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SERVICING UHF TUNERS & CONVERTERS

PART II

PROPER SERVICE of UHF tuners and converters requires adequate test equipment. The necessary test equipment should include a Philco model 7008 sweep generator and oscilloscope, a Philco model G 8000 VHF to UHF signal generator adaptor or an equivalent UHF signal sweep generator and oscilloscope, a good multimeter or volt-ohm ammeter and a television chassis as a source of power for the UHF unit under test.

The tests described in this article are based upon the use of the aforementioned Philco test equipment.

The model G 8000 converts a 60 megacycle sweep signal from the model 7008 generator to that of any of the UHF channels, with a negligible amount of distortion, to be fed to the antenna input of the UHF tuner.

The output cable of the model 7008 is fed to the model G 8000 with the shortest possible cable in order to reduce standing wave ratio. The output of the model G 8000 adaptor is fed through a 6DB pad to the UHF tuner or converter input. The construction of the 6DB pad is illustrated in figure 9. The oscilloscope input of the model 7008 is connected to the

(Continued on next page)

Servicing UHF TUNERS and CONVERTERS

(Continued from Front Cover)

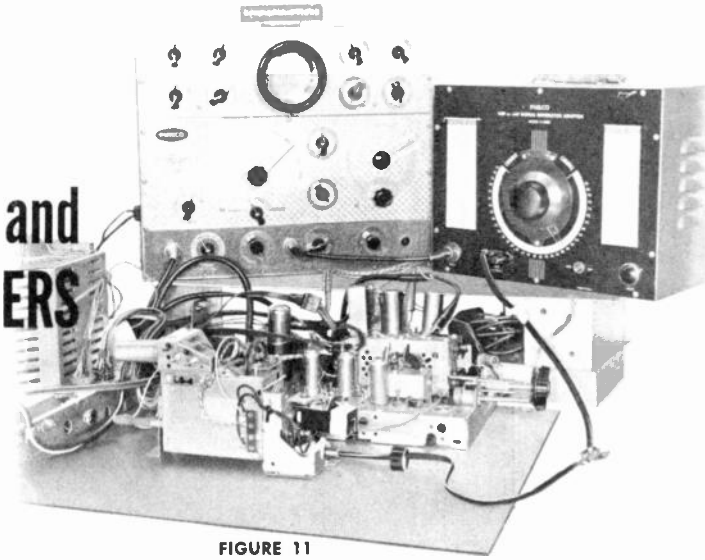


FIGURE 11

mixer test point of the VHF tuner on the television chassis through a series isolating resistor of 100,000 ohms. In figure 10 the hook up of the test equipment is illustrated while in figure 11, the actual layout of the test equipment is shown.

Calibration of the test equipment is necessary for accurate check of the UHF units. The response curve of the VHF tuner should be checked first in accordance with alignment specifications to eliminate possible false indications from this source.

In order to calibrate the model 7008, set the function switch to "calibrate" position, with the marker band switch to "B" position and calibrate the marker at the 60 megacycle crystal check point for "zero beat". This calibration is for the servicing of a UHF converter. For the UHF tuner whose output is a 40 megacycle IF signal, the 43.333 megacycle crystal check point should be used on the model 7008.

Turn the function switch to "marker" position. Next, turn the sweep generator portion of the 7008 to the "A" band, with the sweep control to approximately the center frequency of either channel two or three for servicing a UHF converter or to 43 megacycles for servicing a UHF tuner.

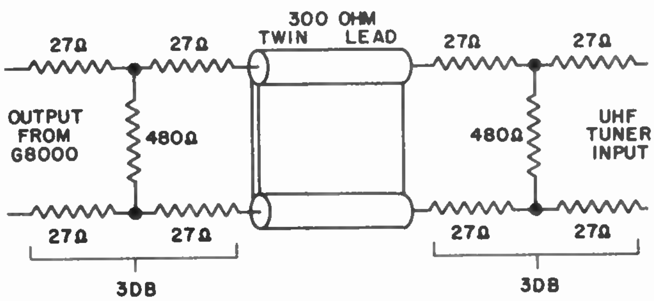


FIGURE 9

The calibration of the G 8000 can be simply performed by plotting it against a UHF tuner or converter that is known to be good. The G 8000 should be calibrated at both the high and low ends of the UHF band and also at the points where the local UHF stations occur.

This calibration can be performed by either beating the outputs of the G 8000 and the "standard" UHF adaptor together or by feeding the model G 8000 adaptor output to the standard unit and checking for maximum indication with an oscilloscope or meter at the output of the standard unit.

The first step in servicing the UHF unit is to visually inspect it for any physical or mechanical defects, after it is removed from the cabinet.

This preliminary visual inspection can very often be a time saver to the service technician since due to the simplicity of electrical design, the problems that occur are more often mechanical. Removal of the unit from the cabinet will present no problems if the instructions for installation are followed in the reverse order.

The next step in the operational check of the unit begins with a check of the tubes, and is followed by a check of the mixer crystal. The tubes and the crystal are readily accessible and, therefore, more easily checked and replaced.

In order to check the mixer crystal operation, an ammeter should be used at the mixer check point, figure 12. The reading here will indicate the output current of the mixer stage and the current reading should be between .5 to 3.5 mils. Actually the current reading may go down to .3 mils, however, noise performance is lost if the reading goes below this figure. In checking the current reading at the crystal check-

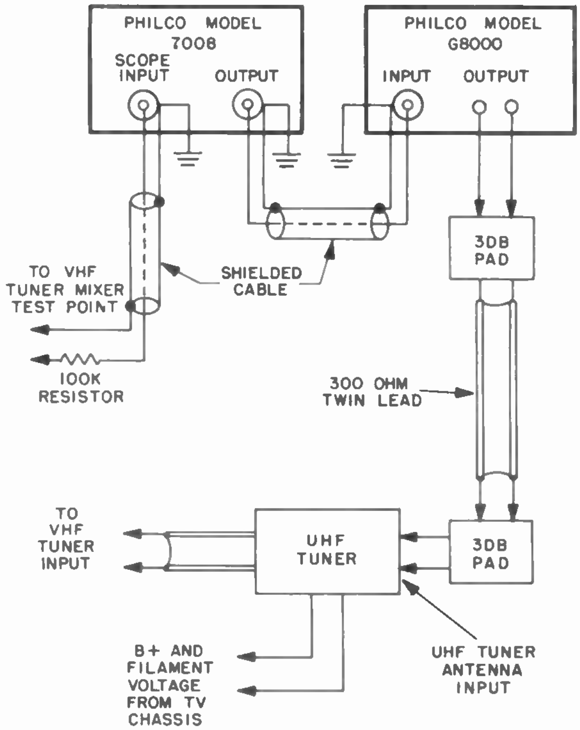
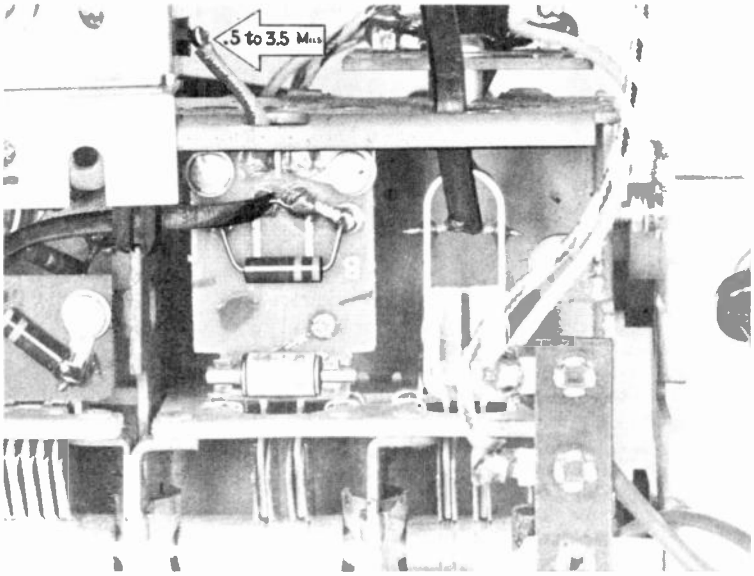
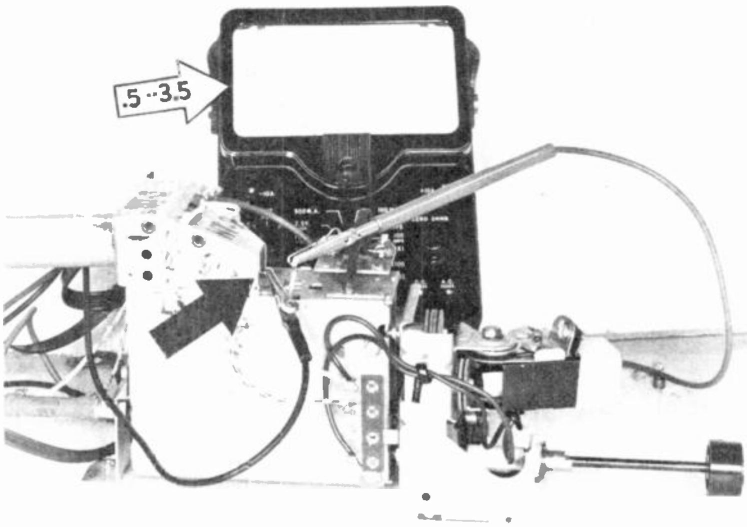


FIGURE 10. UHF Test Equipment Connections



▲ FIGURE 12. Mixer Test Point



▲ FIGURE 13. Current Check at Mixer Test Point

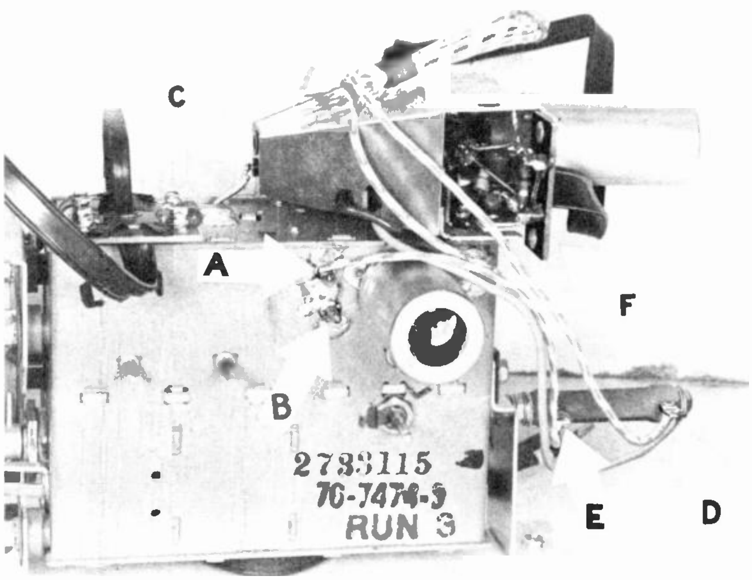
point the lead from the test point should be removed and the meter is then connected from the end of the lead in series to the test point, as shown in figure 13. If the crystal is defective, no current will be obtained and substitution of the crystal should be made.

In figure 14, all of the converter test points are indicated by the lettered arrows.

These will be similar for the UHF tuner with the exception that the preamplifier will be absent. All of the test points are externally located for easy accessibility. Arrow "A" indicates the check point for the oscillator plate current, and at arrow "B" is located the oscillator grid current check point. Both check points will be discussed further in this article. At arrow "C" is the crystal mixer test point which was described earlier.

