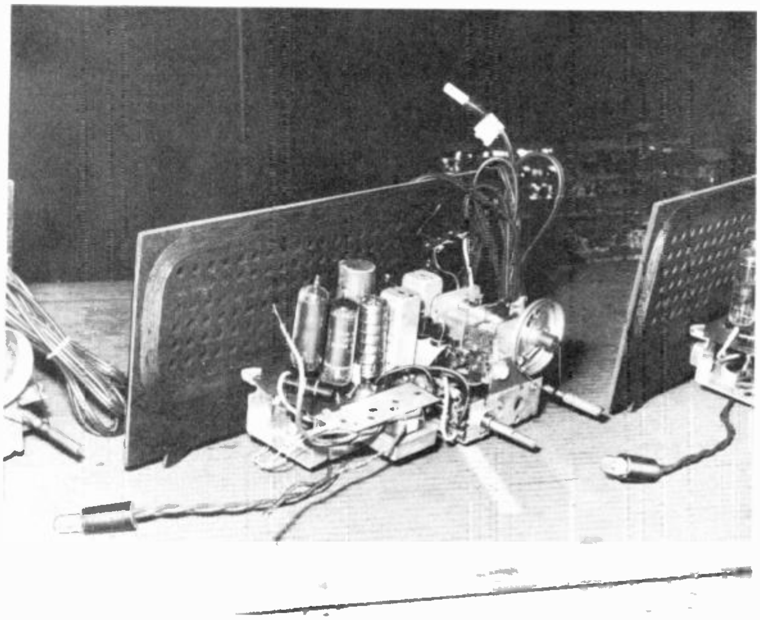


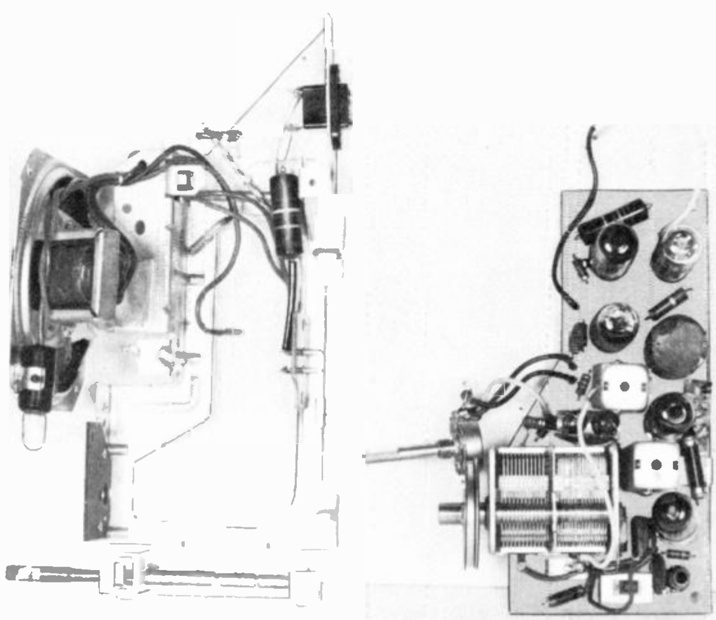
FIGURE 1

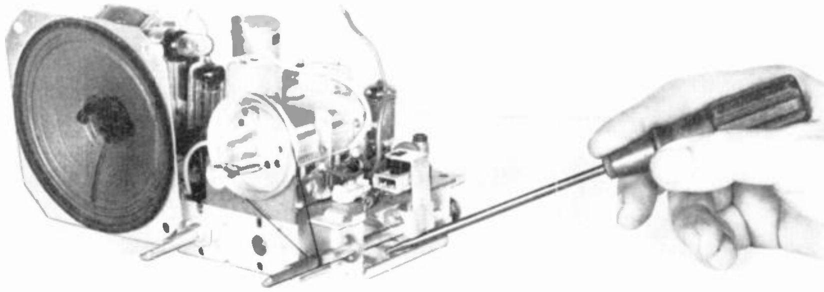
When making service replacements on a printed wiring chassis, there are new servicing techniques which must be followed. These modified procedures are not difficult, but irreparable damage may be done to the panel if proper care is not taken.

For all soldering operations, a twenty-two to twenty-five watt iron should be used so that excessive heating of the printed panel is avoided. When installing new components, a low-melting point solder such as 60% tin—40% lead should be used. This type of solder melts more quickly and so allows the connection to be made in less time with less heat.