The test point indicated by arrow "F" is the pre-amplifier plate voltage check point. The plate voltage should be approximately 220 volts at the test point.

The B plus resistor mounted on the rear of the chassis in some units and on the front of others also contains two test points as indicated at arrows "D" and "E". At the test point indicated by arrow "D", which is the B plus side of the resistor, the voltage should



▲ FIGURE 14. Converter Test Points

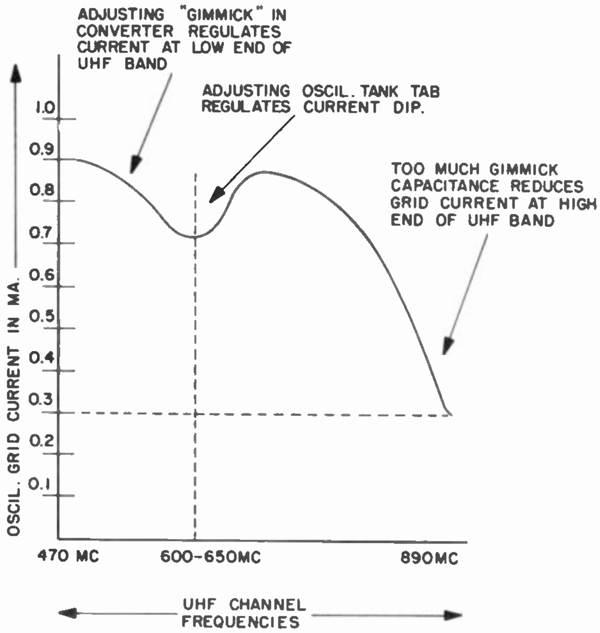


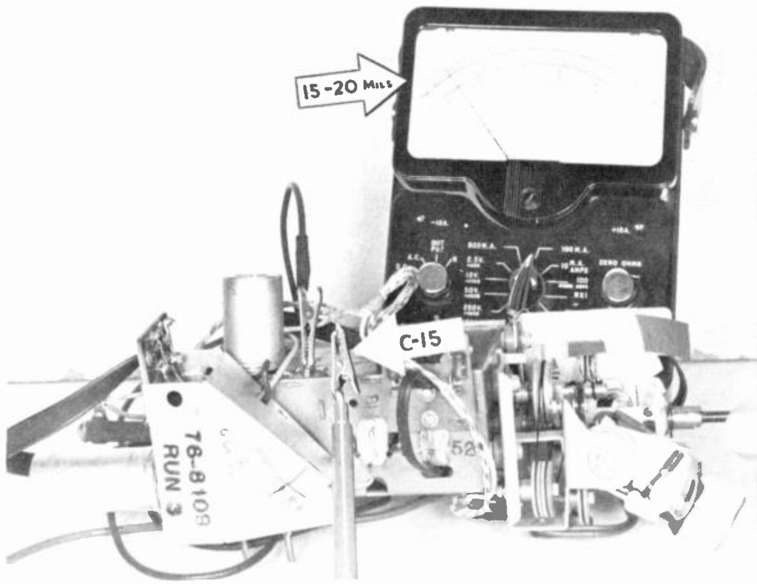
FIGURE 15. Oscillator Grid Current

be approximately 250 volts. On the side feeding into the converter, indicated by arrow "E", the voltage should be approximately 75 to 80 volts.

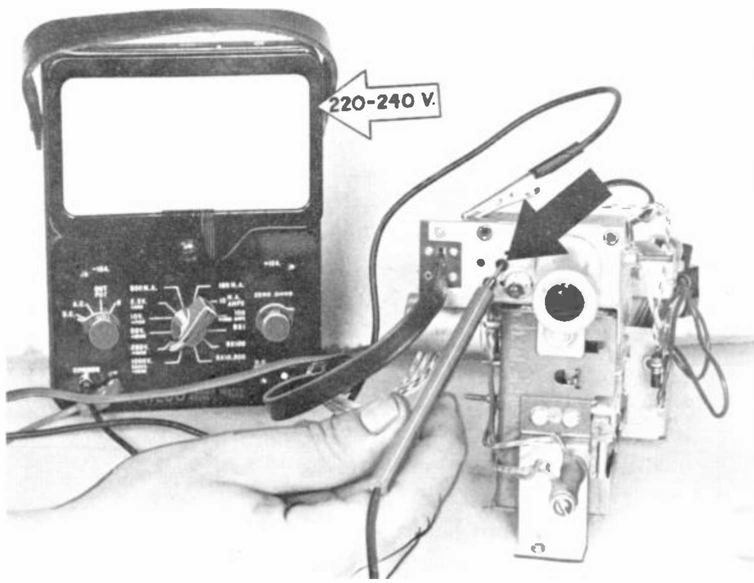
After the tubes and the crystal have been checked, the technician should then proceed to the remaining test points.

The first step is to check the oscillator grid current at the test point indicated by arrow "B" in figure 14. In the service manuals this check point is symbolized as C12 or test point J-1. Unsolder and lift off the small ground wire and connect the test leads between the test point and ground. The current reading should not be below .25 Ma. The grid current graph in figure 15, illustrates the grid current curve at the various UHF channel frequencies. In the factory, the grid current dip between 600 and 650 megacycles is regulated by the oscillator tank tab, or the flat metal portion of the tank assembly which is parallel to the side of the chassis. Bending the tab slightly increases or decreases the capacitance and the tab is adjusted for best grid current at this point. This tab adjustment is the same in the converters and tuners, however, in the converters an additional adjustment is available. The "gimmick" or pair of twisted wires from the oscillator tank to the oscillator tube socket is adjusted to regulate the grid current at the low frequency end of the UHF band, and this adjustment must be carefully performed since too much capacitance or too many twists of the leads will reduce current at the high end of the band. These adjustments are very critical and under no circumstances should the technician attempt to perform the adjustments without adequate test equipment. When replacing a defective oscillator tube the technician should try a number of tubes and select that one which more closely approximates in

▼ FIGURE 16. Oscillator Plate Current Test



▼ FIGURE 17. Preamplifier Test Point



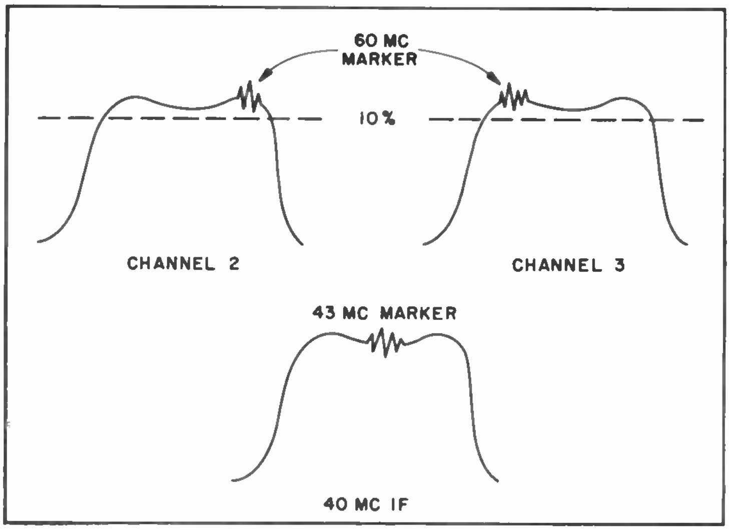
performance the original tube. Thus the need for any oscillator adjustments will be eliminated.

The oscillator plate current may be checked at a point located close to the oscillator grid current test point and is symbolized in the service manuals as C15 which is a small feed through condenser of 500 uuf. Referring again to figure 14, this test point is indicated by arrow "A".

Unsolder the lead from the condenser and insert the ammeter in series as shown in figure 16. The current reading should be between 15 and 20 ma.

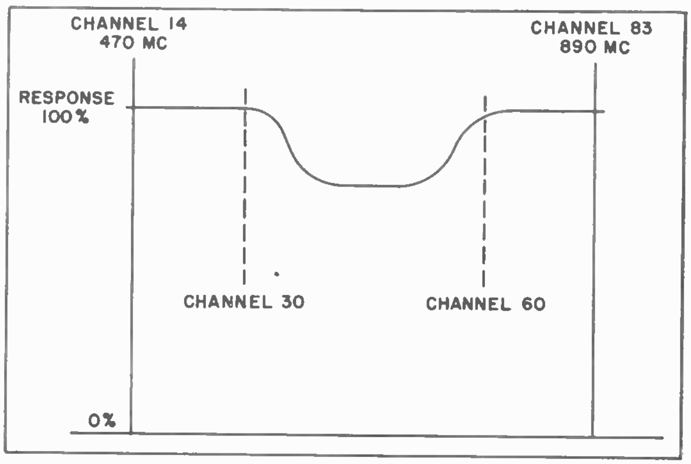
The operation of the preamplifier is the next step to be considered. The test point for the preamplifier stage is symbolized as J3 in the service manuals, and is the plate voltage reading of the output stage of the preamplifier. The voltage value at the check point should be between 220 to 240 volts. The method of connecting the voltmeter is shown in figure 17, with the meter leads connected from the test point to ground. It may be noted that a second test point is located close to test point J3 on some preamplifiers, however, it is intended for use only during production. In general the preamplifiers on the converters with channel 2 or 3 output will have the second test point while those used on the tuners with a 40 megacycle IF output will not. The UHF tuners ordinarily do not have a preamplifier with the exception of the UHF tuner used on the TV-190 series chassis which does employ a preamplifier. This UHF tuner is the model UT-22.

At the VHF tuner test point on the television chassis and with the test equipment set up as previously described in the beginning of this article, the overall response of the UHF unit can be checked. The response curves of a converter with channel 2 or 3 output and of a tuner with a 40 megacycle IF output, showing the marker frequency positions, is illustrated in figure 18. As may be noted, the 60 megacycle marker is on the high side of the curve for channel 2 and on the low side of the curve for channel 3, but in neither case is it below the top 10 percent portion of the curve. In the case of the 40 megacycle IF output of the tuner the marker is at 43 Mc in the center of the curve. This relationship should exist throughout the entire band of the UHF channels. It may be noted when tuning through the entire UHF band that a response drop occurs approximately between channels 30 to 60, see figure 19. This effect does not indicate trouble in the unit but is due to characteristics of the test equipment and UHF units, plus the effects of the lead terminating impedances. If the response curves of the UHF units do not correspond to the figures illustrated, the technician should not attempt to align the unit but should return the unit to the Philco Distributor for service. This procedure should also be followed by the technician for any services to the unit other than the replacement of tubes or of the mixer crystal.



▲ FIGURE 18. Position of Marker Frequencies

▼ FIGURE 19



OVEN COOKING

FIGURE 1

The automatically controlled ovens in all Philco Ranges are built to proportions that permit the best heat circulation. The thermostats are made to maintain constant uniform temperatures. The heating units are designed with the proper wattage to supply the necessary heat for all over operations, and also fast pre-heating. When the above components are properly assembled, perfect baking and oven cooking results should be obtained.

The Banquet Oven has two racks and when both are used for baking cakes or pies, arrange the racks and pans so that no pan will be directly over another and also allow room on all sides for free circulation of baking heat. When using only one rack, place the straight rack in No. 2 position guides. The same applies to the Thrift and monounit ovens except they have a single offset rack which can be installed either up or down as needed. When using a single pan it should be placed in the center of the rack. Two pans should be placed in diagonal corners of the rack, but not touching the sides of the oven or each other. (Fig. 1.)

It is not necessary to pre-heat the oven before placing a roast in it. Results from time and temperature guides will be about the same for starting with a hot or cold oven. It is not necessary to cover a roast as the moist, controlled heat will roast them to a delicious flavor without adding any water.

The baking of breads, cakes, cookies and pastries, however, need somewhat more accurate oven temperatures and circulation than for roasting operations. They require a pre-heated oven and proper placement of the oven racks and baking pans. Incorrect temperature or a poor door adjustment can cause cakes to bake unevenly or not brown properly.

CHECKING BAKING FAILURES

Printed time and temperature charts in recipe books try to strike a general average to cover all tastes and local conditions. Some people like well browned baking and some prefer lightly done baking. In higher altitudes the directions published by the Colorado A & M College should be followed. In other words, most users will soon get to know the temperature and baking time to best suit their tastes.

When a complaint of over done, burning, or too fast baking occurs, it is obvious the oven is too hot and the thermostat is either defective or needs recalibration. In this case place a thermometer on the center of an oven rack and have the rack in No. 2 guides. A reliable mercury thermometer, such as a Taylor, should be placed so an instantaneous reading can be made when the door is quickly opened. (Fig. 2.)

If a thermo-couple with meter, like those manufactured by Philco of J.B.T. Inst. Co., is used, attach the clip to center of rack and arrange the lead wires under the door so the door closes tightly. Turn the thermostat to 350° and WAIT UNTIL IT CYCLES THREE TIMES, so that the oven is saturated with heat, and a true reading can be obtained. The temperature will drop rapidly once the door is opened, so with a mercury thermometer a quick reading is absolutely necessary. A flashlight will help to get this quick reading.

If the temperature is found to be too high, make the necessary adjustment to the thermostat to recalibrate it. The simplest way is to turn it to "off" position, pull off the dial and loosen the two set screws about one turn. Then grasp the calibration plate and rotate (the plate only counterclockwise to lower the temperature. The plate has a stamped "R" with arrow for raise and an "L" with arrow for lower. Each calibration line represents about 25 degrees of temperature. After adjusting the thermostat the oven should be checked again to see

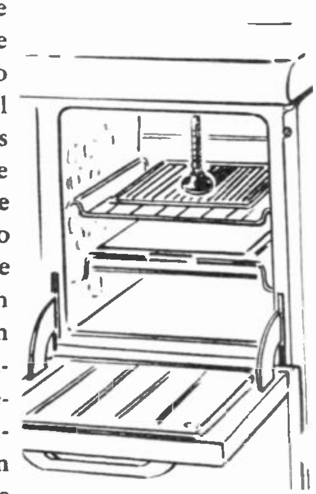


FIGURE 2

if the temperature is correct and will hold the correct setting. If the thermostat won't respond to adjustment or won't hold its position, it should be replaced.

The foregoing instructions cover the adjustment to raise or lower the dial setting, to correspond with the actual oven temperature as shown by a thermometer reading in the oven, but will not change the differential setting. For example, a thermostat set at 400° and erroneously holding an average temperature of 375° by cycling on and off from 370° to 380° can be corrected by moving the calibration plate one division to the right. After making the correction, the thermostat should cycle off at approximately 405° and on at 395° giving an average oven temperature of 400°, but still holding the same 10-degree differential.

The amplitude or differential of the thermostat is the difference in degrees between the "cut in" and "cut off" temperatures. This differential may vary from 10° to 25° and should extend both above and below the temperature at which the thermostat dial is set. A thermostat holding an average temperature of 350° may turn off at 358° and on at 343° which gives a differential of 15°. The differential adjustment is inaccessible without disassembling the thermostat and is too critical to attempt adjusting in the field.

On complaints of not browning, under done or long baking periods, the trouble could be either low temperature or an improper fitting door. As too low temperature is most likely to be the cause of the trouble, it is recommended the thermostat be checked first before inspecting the latch spring assembly and fit of the oven door. Use the same procedure to check the thermostat setting against the actual oven temperature as previously given. Again be sure to allow enough cycles or time for the oven heat to settle down and then take the thermometer reading. If temperature is found to be low, recalibrate thermostat higher by rotating the calibration plate clockwise to raise the temperature the amount required.

If the temperature is found to be correct, the oven door should be checked. The door or oven may be out of adjustment so that while the door closes properly with a cold oven, it tips slightly open due to expansion, when the oven is heated. When this occurs, there may be enough heat loss to slow up the baking. If the bottom flange of the oven liner presses against the bottom of the door, it will tip the door slightly open at the top. To check for bottom clearance proceed as follows:

1. *Heat oven to 450 degrees or more.*
2. *Open door and insert a narrow strip of wrapping paper up between the bottom of the door and the lower oven liner flange.*
3. *With door snugly closed, determine if the paper will slide freely from hinge to hinge.* (Fig. 3.)

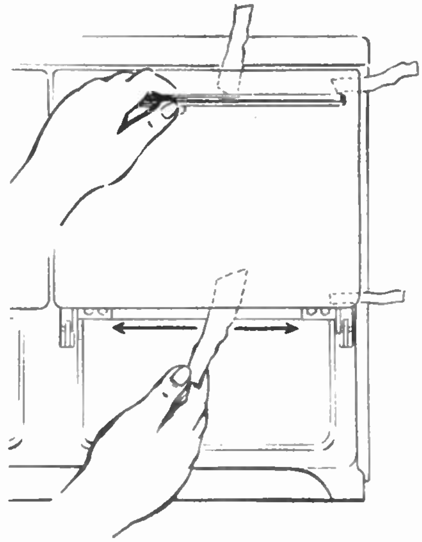


FIGURE 3

If the paper binds at any point, the oven liner should be first checked for position. Move range out from wall and feel tension on the four oven hook bolts. The two bottom ones should be drawn up fairly tight and the top ones enough to take up any slack. If this does not provide proper door clearance, then the door should be moved out by shimming the hinge brackets.

Figure 4 shows a door shim and how it is installed under a hinge support bracket. Before doing this operation, it is necessary to remove the oven door by unhooking the two coil springs under the oven, after first removing the storage drawer. Whether one or

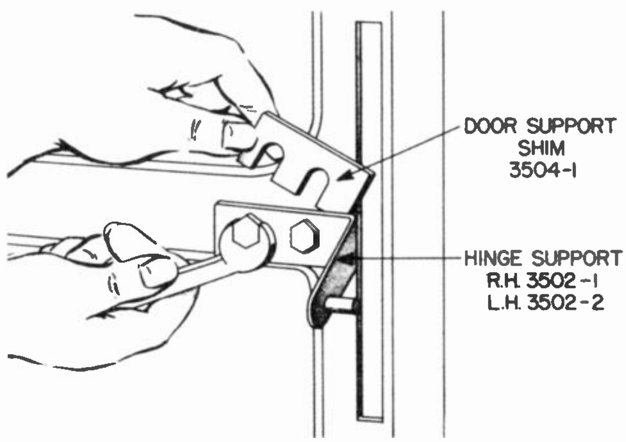
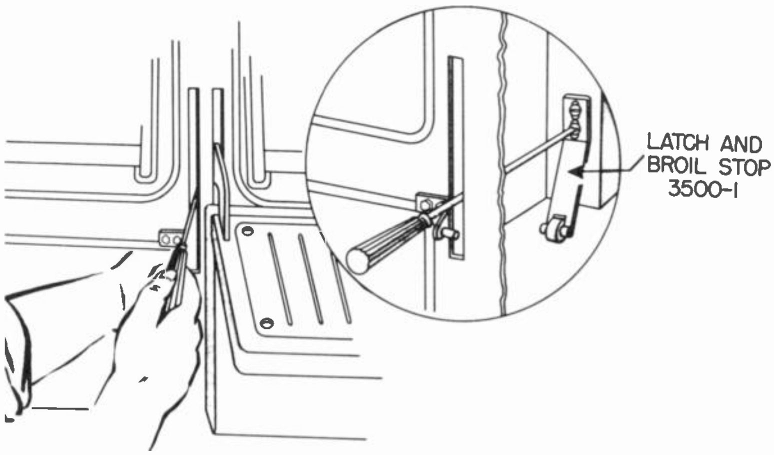
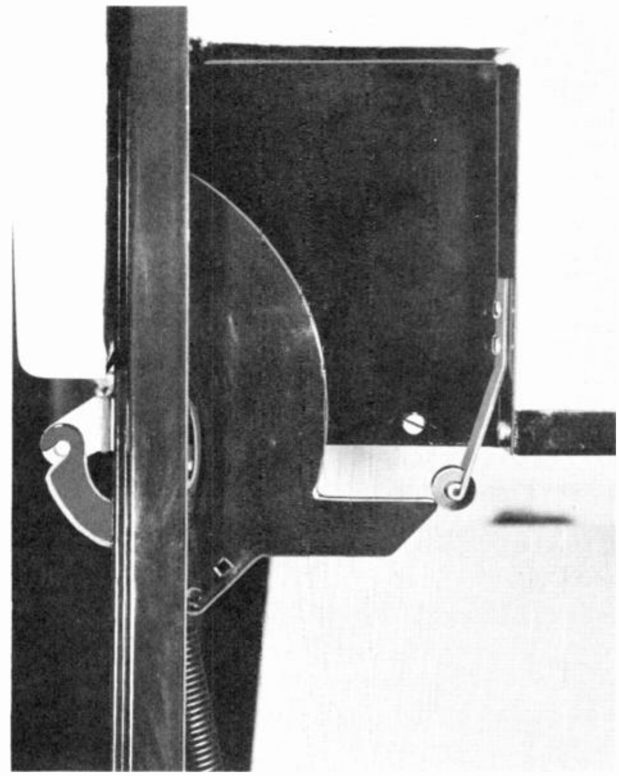


FIGURE 4



◄ FIGURE 6

▼ FIGURE 5



both hinge brackets require shimming can be determined by the fit of the door. If the lack of clearance extends across the door, shim both hinges. Where paper test shows binding near one hinge, then try shimming that side only.

After shimming door brackets, the door latch springs should always be checked. The purpose of these door latch and broil stop assemblies #171651 is to hold the door in the closed position under spring tension as shown in figure 5. They also act as a broil stop when the door is tilted open. Besides the two roller latch springs, each door also has two coil springs and their purpose is to balance the door from the broil position to full open position. In addition they exert a tension on the door bearings by holding the hinge slots in position on the bracket pins. They have a threaded hook bolt at the bottom to adjust the tension for balancing the door so it won't drop open too quickly or swing shut with a bang. No adjustment of these coil springs will affect the closed position of the door. This function is accomplished only by the latch springs.

Figure 5 shows the right hand latch spring roller in the correct position. The upper curved section of the hinge tip should be a few degrees below the center of the roller. It can be seen from the picture that if the door was moved out by two or more shims, the hinge tip would also move and the tension thereby lessened on the spring roller. The latch assembly has slotted mounting holes and can be adjusted up or down for proper tension on the hinge.

The position and tension of these latch springs can be checked by removing the storage drawer, reaching up under the oven and turning the roller. On a properly adjusted assembly, the roller will rub or drag quite snugly when rotated against the hinge tip.