To replace an IF or a socket we have found the most convenient way is to first remove the printed wiring panel from the sub-base (Fig. 2). This looks like a long and arduous task but actually it takes only minutes. There are only five connections to unsolder. Two to the loop. One at the volume control and two at the AC terminals.

FIGURE 2





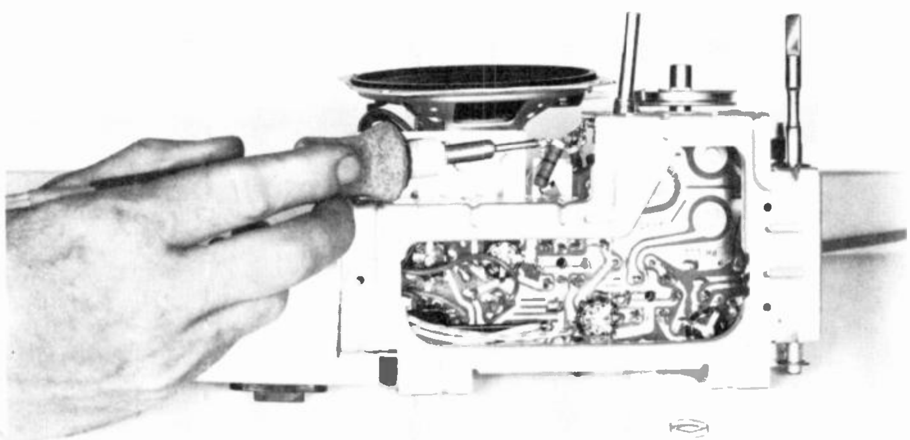


FIGURE 3

FIGURE 4

First, unsolder the two loop leads and remove the back and loop assembly. Two drive screws hold the loop to the sub-base and the AC cord with its interlock plug comes out with the back.

Then remove the "special services" switch bracket (when used) by prying up between the sub-base and the bracket (Fig. 3). This bracket snaps onto the tuning shaft and the set is changed from broadcast to special services by merely pulling the tuning shaft towards you.

Remove the dial cord by unhooking the spring.

Remove the volume control nut and unsolder the series condenser at the chassis (Fig. 4).

Remove the mounting screw holding the front of the gang condenser to the sub-base. The fibre board is riveted to the sub-base.

Next, unsolder the two AC leads from the AC terminals at the rear of the sub-base along with the AC filter condenser.

Pull the tip jacks of the output transformer and dial light off their pins.

At the rear of the sub-base are three tabs bent over the bakelite to hold the rear of the panel down (Fig. 5). Bend these tabs back. The front of the panel is slipped under three similar clamps. Now lift the rear of the panel and gently pull out from under the front tabs.

The PW panel and volume control is now free of the sub-base and easily accessible for repairing or replacing an IF transformer or socket.

We have found by experiment that the most convenient way to remove a component, having multiple connections going to the one unit, is as follows: Hold the panel right-side-up (Fig. 6) and apply the soldering iron tip to the component lug, not to the copper foil, and heat the connection so that the solder will run down onto the iron. Shake excess solder from iron and repeat if necessary to remove the bulk of the solder. Repeat this procedure for each connection to the component. This will remove all solder except a very thin layer between the component lug and the copper foil of the panel circuit.

After a connection at an IF transformer has been heated and the greater part of the solder removed, use a sharp knife to score the thin bond left on either side of the connection between the terminal and foil (Fig. 7). Wiggle the terminal back and forth to be sure it is free in the panel hole and proceed to the next connection repeating the procedure until all connections are cut.

Now simply slip the IF terminals out by pulling and wiggling the can. You will find the holes clean and ready to receive the new IF and no lifting of the foil results.

To remove a socket the same procedure is used. The solder lugs on the sockets have a slight outward tension so they will hold the socket in the panel for the initial soldering at the plant.