If adjustment is needed, procure a long shank screwdriver and proceed as follows: (See figure 6)

1. *Unhook the two door coil springs.*
2. *Lift door off hinge pins and remove door.*
3. *Insert screwdriver through hinge slot and loosen one screw.*
4. *Grasp roller with one hand and apply screwdriver to other screw.*
5. *Adjust and re-tighten latch assembly as determined by the previously described check.*

Re-mount the door and again check the roller for proper tension. The right roller can be visually inspected on any model by merely removing the right side panel. On all single oven models the left roller can be inspected by removing the hinge cover in the storage compartment.

Air Conditioning TERMINOLOGY

Every serviceman wants to improve himself and have the satisfaction of knowing he is getting on in his line of work. One way of realizing this goal is to know the product well enough to be able to thoroughly explain any phase of it to the customer.

There are numerous terms in Air Conditioning with which the serviceman should be thoroughly familiar. At times questions will be brought forth by a dealer or customer which may be intelligently answered by a few of these terms.

A

ABSOLUTE ZERO—the zero point on the absolute temperature scale, 459.7 degrees below the zero of the Fahrenheit scale, 273.16 degrees below zero on the Centigrade scale.

ABSORBENT—a material which has the ability to take up water vapor or some other vapor but which changes chemically, physically or both, during the cycle. Calcium chloride is an example of a solid-liquid material, while liquid materials include solutions of lithium chloride, lithium bromide and the ethylene glycols.

AIR CLEANER—A device designed for the purpose of removing airborne impurities such as dusts, gases, vapors, fumes and smokes. (Air cleaners include air washers, air filters, electrostatic precipitators and charcoal filters.)

AIR CONDITIONING—The simultaneous control of all, or at least the first three, of those factors affecting both the physical and chemical conditions of the atmosphere within any structure. These factors include temperature, humidity, motion, distribution, dust, bacteria, odors and toxic gases, most of which affect in greater or lesser degree human health or comfort.

AIR CONDITIONING UNIT—an assembly of equipment for the control of at least the first three items enumerated in the definition of air conditioning.

AMBIENT AIR—generally speaking, the air surrounding an object. In a domestic or commercial refrigerating system having an air cooled condenser, the temperature of the air entering the condenser.

ATMOSPHERIC PRESSURE—The pressure due to the weight of the atmosphere. It is the pressure indicated by a barometer. Standard Atmospheric Pressure of Standard Atmosphere is the pressure of 76 cm of mercury having a density of 13.5951 grams per cu cm, under standard gravity of 980.665 cm per (sec) (sec). It is equivalent to 14.696 lb psi or 29.921 in. of mercury at 32 F.

B

BAROMETER—instrument for measuring atmospheric pressure.

BIMETALLIC ELEMENT—one formed of 2 metals having different coefficients of thermal expansion, used as a temperature control device.

BLOWER—enclosed fan device of low-pressure used to impart motion to air.

BOILING POINT—the temperature at which a liquid vaporizes upon the addition of heat, dependent upon the absolute pressure at the liquid-vapor surface.

BRITISH THERMAL UNIT (BTU)—heat required to produce a temperature rise of 1 degree Fahrenheit in 1 lb of water. Strictly, 1 Btu=251.996 I.T. calories, where the I.T. calorie is 1/860 kilowatt hour. The mean Btu is 1/180 of the energy required to heat water from 32 deg F to 212 deg F.

C

CAPACITY—of a refrigerating compressor is the refrigerating effect in Btu per hour produced by the change in total enthalpy between the refrigerant liquid at a temperature corresponding to the pressure of the vapor leaving the compressor and the total enthalpy of the refrigerant vapor entering the compressor per hour. Of a condensing unit, the refrigerating effect in Btu per hour produced by the change in total enthalpy of refrigerant liquid leaving the unit and the total enthalpy of the refrigerant vapor entering the unit. Generally measured in tons per day or Btu per hour.

CAPILLARY TUBE—a vapor lock device comprising a tube of small ID; also a small diameter tube connecting a thermostatic bulb with the bellows or diaphragm of a control device.

CENTIGRADE—thermometric system in which the freezing point of water is called 0° and its boiling point 100° at normal atmospheric pressure (14.696 psi).

CHANGE OF STATE—change from one phase, such as solid, liquid, or gas, to another.

CHARGE—amount of refrigerant in a system; charging, putting in charge.

CLOSED CYCLE—any cycle in which the primary medium is always enclosed and repeats the same sequence of events.

COMFORT AIR CONDITIONING—the simultaneous control of all, or at least the first three, of the following factors affecting the physical and chemical conditions of the atmosphere within a structure for the purpose of human comfort; temperature, humidity, motion, distribution, dust, bacteria, odors, toxic gases and ionization, most of which affect in greater or lesser degree human health or comfort.

COMFORT ZONE—(average) the range of effective temperatures over which the majority (50% or more) of adults feel comfortable. (Extreme) The range of effective temperatures over which one or more adults feel comfortable.

CONDENSATE—The liquid formed by condensation of a vapor. In steam heating, water condensed from steam; in air conditioning, water extracted from air, as by condensation on the cooling coil of a refrigeration machine.

CONDENSER (liquefier) a vessel or arrangement of pipe or tubing in which the vaporized (and compressed) refrigerant is liquefied by removal of heat.

CONDENSATION—The process of changing a vapor into liquid by the extraction of heat. Condensation of steam or water vapor is effected in either steam condensers or in dehumidifying coils and the resulting water is called condensate.

CONDUCTOR, THERMAL—A material which readily transmits heat by means of conduction.

CONVECTION—transfer of heat by movement of fluid containing thermal energy.

CYCLE—complete course of operation of refrigerant back to a starting point, measured in thermodynamic terms (functions); also used in general for any repeated process or any system.

D

DEHUMIDIFICATION—the condensation of water vapor from air by cooling below the dew point or removal of water vapor from air by chemical or physical methods.

DEW POINT—temperature at which condensation starts if moist air is cooled at constant pressure with no loss or gain of moisture during the cooling process.

DIRECT METHOD OF REFRIGERATION—a system in which the evaporator is in direct contact with the material or space refrigerated or is located in air circulating passage communicating with such spaces.

DRIER—a chemical compound capable of absorbing, or reacting chemically with the moisture contained in the liquid or gaseous refrigerant-oil mixture.

DRY BULB—temperature, temperature by ordinary thermometer (term used only to distinguish from wet-bulb temperature).

E

ENTHALPY—a thermodynamic property of a substance defined $h = u + Pv/J$ where u=internal energy, customarily in Btu per lb; P=pressure in lb per sq ft; and v is specific volume in cu ft per lb. $J = 788$ ft lb per Btu. Also called total heat or heat content.

ENTROPY—entropy is the ratio of the heat added to a substance to the absolute temperature at which it is added for a reversible process. It is a thermodynamic property which, for practical purposes, is best defined by stating its principal functions: (1) during a reversible adiabatic change of state, entropy is constant; (2) during a reversible isothermal change of state, the heat absorbed is equal to absolute temperature times change of entropy.

EVAPORATION—change of state from liquid to vapor.

EVAPORATOR—that part of a system in which refrigerant is vaporized to produce refrigeration.

F

FAHRENHEIT—a thermometric system in which 32° denotes freezing and 212° the boiling point of water under normal pressure at sea level (14.696 psi).

FLARE FITTING—a type of soft-tube connector which involves the flaring of the tube to provide a mechanical seal.

FREON—12—the trade name for dichlorodi-fluoromethane (CCl_2F_2), also called F-12.

H

HEAT OF CONDENSATION—latent heat given up in changing from gas to liquid.

HEAT EXCHANGER—apparatus in which heat is exchanged from one fluid to another through a partition.

HEAT, LATENT—heat characterized by a change of state of the substance concerned, for a given pressure and always at a constant temperature for a pure substance, i.e., heat of vaporization or of fusion.

HERMETICALLY-SEALED UNIT—a sealed (hermetic-type) condensing unit is a mechanical condensing unit in which the compressor and compressor motor are enclosed in the same housing, with no external shaft or shaft seal, the compressor motor operating in the refrigerant atmosphere. The compressor and compressor motor housing may be of either the fully-welded type, or brazed type, or of the service-sealed type. In the fully-welded or brazed type, the housing is permanently sealed and is not provided with means of access for servicing internal parts in the field. In the service-sealed type, the housing is provided with some means of access for servicing internal parts in the field.

HORSEPOWER—unit of power in foot-pound-second system, work done at the rate of 550 ft lb per sec, or 33,000 ft lb per min.

HUMIDITY—Water vapor within a given space.

HUMIDITY, RELATIVE—the ratio of the partial pressure of water vapor in the air to the pressure of saturated water vapor at the temperature of the air. This is closely equivalent at temperatures below 150° F to a more rigorous definition—the ratio of density of water vapor in the air to the density of saturated water vapor at the air temperature.

I

INFILTRATION—air flowing inward as through a wall, leak, etc.

K

"K" FACTOR—thermal conductivity; the amount of heat expressed in Btu transmitted in one hour through 1 sq ft of a homogeneous material 1 in. thick for a difference in temperature of 1 deg F between the two sides of the material. The conductivity of any material depends on the structure of the material and its density. Heavy or dense materials, the weight of which per cubic foot is high, usually transmit more heat than light or less dense materials, the weight of which per cubic foot is low.

L

LATENT HEAT—change of enthalpy during a change of state usually expressed in Btu per lb. With pure substances, latent heat is absorbed or rejected at constant temperature at any pressure.

LIQUID LINE—the tube or pipe carrying the refrigerant liquid from the condenser or receiver of a refrigerating system to a pressure-reducing device.

LOW SIDE—parts of a refrigerating system under evaporator pressure.

O

OUTSIDE AIR—external air, atmosphere exterior to refrigerated or conditioned space, ambient (surrounding air).

P

POWER—the rate of doing work usually expressed in horsepower, kilowatts, etc.

PRESSURE—Force per unit area. Common units are pounds per square inch, gram per square centimeter inch of water, millimeter of mercury.

PSYCHROMETER—instrument for measuring relative humidities by means of wet and dry-bulb temperatures.

R

RADIATION—the transmission of heat through space by wave motion. The passage of heat from one object to another without warming the space between.

RECIRCULATED AIR—return air passed through the conditioner before being again supplied to the conditioned space.

REFRIGERANT—the medium of heat transfer in a refrigerating system which picks up heat by evaporating at a low temperature and pressure and gives up heat on condensing at a higher temperature and pressure.

REFRIGERATING SYSTEM—a combination of interconnected refrigerant—containing parts in which a refrigerant is circulated for the purpose of extracting heat.

RETURN AIR—air returned from conditioned or refrigerated space.

ROOM AIR CONDITIONER—air conditioning element for a room, self-contained system for conditioning atmosphere for comfort.

S

SENSIBLE HEAT—heat which is associated with a change in temperature; specific heat exchange of temperature; in contrast to a heat interchange in which a change of state (latent heat) occurs.

SPECIFIC HEAT—energy per unit of mass required to produce one degree rise in temperature, usually Btu per lb deg F numerically equal to cal per gram deg C.

SUCTION LINE—tube or pipe which carries the refrigerant vapor from the evaporator to the compressor inlet.

SWEATING—condensation of moisture from air on a surface which is below the dew-point temperature.

T

THERMAL CONDUCTIVITY—the ability of a material to transmit heat from one point in the material to another. Indicated in terms of Btu per hr sq ft deg F per in. of thickness.

THERMOMETER—instrument for measuring temperature.

TON OF REFRIGERATION—a rate of heat interchange of 12,000 Btu per hour; 200 Btu per min.

TON-DAY OF REFRIGERATION—the heat removed by a ton of refrigeration operating for a day, 288,000 Btu. Approximately equal to the latent heat of fusion or melting of 1 ton (2000 Lb) of ice.

V

VELOCITY—the time rate of motion of a body in a fixed direction. In the fps system it is expressed in units of feet per second.

VENTILATION—the process of supplying or removing air by natural or mechanical means, to or from any space. Such air may or may not have been conditioned.

VOLATILE LIQUID—one which evaporates readily at atmospheric pressure and room temperatures.

W

WINDOW UNIT—self-contained room cooler arranged to be supported in or connected with a window opening, circulating outside air over the high side and room air over the low side.

FROM THE FOREGONE TERMS WE CAN READILY ANSWER SUCH QUESTIONS AS:

What is a BTU?

BTU is the abbreviation of British Thermal Unit and is an arbitrary quantity of heat, just as the foot and the inch are man-made units. A simple definition of a BTU is that it represents the amount of heat required to raise the temperature of one pound of water, one degree Fahrenheit.

What is meant by BTU PER HOUR?

An expression involving a definite number of BTU'S such as 4,000 BTU, means a certain quantity of heat, whereas the expression 4,000 BTU per hour means a certain specified rate of heat transmission from one material to the other, or from one place to another.

Why are BTU'S, which are a measure of heat, used to express the cooling or refrigerating capacity of an air conditioner?

Cold is merely the absence of heat. The only way the cooling capacity of a unit can be expressed is to state the amount of *heat* which the unit is capable of removing from the air in a given length of time.

It is a standard practice to use one hour as the length of time with the result that the cooling effect of an air conditioner, for example, is expressed as "10,000 BTU per hour or 10,000 BTU/hr".

What is meant by a "TON OF COOLING" or a "TON OF REFRIGERATION"?

When one ton (2000 pounds) of 32°F. ice melts, it removes 288,000 BTU's from its surroundings. This is true regardless of the time it takes for the ice to melt.

It has been arbitrarily established in the refrigeration industry that when an air conditioner is a "1 ton unit" or has the "capacity of 1 ton", it means that such a unit is capable under certain operating conditions of extracting 288,000 BTU's from the air in 24 hours.

The conventional method of expressing the cooling capacity of air conditioners is to use one hour instead of twenty-four as the time basis. Therefore, an air conditioner having one ton cooling capacity is expressed as a 12,000 BTU per hour unit, which is 1/24th of 288,000. Similarly, the cooling capacity of a ½ ton unit is expressed as a 6,000 BTU/hr. unit.

What is DRY BULB Temperature?

(expressed 80°F. db. . . . meaning 80 degrees Fahrenheit—dry bulb)

The dry bulb temperature is the true temperature of the air as determined by an ordinary thermometer. It does not, however, accurately indicate a person's feeling of warmth. If the humidity is high, a person will feel warmer at the same dry bulb temperature than he will if the humidity is low. It, therefore, follows that another factor is needed to measure temperature for human comfort. We then should ask . . .

What is WET BULB Temperature?

(expressed 80°F. wb . . . meaning 80 degrees Fahrenheit—wet bulb)

The wet bulb temperature is *not* the temperature of the air, but that which a thoroughly wet material will attain if the air passes over it for a sufficient length of time and with a sufficiently high velocity. A so-called wet bulb thermometer is used to measure this temperature, the bulb of the thermometer being covered with a closely fitting cotton tubing thoroughly wet with distilled water.

Since a cooling effect is created by the evaporation of water, the wet bulb temperature depends on the rate of evaporation from the wet tubing on the thermometer bulb. The wet bulb temperature is generally below the dry bulb temperature. It can never be above.

When a person whose body is wet with perspiration is subjected to air in motion at a given dry and wet bulb temperature, he will feel cooler than he would in still air at the same temperature approached the wet bulb temperature of the air. Comfort conditions then would appear to depend not only on temperature. We should then ask . . .

What is RELATIVE HUMIDITY?

When the air holds all the water vapor it can at a given temperature, the air is said to be saturated or at 100% relative humidity. Under such conditions, the wet and dry bulb thermometers would show the same temperature because no water could evaporate from the wet bulb wick into the air. For example, if the air contains only one-half the amount of water vapor it can hold at some given temperature, the relative humidity is said to be 50%. In other words, the humidity is based on, or is "relative" to, the maximum amount of water vapor the air *could* hold at that temperature.

WHAT is DEW POINT?

As air containing a given amount of water is cooled, without adding or subtracting any water vapor, the air will eventually reach a temperature where some of the water vapor will start to condense out . . . this is called the dew point temperature. When a cloud is cooled to its dew point temperature, rain is formed by the water vapor which the cloud can no longer hold in vapor form. At this condition, the air is said to be saturated or is at 100% humidity and its dry bulb, wet bulb and dew point temperatures all have the same value.

Accepted that an air conditioner is basically the same as a mechanical refrigerating unit, why doesn't it freeze ice on the evaporator?

In designing an air conditioner, the size of the evaporator or its heat absorbing capacity (in combination with the desired amount of air flow through it) is *selected* to balance the cooling capacity of the motor compressor unit *at an evaporator temperature above freezing.*

The evaporator of an air conditioner *will* collect frost and even ice under certain conditions. First of all, if the filter becomes sufficiently clogged with dirt as to substantially reduce the air flow through the evaporator, the reduction in air flow will reduce the heat load on the evaporator with the result that the refrigerant pressure and, therefore, temperature will fall below the freezing point. Secondly, if the air conditioner is operated when the outdoor temperature is very low, such as below about 70° F., the condensing pressure will fall considerably below normal. This reduced condensing pressure will reduce the load on the compressor and slow down the flow of refrigerant, causing the evaporator to frost.

If the air in passing through the evaporator is cooled to say 60°F. why doesn't the room get that cold?

The air rising from the top of a steam radiator may be as high as 130°F. but, as everyone knows, the room never gets that hot. By the same token, if 60°F. air is flowing from the conditioned air outlet grilles of an air conditioner, it will not reduce the temperature of the air throughout the room to 60°F.

Heat flows through the walls and window glass into the room at a certain rate, depending on the difference between the temperature outside and inside the room. Heat from occupants, lights and appliances add to this heat load in the room.

Assuming that the air outside the room is 95°F. and the air leaving the unit is 60°F., a unit of the proper capacity should maintain about 80°F. average room temperature, and a relative humidity of about 50%. Of course, if a larger sized unit were installed than is necessary to provide comfort during hot weather, the unit could cool the room air to a value closer to the temperature of the conditioned air supplied by the unit. It would require an extremely large unit with correspondingly large air handling capacity to reduce the room temperature within a degree or two of the temperature of the air leaving the unit.

How wide should the fresh air damper be opened?

A brief answer to this question is that it should be opened as wide as possible without causing the room temperature and/or humidity to rise sufficiently to result in a feeling of discomfort.

Ordinarily, when the air conditioner is operated on "cooling", the amount that the fresh air damper should be opened depends upon the number of people in the room and upon the outdoor temperature and/or humidity. Obviously, the greater number of occupants, the more ventilation air is required. Also, as the outdoor temperature and/or humidity drops, the fresh air damper can and should be opened wider.

Except in cases where it is desired to cool off a hot room as rapidly as possible, the fresh air damper should be adjusted in some open position. In addition to the need for a constant flow of ventilation air into the room to keep the air fresh and healthy, the continual introduction of outdoor air through the unit and into the room eliminates, or at least reduces, the amount of unfiltered air that would otherwise enter the room through the cracks under the doors or around the windows.

refrigerator cabinet CONSTRUCTION

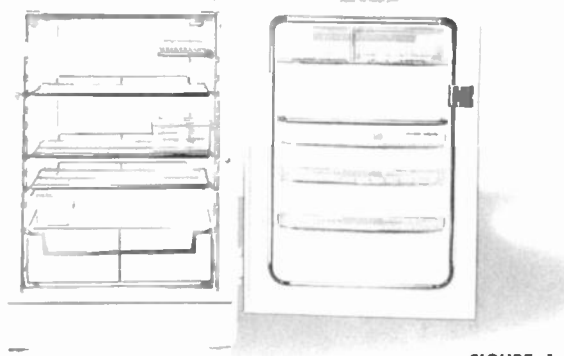


FIGURE 1

An understanding of refrigerator cabinet construction and the design features involved in building the modern Philco Refrigerator (figure 1) is a great aid in diagnosing trouble in the refrigerator. It is of utmost importance to have a clear understanding of the nature of the various parts and their function in the refrigerator to know how it operates.

To build a refrigerator that will store perishable foods between temperatures of 32 to 40°F. and maintain frozen food temperatures in the evaporator, near zero degrees, many factors must be taken into consideration.

The refrigerator must be of durable construction and be capable of securing satisfactory economical operating conditions.

This type of refrigerator is made up with an external shell or cabinet (figure 2) of heavy gauge, die formed, cold rolled steel with bottom and back panel firmly welded to it to provide tight seams and rigid construction. The door panel is of one piece die stamped, cold rolled steel of the same gauge metal as used in the cabinet.

These metal components are then cleaned and given a Phosphate coating which acts as a bonderizer for the protective enamel. All exterior surfaces are then painted with an oil primer which is then baked. A finish coat of white enamel is then applied and again baked to give a durable finish. All internal seams of the cabinet are then sealed from the inside with permagum and Hydrelene to make doubly sure that there will be no air leakage through the seams of the cabinet.

The food compartment liner assembly (figure 3) is die formed of heavy gauge vitreous enameling stock. The liner is thoroughly cleaned and then given a ground coat of colored porcelain by a dipping process. This ground coat is then baked at a temperature of approximately 1400° F. A white enamel finish coat is then sprayed on the interior portion of the liner after which it is fired in an oven to give the liner a gleaming white titanium procelain finish.

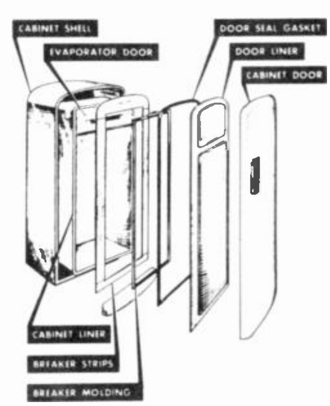
The process by which this porcelain is manufactured is quite interesting.

Specially prepared glass in the form of frit is poured in huge cylindrical vats. These vats are lined with 3 inches of porcelain blocks and filled with 2½ inch porcelain balls that take up 55% of the interior space. Porcelain is used, as steel or other metals might be ground off by the glass frit. The vats revolve at the speed of about 24 revolutions per minute for 3 or 4 hours and grind the glass frit into a very fine powder. Magnets later separate any particles of metal that might have accumulated in the material.

Water and a special clay preparation together with titanium oxide powder are added that turn the mixture into a white paste. The clay is added for the purpose of suspending the powdered frit in the solution otherwise the glass particles would drop to the bottom. The titanium finish is now ready to be applied. The gleaming white titanium porcelain is sprayed into the interior of the cabinet after the cabinet is dipped a black ground coat and then baked in an oven at approximately 1400°F. The ground coat acts as a bonding agent and is necessary so that the titanium coat will adhere properly to the cabinet.

The first and greatest advantage of Philco's titanium porcelain finish is the fact that it is completely im-

FIGURE 2



pervious to lactic acids as found in sour milk and various vegetable juices. It is also practically impervious to the citric acids contained in lemons, oranges, grapefruits, tomatoes and other fruits.