After the solder has been removed, use the point of the knife and push and twist slightly against the lugs between the panel and lug. The thin remaining solder bond will cut quite

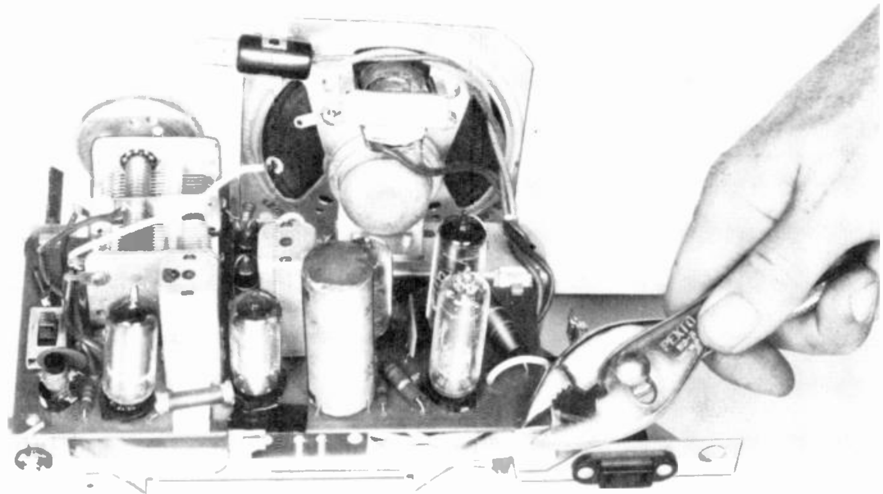
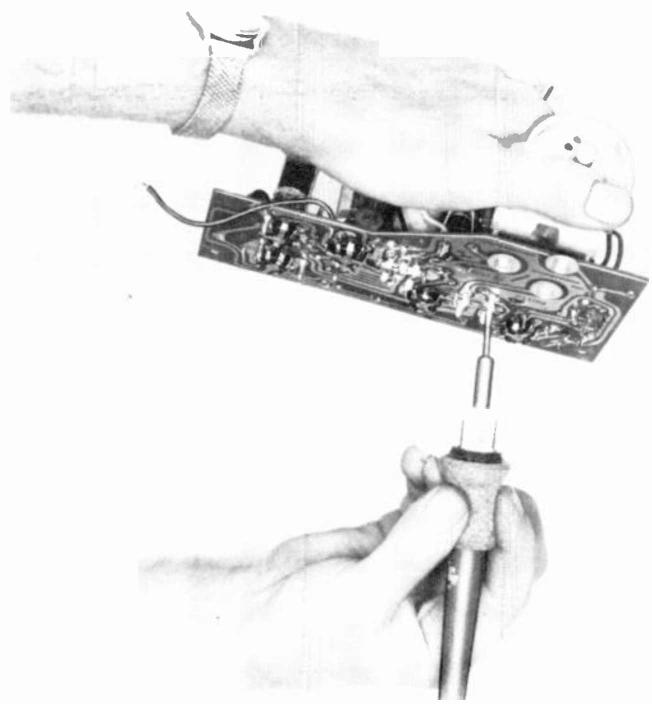


FIGURE 5

FIGURE 6



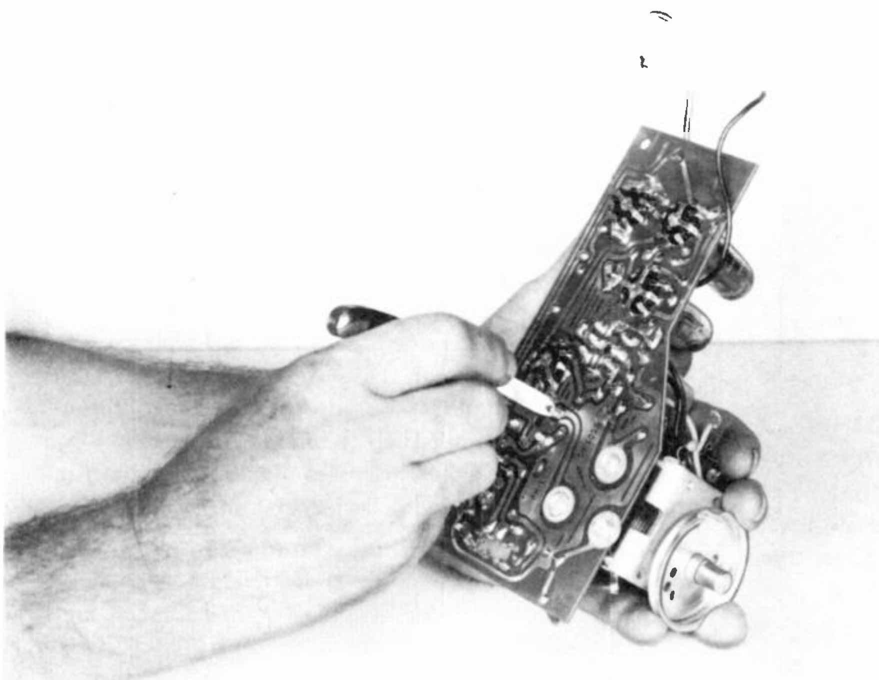


FIGURE 7

easily. Repeat around the socket and then remove like you would ring a doorbell. Just push out from the bottom.