The mechanical structure of the modern refrigerator consists of an outer cabinet shell and an inner metal tank. The space between these two components is filled with insulation which consists of any material that will retard heat flow. Mineral wool and fiberglass are used exclusively in domestic refrigerators to retard the inward flow of heat. Both of these products are well suited for this purpose, because each has the following requirements for a good heat insulator:

1. Conducts heat slowly.
2. Has good handling characteristics.
3. Has high resistance to decay.
4. Has no odor absorption.
5. Has the ability to retain its volume dimensions.
6. Is made of light material so adds little weight to the finished product.
7. Is resistant to moisture.

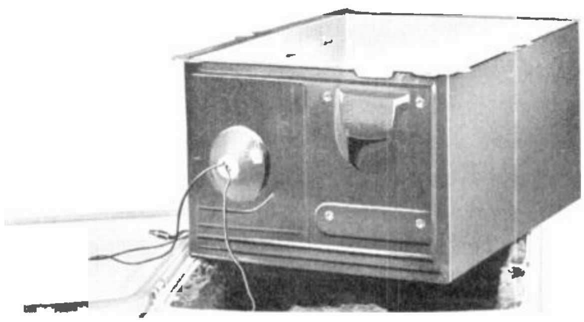


FIGURE 3

Dead air (perfectly still air) is an ideal insulator against heat transfer. To reduce air motion in insulation to a minimum, it is necessary to break up the air spaces into very small units. This is accomplished by using cellular material of low conductivity, thus stopping air motion and not adding materially to the conductivity factor.

Air space or voids in the insulation which extend through the cabinet wall from the food liner to the cabinet shell would permit an appreciable amount of heat leakage, therefore, to avoid this undesirable condition the batts of insulation are installed in the cabinet so that the inner layer of insulation overlaps the outer layer joints thus creating a high resistance to heat flow through the possible air spaces between the butt joints of the insulation.

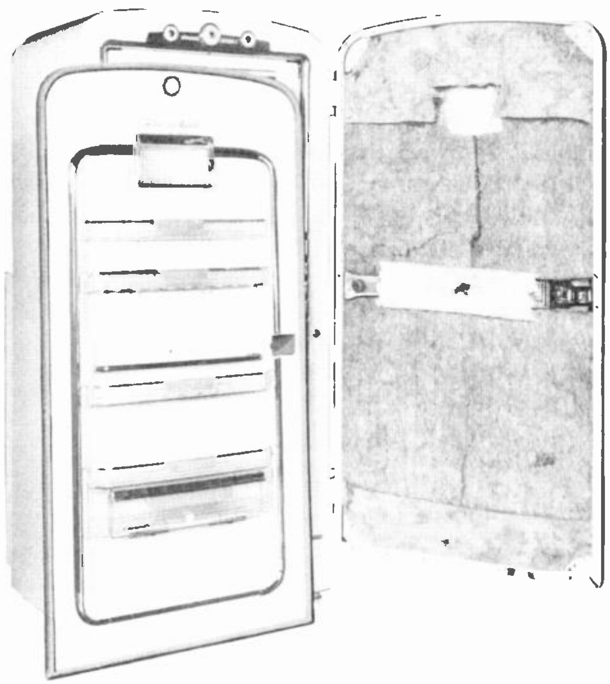


FIGURE 4

The efficiency of insulation is greatly reduced if it becomes wet, therefore, it is of the utmost importance to prevent saturation of the insulation.

If there are small cracks or openings in the outer shell, moisture-laden air enters the insulated area. It then migrates through the outer layer of insulation and upon reaching the cold surfaces of the food liner it condenses and is absorbed by the insulation.

The food liner is joined to the outer cabinet shell with as little metallic contact as possible. The best refrigerator design necessitates the use of plastic supports between the liner and shell, and plastic washers at the points where mounting screws are required, thus avoiding metal-to-metal contact between the warm shell and the cold liner. Since metal is a good conductor and plastic a very poor one, this construction tends to stop the inward flow of heat.

The cabinet shell is sealed in all places except the front of the cabinet. Since it is most important to completely seal the insulation within the walls of the refrigerator, the front of the cabinet is sealed with plastic breaker strips which have a very low rate of heat conductivity.

The plastic strips are fastened in place in the food liner with a breaker molding and on the cabinet shell with a special dutch bend.

The structural detail of a standard refrigerator door (figure 4) are comparable to the cabinet in that it has an outer metal shell with layers of insulation isolating the inner plastic liner. If the door liner is metal, it requires the use of plastic breaker strips around the entire liner to form a thermal break between the liner and the door panel. This breaker strip acts as an insulator between the cold metal liner and the door panel. To prevent heat leakage into the cabinet, the door seals against the cabinet with a rubber or plastic door seal gasket which is formed around the door edge and held in position by the door liner mounting screws.

MOISTURE CONDENSATION

Air always contains water in a gaseous state, and generally contains more water during hot weather than during cold weather. Whenever hot moist air is chilled sufficiently, moisture is released from the air. For instance, when an ice-cold beverage is placed on a table on a hot day, the contact of the warm air with the cold glass causes drops of moisture to collect on the outside surface of the glass. In a similar manner, during hot, humid weather, air which enters the cabinet when the door is opened deposits moisture on the cold interior surfaces when the moist air becomes chilled. Also, warm, moist foods which are stored uncovered in the food compartment will cause additional moisture deposits.

To assist in reducing condensation to a minimum, the following precautions should be observed:

1. *Do not store uncovered, warm, moist, or liquid foods in the refrigerator.*
2. *Never operate the refrigerator colder than necessary to properly protect food and make ice cubes.*
3. *Never allow too much frost to accumulate on or in the evaporator. Frost accumulation of over ½ inch is definitely too much. When defrosting, be certain that all frost is melted before starting the refrigerator. Remove water, resulting from defrosting, from the meat pan and crispers, and wipe the interior of the cabinet to remove excess moisture.*
4. *Do not crowd food and containers on the shelves. Allow at least ½ inch between articles, to provide space for proper circulation of air in the food compartment.*
5. *Keep the refrigerator door closed as much as possible, and be sure that the latch engages properly to hold the door tightly closed.*

If the air is extremely humid, a slight amount of moisture may collect even at points on the outside surface of the cabinet. This condition will exist when weather conditions are such as to produce a high relative humidity, and is not necessarily an indication of any defect in the refrigerator.

Service Manual Notes

In order to bring your refrigeration service publications up to date, the following changes should be noted:

H-1137, H-1138, H-1238, Service Manual PR-2427—In the "H" line parts list the part number for the True Zone Control, Feeler Tube Well was omitted. The Feeler Tube Well part number is 6187-195.

Models F-712, G-722, G-723, H-732, H-733—In cases where the 5250-277 unit, used in the Models F-712, G-722, G-723, H-732 and H-733, exhibits an abnormally high sound level during operation, the unit should be checked to be sure that there is clearance between the bracket on the compressor housing and the base of the cabinet. An easy method of checking this is to remove the motor compartment cover and attempt to insert a piece of cardboard between the bracket and the cabinet base.

If it is found that the bracket is touching the base, or not enough clearance exists, the two rear compressor base mounting screws should be removed and two washers inserted on each side of the mounting. Standard boom-bolt washers found in the unit shipping crate can be used, or a washer of similar size. Be sure that the compressor pinchoff stub is not striking the cabinet after the addition of these washers.

It is important this information be passed on to any trailer manufacturers in your area who are installing the above 7-foot models in trailers. Prior to the installation of the refrigerator in the trailer, these washers can be easily inserted. After installation, however, this procedure would be more difficult.

H-1137- H-1138, H-1238, Service Manual PR-2427—In the Automatic models, H-1137, H-1138 and 1238, a vinyl sleeve has been placed over that portion of the control feeler tube which passes through the insulation. In addition, the control is being mounted in the food tank with the control tube extending from the bottom or opposite to that mounting used in previous production.

These changes have been instituted in production to minimize the possibility of shifting the control point on the feeler tube. Abnormal food compartment temperatures can occur, however, if the routing of the plate feeler tube or the well mounting is not correct despite these changes, as pointed out in previous Service Publications.

G8004

M8104

FIGURE 1

Inasmuch as the Service Lab. For Test Equipment comes under the jurisdiction of the Home Radio Department at service headquarters in Philadelphia, we will, periodically, publish technical and service data on this material.

This month we wish to introduce to you two new pieces of Philco test equipment. These are, the Model G8004—Cross-Dot Linearity Generator and the Model M8104—Field Strength Meter.

Basically, the Philco Model G8004 Cross-Dot Linearity Generator is an r-f generator capable of continuous tuning from television channels 2 through 6, the r-f signal being modulated by a video signal to produce either a cross-dot or a plain bar pattern. The cross-dot type of pattern is the most convenient of the two. With this single pattern displayed on the screen of a television set, both the vertical and horizontal sweep circuits and controls can be checked and adjusted. In addition, the dots help in evaluating focus, astigmatism, high-voltage regulation, blooming and many other characteristics.

In the Philco Model G8004 Cross-Dot Linearity Generator, the careful design of circuits and switching has resulted in an unusually efficient instrument. The heart of this new cross-dot generator circuit is a type 12AU7 dual triode tube. The r-f generator section of the unit uses one-half of the 12AU7 tube as an r-f oscillator, the frequency being controlled by an L-C arrangement in its grid circuit. Cathode feedback is employed, and r-f output is taken from its plate circuit.

The other half of the 12AU7 tube operates as a pulse generator and modulator. With the function switch in either the left-hand or center position, this section of the tube operates as an L-C oscillator at a frequency of about 189 kilocycles when adjusted to produce 12 vertical lines on the screen of the television receiver.

When the function switch is placed in the right-hand, or cross-dot position, the grid time constant of the modulator is made unusually long. This fact, plus proper design of the modulator coil and choice of resistor and condenser values, results in a modified blocking oscillator action. The frequency of oscillation is adjusted by means of the horizontal-line control, a potentiometer used to control the grid time constant. The blocking oscillator generates sharp pulses which, after shaping and clipping, are used to produce the horizontal bars in the pattern. When the horizontal-line control is adjusted to produce an 8-line pattern, the frequency of the blocking oscillator is about 480 c.p.s.

The blocking oscillator action of the modulator also serves to produce the dots which are superimposed on the horizontal line. The carefully designed L-C grid circuit is made to perform as a ringing oscillator, producing periodic oscillations as the result of shock excitation by the blocking oscillator pulses.

The damped oscillations, produced in the grid L-C circuit as the result of shock excitation from the blocking oscillator, are then shaped by the use of damping, differentiation and clipping. The phase and frequency of the pulses which form the dots is controlled by adjustment of the vertical-line control, a variable condenser in the grid circuit of the modulator. Because this variable condenser adjusts the frequency and phase of the dots, it also effectively serves to control their stability on the screen of the television receiver. While the same synchronization effect can be obtained by adjustment of the horizontal hold control on the television receiver, this method will cause a change in the receiver sweep frequency. An outstanding feature of the method used in the model G8004 to produce the dots is that, since the L-C Circuit is shock-excited by the pulses from the blocking oscillator, the dots and bars are automatically locked in step.

The shaping of the various modulation pulses to provide sharper lines and dots is accomplished by the clipping crystal and the R-C circuits associated with the modulator output.

The modulation pulses and the r-f signal are combined in the modulator crystal in the output circuit of the generator.