To remove other components such as the tube saver resistor, merely heat the connections under the panel, one at a time and lift out the wire. Be sure the asbestos block is cemented in place under this resistor as it heats considerably and the panel must be insulated from this heat. To remove the filter condenser, cut the leads at the condenser on top of the panel with a pair of diagonals. Heat the connections, one at a time, and remove the solder as given above, then remove the wire ends by heating and pulling through the hole with a pair of long nose pliers.

The multiple by-pass condenser can be removed like the filter. Cut the leads at the top of the panel, heat each connection, remove the excess solder and pull out the wire ends.

The two molded tubular by-passes between the gang and the second i-f transformer may be removed by cutting the lead running to the ground bracket holding these condensers in position, unsoldering the other end and pulling the condenser out of the bracket.

It has taken some time to tell you how to handle the repair of the printed circuit receiver. Actually, an i-f transformer or socket can be replaced in less than ten minutes. This is, of course, less the alignment procedure.

We are sure you will find these new sets completely serviceable but the service man must be aware of and practice the necessary precautions.

Thermostats

The Electric Range hydraulic type of thermostat such as used on all Philco ranges, has a similar action to a refrigerator thermostat except the expansion of the charge causes the electrical contacts to open whereas the opposite occurs in the refrigerator thermostat (Figure 1).

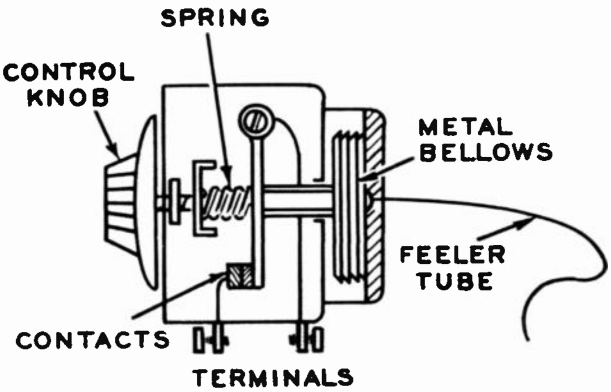
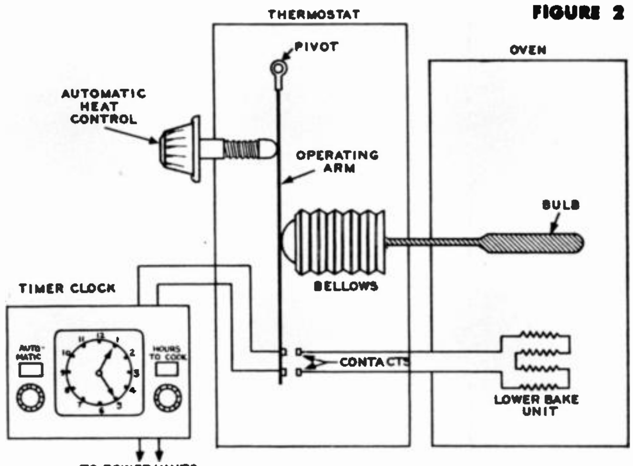


FIGURE 1

Another difference is that where the refrigerant charge in the refrigerator is partially gas, the range thermostat is completely charged with a liquid. The bulk of the liquid is in the bulb so that the slightest change in temperature will immediately effect the pressure in the diaphragm or diastat, as some suppliers call it. This corresponds to the refrigerator thermostat bellows.

The diastat assembly consists of a corrugated 1¼" diameter disc which is fastened to a shaft that extends from both sides. The shaft projection on the face side of the disc has a tapered point and seats in a depression in the actuating arm of the toggle mechanism. The other end of the shaft extends up in the case stem and seats in the recessed hole of the temperature setting screw. The end of the thermostat tube is wound in a coil and is braised to the disc assembly (Figure 2).

FIGURE 2



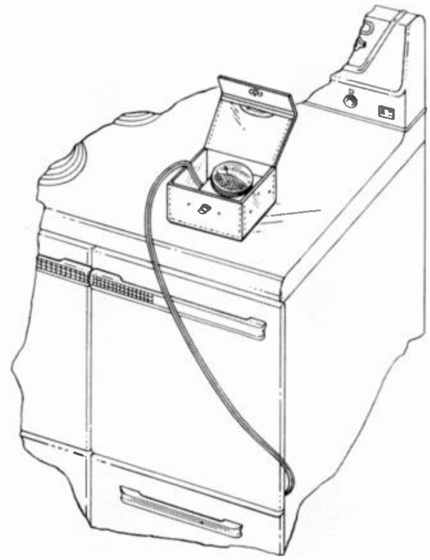


FIGURE 3

The double pole contacts are opened and closed by a toggle action with a heavy enough coil spring to give a positive snap action. On the rear mechanism there is a differential adjustment screw which changes the angle of a pivot bracket. Due to the critical effect and lack of testing material, no adjusting of the differential should be attempted in the field. Raising or lowering the range of the thermostat is done by rotating the calibration plate, clockwise or counterclockwise.

The thermostat is calibrated at the factory by immersing the bulb in a tank of heated oil. The tank temperature is controlled by a master thermometer and is raised and lowered to check the "On" and "Off" positions. Before each thermostat is passed by inspection it must be accurately calibrated and have a differential, which must be between four and nine degrees in the oil bath (Figure 3).

Should a thermostat need adjusting in the field the most accurate way to calibrate it is by use of a thermocouple with a remote meter. A good tubular thermometer may be used if no thermo-couple meter is available, but the readings have to be taken instantly upon opening the door as the temperature will then drop very rapidly. Another factor to remember is not to make any adjustments until the thermostat has cycled two or three times, as the temperature over-shoot on the first cycle does not allow a true temperature reading (Figure 4).

To adjust, proceed as follows:

1. Turn thermostat to "Off" position.
2. Remove dial by pulling straight off.

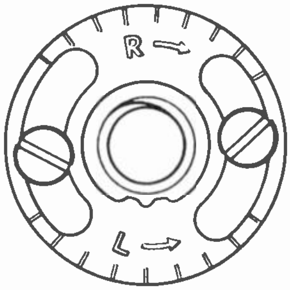


FIGURE 4

3. Loosen the two set screws about one turn.

4. Grasp calibration plate with fingers and rotate the plate only per "R" arrow to raise, or "L" arrow to lower temperature.

5. Tighten screws and re-install dial.

NOTE: If calibration plate has to be rotated further than the slots permit, remove the set screws and reinstall them in the other pair of holes. This allows another quarter turn of adjustment.

An approximate but very quick calibration check can be made by the so-called "Cold Check." This refers to when the oven has not been in use for a couple of hours and it is at room temperature. On the dial about midway between "Off" and 200°, is the approximate point where 70° should be. By slowly turning the dial past this point, the thermostat should turn "on" which can be heard when the mechanism clicks. By turning dial back again, it should click "off" just below this point. A normal thermostat should act in this manner.

However, if both "on" and "off" positions should occur on one side or the other of the half-way point between "off" mark and 200° mark, the oven should be heated up and the thermostat checked and adjusted with a thermometer, as previously given in the hot check method.

The pre-heat automatic feature in thermostats as used in models prior to 1953 is accomplished by attaching a bakelite box to the back of the thermostat which houses the extra contacts, and a tripping mechanism. When the thermostat is turned on, the main terminals close and they are wired direct to the two "Bake" terminals. When the dial is turned all the way to "Broil" position, a plunger pushes the "Bake" terminals open and also releases the spring-mounted "Broil" terminals so they close or go on. If the dial is then turned from broil to some bake temperature but not all the way off, the plunger is released and the bake terminals close or come back on. Both "Bake" and "Broil" terminals are then closed and will remain so until the thermostat cycles off by the oven reaching the set temperature. When the oven cools and calls for more heat, the thermostat main terminals close, thereby energizing the "Bake" terminals again, but not the "Broil" terminals as they will not turn on at any time unless the plunger is pushed down manually, which only occurs when the dial is turned to "Broil."

On some models which use a single combination oven unit, such as the Thrift Oven, a single thermostat is used. This thermostat is exactly the same as the one described above except it does not have the bakelite box mechanism attached to it. It uses only the main terminals for contacts. The open side is the two line terminals, and the closed side the two load terminals which feed the single oven unit.