The operation of this instrument is quite simple by use of the convenient panel controls.

FUNCTION SWITCH. This three-position switch provides a choice of three patterns as shown in figure 2. In the left-hand position, narrow, vertical black lines for adjustment of horizontal linearity or width are produced. In the center position narrow, vertical white lines, also used for horizontal adjustments, are available. In the right-hand position, the cross-dot pattern is produced. The two positions for vertical lines were provided because some television receivers will be found to synchronize better on the black-line pattern, while others will give more satisfactory results on the sharp white-line pattern.

CHANNELS. The large channel-tuning control is used primarily to tune the r-f signal from the generator to the same frequency as the television channel under test (channel 2 to 6). Because of the variation of frequency and phase response in any television r-f tuning, it is possible to change the intensity and sharpness of the test pattern of a slight movement of the generator channel tuning control. A similar effect is obtained by adjusting the television fine tuning. In the case of the cross-dot pattern, the generator channel-tuning control is adjusted to produce sharp white dots.

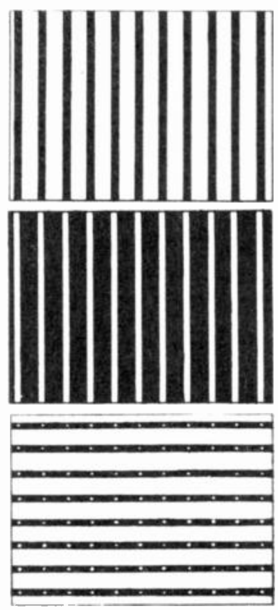


FIGURE 2

DOT CONTROL. This control is used only for the cross-dot pattern, and is adjusted to change the number of horizontal lines in the pattern. Because it also acts like a vertical hold or sync control, its adjustment will synchronize the horizontal-line pattern.

VERTICAL LINES. This control is used primarily to synchronize the vertical-line pattern when the function switch of the generator is in either of the first two positions. The action of this control is similar to that of the horizontal hole control on the television receiver. When a cross-dot pattern is used, the control is still used like a horizontal hold control, but its effect is to stabilize the dots.

VERTICAL LINE NUMBER CONTROL. This control is located at the rear of the generator housing, and is adjusted by using a screwdriver. Turning the control clockwise will decrease the number of vertical bars, while rotation in the opposite direction will increase the number. This control is normally set to give about 12 vertical bars when the vertical-line control is adjusted to about half-scale. Because the cross-dot pattern is derived from a part of the vertical-line circuit, the number of vertical dot rows will always be equal to the number of vertical lines.

ATTENUATOR. This control provides a means of varying the r-f output from the generator. Adjustment of this control will have some effect on the pattern sharpness. It is normal for the attenuator to give a slight smear effect when it is set to the extreme counterclockwise position. When a very weak signal is desired, the r-f output cable can be disconnected from the television receiver and loosely coupled to the receiver input.

EXT. SYNC. One of the problems in the use of linearity-pattern generators is synchronization. The Model G8004 has built-in stabilizing circuits to aid in synchronization. Because of the normal amount of hum present in television receivers, however, there will be a certain amount of weave or jitter unless all circuits are very carefully adjusted. Usually this is not too important, and is taken as an indication of the amount of receiver hum. When extra stability is desired, however, a wire or test lead may be connected to the external sync jack on the front of the generator, and the insulated end of the wire wrapped around the yoke cable of the television receiver. While no actual connection is made to the yoke cable, wrapping the insulated lead around the cable serves to couple some of the vertical and horizontal sweep signal back into the generator, and thus provides a means of synchronizing the generator with the television receiver sweep frequencies. Because of the sync characteristics of the television receiver, increased stability of the cross-dot pattern can often be obtained by slight readjustment of the hold, brightness, contrast, and fine tuning controls on the receiver.

In all of its applications, the operation of the Philco Model G8004 is simple and straightforward. Some of the many applications of the generator are given.

1. *Adjustment of Vertical Linearity*
2. *Adjustment of Raster Height*
3. *Adjustment of Horizontal Linearity*
4. *Adjustment of Raster Width*
5. *Adjustment of Beam Bender*
6. *Yoke Adjustment*
7. *Picture Centering*
8. *Focus Adjustment*

9. *Defocusing and High-Voltage Regulation Check*
10. *Blooming*
11. *Power-Supply and Television Circuit Hum*
12. *Synchronizing Circuit Tests*
13. *R-F Testing and Tracing*

The circuit used in the Philco Model G8004 Cross-Dot Linearity Generator is simple, and quality components are used to reduce the possibility of trouble. However, if at any time the unit should become inoperative, the tube should first be replaced by one which is known to be good. If the trouble persists, a visual inspection of parts, wiring, and connections is next in order.

If r-f signal output is present but modulation is lacking (as indicated by a washout of snow on the screen of a television receiver), the parts associated with the modulator section, such as the modulator coil, should be checked.

If r-f signal output is lacking the B+ voltage of the power supply should be measured. About 105 to 110 volts d.c. should be present. Filament voltage should be about 6.3 volts, a.c. If these tests provide normal indications, the r-f oscillator coil and associated parts should be checked. D.-c. voltage at both the modualtor and r-f oscillator plates should be measured with a vacuum-tube voltmeter or a 20,000-ohms-per-volt meter. Using the same type of meter, a check should be made for the presence of a negative d-c voltage at the grid of the r-f oscillator. Absence of a negative voltage at this point indicates a lack of oscillation.

Alignment of the Model G8004 is simple and straightforward. Alignment of the r-f oscillator is accomplished by first setting the channel dial pointer on the Channel 2 mark and then adjusting the oscillator coil core to produce the strongest and clearest cross-dot pattern on a properly adjusted television receiver which has also been set to Channel 2. Alternately, the core of the r-f oscillator coil may be adjusted to peak the circuit at 58 megacycles by means of a grid dip oscillator.

The modulator coil is usually adjusted to produce about 12 vertical lines when the vertical-line control is set midway in its range. If a different number of lines is desired, the adjustment can be made by means of a screwdriver inserted into the hole provided in the rear of the generator housing.

For best stability of the linearity pattern, the case of the generator should not be grounded or placed upon a metal grounding plate.

If the modulator coil is adjusted when the cross-dot pattern is being used, it will be noted that a change in adjustment will not only vary the spacing and number of vertical dot rows, but will also pull the number of horizontal lines along with the change, thereby tending to maintain the same proportion between the number of vertical dot rows and the number of horizontal lines.

THE MODEL M8104 TV FIELD STRENGTH METER (shown in figure 1) is designed around the highly efficient, low-noise Philco VHF television tuner. This tuner together with a high-gain i-f amplifier and crystal detector, is used in conjunction with a sensitive indicating meter to produce an instrument of exceptional sensitivity and usefulness.

The Philco Model M8104 is designed primarily for use in checking relative field strengths or signal levels. It has a wide range of applications for television service, antenna installation, community antenna systems, and laboratory tests. Front panel controls have been carefully arranged for convenience of operation.

CIRCUIT DESCRIPTION. The circuit used in the Philco Field-Strength Meter, Model M8104, is similar to the front end and video i-f system of a television receiver. The tuner portion of the instrument operates into a two-stage, high-gain i-f amplifier. The output of this amplifier is then rectified by a crystal, the rectified signal being used to operate the sensitivity meter. External monitoring jacks are provided, and permit the use of an oscilloscope for visual monitoring of the composite video signal. The circuit incorporates a new type of electronic sensitivity control which permits the checking of signal levels all the way from 10 to 100,000 microvolts. The indicating meter is calibrated from 10 to 100 microvolts, for reading low signal levels.

Above 100 microvolts, the relative signal levels are obtained directly from the calibrated SIGNAL STRENGTH dial. This control is simply rotated to make the pointer of the indicating meter coincide with the red line at the center of its scale. At this control setting the field strength is then indicated in microvolts on the calibrated scale of the control. The adjustment of the SIGNAL STRENGTH control also adjusts the operating voltages on the tubes to reduce the overload effects from strong signals. This built-in electronic compensation produces a constant output level at the crystal detector and meter for all signal levels within the range of the instrument. The "reference level" calibration system is one which has long been successful in expensive laboratory equipment. It is the use of this system which permits the checking of strong as well as weak signals without overload.

The functions and operation of the controls are as follows:

CHANNEL SELECTOR. This is a 12-position switch, and is used to select the television channel on which measurements are to be made.

FINE TUNING. This control, which is concentric with the CHANNEL selector switch, is used to accurately adjust the instrument for peak signal reading on the meter. When the control is adjusted to obtain a peak reading of the television signal on the meter, the instrument is tuned to the picture carrier of the transmitter.

RANGE SWITCH. This switch is set in the CHAN. 7-13 position for field-strength readings on the higher-frequency channels 7, 8, 9, 10, 11, 12, and 13, and is set to the CHAN. 2-6 position for field-strength measurements on the lower-frequency channels 2, 3, 4, 5, and 6. This switch, in effect, equalizes the sensitivity of the instrument on the high and low ranges, to permit field-strength readings. If accurate measurements of signal strength is not important, this switch can be set to the high position on low channels when high sensitivity is needed to detect very weak signals.

SIGNAL STRENGTH. Basically, this control which is calibrated in microvolts, is used to adjust the sensitivity of the instrument. After the CHANNEL selector, the fine tuning, and the RANGE switch have been adjusted for peak signal reading on the meter, this control is adjusted to bring the meter pointer to the red line on its scale. Other controls may then be rechecked for peak indication. The SIGNAL STRENGTH control will then indicate the signal level in microvolts on its calibrated scale. The meter scale, which is also calibrated in microvolts, is used in cases where the SIGNAL STRENGTH control is turned to maximum sensitivity (100 microvolts) and the meter pointer still indicates below the center (red) line on the scale. The calibration of the meter scale permits readings down to 10 microvolts (noise level).

OSCILLOSCOPE MONITOR JACKS. In order to permit visual monitoring of the waveform, the vertical input terminals of an oscilloscope can be connected to the scope jacks provided on the instrument.

R-F INPUT TERMINALS. The signal source to be checked is connected to the r-f input terminals of the instrument. In order for the calibration of the instrument to be correct, it is necessary that a 300-ohm balanced line be used. 300-ohm twin lead is the most common type of line to be checked. When transmission lines having other impedances are to be checked, a matching transformer or jig should be used.