All Philco ovens operate on 230 volts, so the two line wires only, without any neutral are brought to the thermostat. On ranges without automatic control clocks, power is brought direct to the thermostat from the range main terminal block. On ranges with clocks, the thermostat receives its voltage direct from the clock.

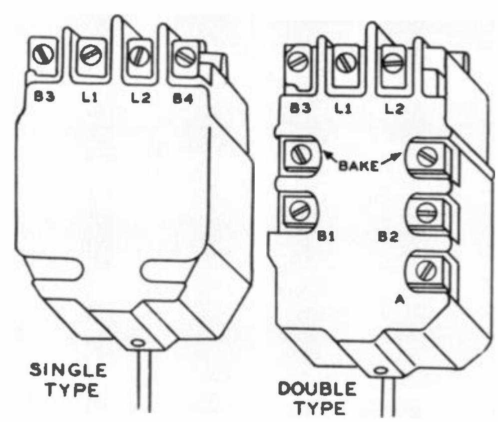
All ovens have a signal light to show when the oven units are at the "on" cycle, but mostly to let the user know when the oven is pre-heated by the signal going out.

On the double type thermostats, a signal terminal is provided which is energized whenever either the "Bake" or "Broil" terminals are in the closed position.

On the single type thermostat, no signal terminal is necessary, as either one of the load terminals can be used. If the signal light is a 230-volt type, it is connected to both load terminals. If it is a 115-volt type, it is connected to one load terminal only. The other wire is run to a neutral terminal.

This year we are using two different thermostats. The one used with the Jiffy Griddle is a special thermostat built exclusively for Philco and makes it possible to provide two speeds on the griddle. When turning the oven on for baking, merely turn the thermostat up to the temperature called for. This is in contrast to our previous system when the dial was required to be turned to broil and then back to the desired temperature. Modern oven thermostats like Philco uses, have been constantly improved and have had many refinements made in recent years. In comparison to the early thermostats, they are much more accurate, reliable, compact and long lasting.

FIGURE 5



This month . . .

JOE F. DENTON, Philco Service District Representative for the Central Division, discusses a seldom considered principle of the service business called showmanship. Joe has spent the past 26 years in electronic service work. These include a full stretch with the U. S. Navy during World War II when he served as project engineer with the Installation and Prototype Group. He joined the Philco family in 1952, immediately assuming his present post.

In my opinion . . .

. . . there are several ways to measure success . . . but if we are talking service business success in dollars, I would like to pass these thoughts along:

Knowing how to use test equipment, having an engineering degree tucked into the back pocket, being blessed with the ability to do a good conscientious service job—these are wonderful . . . but they don't necessarily add up to big earnings.

Service, today, is big business! All we have to do to be successful is to look around us, then apply to our operations the elementary principles common to successful businesses in every field. One of those principles is *showmanship*. Showmanship, as applied to your service business, can be something as simple as a can of paint brushed on the trim of your front door or display window . . . or as complicated as rebuilding the cab of your panel truck to resemble a giant-size TV set to attract people's attention to the business you are in.

Remember the cigar makers in the store window who cut the leaf, moistened it and rolled pure Havanas right before your eyes? Before your time? Well, you have watched the flapjack and frankfurter artists in chef's caps who tend the window griddle plates and provide mouthwatering invitations to come inside and satisfy the appetite. Service showmanship might find you taking a cue from these "window demonstrations" ideas. Repairing the mysteriously complicated TV chassis on a low bench—smack in your front window—would prove a profitable interest-getter, especially if your shop was located at a busy bus stop or heavy traffic point. The community would certainly get to thinking of *your* store or shop when TV service was the problem.

When you or your service technicians answer a service call, are you or they conscious of the showmanship of dress . . . the neat business suit or natty service uniform that instantly makes a favorable first impression on the customer? It builds extra respect—and a readier acceptance of stiff charges when such are justified. Do you take into the home only a screw driver as equipment, when that alone will handle the problem . . . or do you make an impressive living room display of portable test equipment and tools, no matter how simple the job?

Uses extra muscle power, sure, but it pays off when you present the bill . . . it's another small but typical example of showmanship service. By gad, you're a professional man with rich experience and years of training behind you! The principle of showmanship demands more than casual dress and the simple screw driver, even though life seems easier that way.

Give service *showmanship* some thought. Remember . . . *all* successful businesses apply it!

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