APPLICATIONS

Among the many applications of the Philco Field-Strength Meter, Model M8104, the following are some of the more important uses of the instrument:

1. *Measurement of relative signal strength as received from an antenna.*
2. *Measurement of relative signal strength at various points in a community antenna system.*
3. *Locating and orinentating television antennas for optimum results.*
4. *Adjustment and improvement of antenna leadin or transmission-line operation.*
5. *Checking and locating the direction of interfering signals.*
6. *Making comparison checks on the relative gain and performance of TV channel amplifiers, boosters, etc.*

MEASUREMENT TECHNIQUES

Whenever signal-level measurements are made using the field-strength meter, it is always desirable to observe the following precautions:

1. *Connecting cables or lines carrying r-f signals should not run parallel to each other, and should not cross, unless this is unavoidable.*
2. *R-F cables and lines should always be properly terminated in their characteristic impedance. Since in practice this is frequently not the case, it may be necessary to insert a resistance matching pad in the line. See figure 3. While this will "cool off" the line by reducing standing waves, it will also cause some loss in signal strength. In the case of a 6db pad it will cause the signal to drop two times down from the original level.*
3. *Any connections in the cables and lines should be carefully made to avoid changing the spacing or size of the wire at any point. If precise measurements are to be made, the connectors which are used should be rated for use with the impedance of the line.*
4. *"Hot" cables are usually caused by either poor line matching or excessive leakage around the lines when checking at low signal levels. Proper termination, shielding, and grounding with heavy straps should minimize this difficulty.*
5. *Where standing waves on an r-f line are unavoidable, the line should be tuned for maximum indication on the field-strength meter. This can be done satisfactorily by running the hand or a piece of tinfoil along the line to the point which gives the maximum reading.*

CALIBRATION

In the event that tubes become defective in the instrument, it may be desirable to recalibrate if the measurements require a high degree of correlation. If the instrument will be used only for making comparisons it will probably not be necessary to recalibrate. If the calibration points for the local TV stations have been written down on the "CAL" scale, using a particular antenna and leadin as standards, it will be relatively easy to recalibrate and reproduce the original results. If access can be had to a generator with a calibrated attenuator reading up to 100,000 microvolts, a complete recalibration can be made, using curves or tables for each channel.

There are three calibration controls inside the cabinet.

The high-channel sensitivity calibrator is the adjustable coil nearest the power transformer. Before the meter is calibrated, the fine tuning control should be adjusted for maximum. To make the calibration adjustment, set the RANGE switch to the CHAN. 7-13 position, set the CHANNEL selector to a high-frequency channel, such as 12, place the SIGNAL STRENGTH control in full counterclockwise position, and feed a 100-microvolt 205.25-megacycle signal from the generator into the antenna through a matching transformer, such as Philco Matching Transformer, Part No. 45-1736. Then adjust the coil to bring the meter pointer to the center of the scale. This is the high-channel adjustment of the 100-microvolt level.

The low-channel calibration control is a potentiometer, located on the chassis near the tuner. With the SIGNAL STRENGTH control in the fully clockwise position (100 microvolts), throw the RANGE switch to the CHAN. 2-6 position, set the CHANNEL selector to a low-frequency channel not used by local TV stations, and set the generator to the channel picture carrier frequency. Adjust the generator for 100 microvolts, and adjust the fine tuning control for maximum indication on the meter. Then adjust the low-channel calibrator to bring the meter pointer to the center of the scale. This calibrates for the low channels, to provide more nearly the same sensitivity as for the high ones.

The low-sensitivity calibration adjustment potentiometer is located on the top of the chassis, near the power transformer. This adjustment is used to set the upper microvolt limit of the equipment. Using the same setup as in the preceding paragraph, rotate the SIGNAL STRENGTH control fully clockwise, set the generator for a 100,000-microvolt signal on the picture carrier frequency, and adjust the fine tuning control of the field-strength meter for maximum meter indication. Then adjust the low-channel calibration potentiometer to center the meter pointer on the scale.

Because it is sometimes desirable to have a hand-calibrated microvolt scale or curve, the Model M8104 is provided with an extra "CAL" scale on the SIGNAL STRENGTH control and a unit scale on the indicating meter. Local stations can be used for check points, and the readings recorded and used for future reference. The signal strengths from local stations are fairly constant, and can be used as standards. The accuracy of such calibrations will be more than adequate for most purposes, since, in practice, the use of the field-strength meter will be based upon relative rather than absolute values, and it will be employed to obtain comparative indications of signal strength. Signal-strength readings below 100 microvolts are definitely in the fringe-area level, and may be expected to give a showy picture. Signals above the 100-microvolt level should give good picture quality, while signals above 500 microvolts should be practically free from snow.

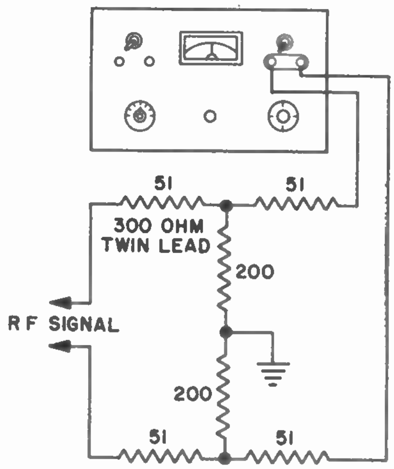


FIGURE 3

Where a higher than ordinary accuracy of signal-strength calibration is needed, the usual procedure is to employ a laboratory type of generator, with a calibrated attenuator for controlling the r-f output. Also, it will usually be necessary to provide matching transformers and proper termination, to minimize standing-wave effects.

Because of the effects which are normal to VHF, the tuner employed in the field-strength meter will have greater gain at the lower-frequency channels than at the higher-frequency channels. While the low-channel calibration control inside the case of the Model M8104 can be used to minimize this difference in gain, it should be remembered that there will always be some variation in gain from one channel to another, and that matching measurements of microvolts.' It is for this reason that the television serviceman and the television engineer are prone to speak of the relative microvolts, and the relative signal levels, based on a particular instrument which has been assumed to be the standard. In normal usage, the only concern is in knowing how much better, or what kind of improvement, is obtained.

Auto Radio Service Notes

As a summary of the changes, corrections and additions, etc., occurring in the 1953 production of Auto Radios we are listing below Service Notes for your complete information on these radios.

STUDEBAKER

Repairs to the Studebaker internally controlled antenna should be checked for a loose mounting bracket if the cable has jumped off the reel. The nut holding the bracket may have been loosened allowing the friction clutch mechanism to become loose and the cable to jump off. There is no occasion for this nut to ever be loosened for either installation or removal.

A .5 MFD condenser has recently been added to the Studebaker installation package for application to the voltage regulator. Complaints of interference should be checked for the need of a condenser on the regulator if not now on the automobile.

Not listed on the S-5323 Service Manual is the right-hand control bushing which is removable on this model so that a rear seat speaker switch may be installed. This bushing is part No. 56-9985FA3.

A word of warning about the repair of S-5327 radios. This set has, as you know, a switch for rear seat speaker operation. It is very important that this switch be left in the "FRONT" speaker position. If the radio is returned to a car dealer with the switch in "REAR SEAT" speaker position and the car has no rear seat speaker it will probably be assumed the radio isn't operating when re-installed.

There have been some problems in supplying the correct volume control for Model S-4627. We are glad to advise the original part, 33-5522, is now in stock.

On Service Bulletin PR-2505 covering the Studebaker internally controlled antenna the part number of the Rod and Reel Assembly was omitted, it is part No. 76-8656.

Early production of the Model S-5327 and S-5323 radio used a condenser assembly, part No. 31-6522-2 (CA400 in the circuit diagram). Later this was changed to the use of part No. 31-6522-4. Part No. 31-6522-2 only will be supplied for replacement purposes. The only difference between the two parts is that the -2 part number has an internal fixed condenser between terminal 1 and terminal 2 whereas -4 has an external fixed condenser which you will find wired between terminal 1 of the padder assembly and the grid of the 6BE6 oscillator tube. When using the -2 assembly for replacement on a radio having a -4 disregard the No. 2 terminal as you already have an external fixed condenser in the circuit. Incidentally, in the Service Manual PR-2425 it is listed as part No. 31-6522-21. This is a typographical error, it should be 31-6522-2.

On Models S-5327 and S-5323 no lubrication information is given in the Service Manual but if the tuning drive becomes stiff it may denote the lack of lubrication in one of two spots in the tuning unit.

1. THE TUNING DRIVE SHAFT BEARING. With the set placed so that the tuning unit is level with the horizontal plane a drop of oil placed on the tuning drive shaft will work its way down into the tuning shaft bearing for sufficient lubrication.
2. THE SPRING LOADED BRAKE ON THE DRIVE CORD DRUM SHOULDER may cause stiff tuning if there is a lack of lubrication. If this point is dry it will bind and result in the cord slipping on the drive shaft. A drop of light oil at this point will provide sufficient lubrication.

Due to variations in spring tension on the dial cord, three turns of dial cord will now be found on the dial shaft in place of two. This creates enough friction drive so tolerance in spring tension will be compensated for. If persistent slippage occurs, it is advisable to install a new dial cord using a three turn loop on the drive shaft.

There is an error in the Service Manual PR-2425 for the Studebaker S-5327 radio. The manual shaft assembly is listed as part No. 76-8377 but it should be 76-8379.

Also on PR-2426 for the S-5323 the reverse is true. The number listed for the shaft assembly is 76-8379 and should be 76-8377.

Changes and additions to the Service Manual for the Model S-5123 (PR-1914):

Knob and Shaft Assembly, Volume and Tone

Should Read

Knob and Shaft Assembly, Manual Tuning

ADD

Knob, Volume Control	56-7556FA8
Coil, Antenna	65-0443-25
Coil, R.F.	65-0443-26
Coil, Osc.	65-0443-27
Washer, Set Mounting Bolt	54-8072

CHRYSLER

We have had some reports of bezel warpage on Model Plymouth P-5206 causing the pointer to stick. The bezel does not have to be replaced. To correct this condition remove the bezel by removing the two screws (one at each end of the bezel) then with a pair of pliers bend outward the extruded portion of the back plate where the hole is located to which the mounting screw is attached. Replace the bezel and tighten securely. You will note that this bending has resulted in pressure being applied to the bezel thus correcting the warpage.

The size of the deadening felt located under the push button slide bars (all models) has been increased to better prevent rattle. If complaints are received of push button rattle replace the felt with the thicker type, part No. 54-7842-3.

Models C-5211 and C-5212 12-volt radios—A 47 ohm resistor has been added in series with the .5 mfd condenser (reference C-106, Service Bulletin PR-2492) that is now across the primary of the power transformer. This was added to reduce low frequency noise on some installations.

If you receive one of this model radio for repair, on which the complaint is that of low frequency hash, insert the resistor as described above. The resistor being used is a ½ watt, 47 ohm, Philco Part No. 66-0479340.

Omitted from PR-2492 on the 12 Volt Chrysler set was the dimmer control. This also is different from that used on the six volt set and is part No. 33-5568-6.

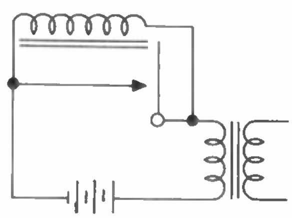
The antenna coil assembly listed in PR-2408, part No. 76-4602-1, is not a common replacement part for all of these model sets.

On the P-5206 radio it was never used. The correct part number for this model is 76-4602-2. During production of the D-5207 and C-5209 the coil assembly was changed from 76-4602-1 to 76-4602-2 so either type may be found on them. Part No. 76-4602-1 has a flat bracket for the antenna socket and 76-4602-2 has an angled bracket which drops the socket down about 1 inch. The two assemblies are not interchangeable for this reason.

The models C-5211 and C-5212 all use part No. 76-4602-2.

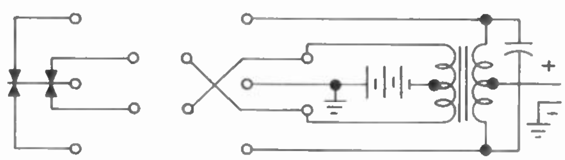
Correction—

OCTOBER SUPERVISOR



◀ Page 15
Fig. 6

Page 17
Fig. 11
▼



This month . . .

J. RUSSELL KANOUSE, Service District Representative in the Texas Division, proves for us that three heads are better than one.

This month Russ celebrates his 25th Anniversary as a member of the Philco family. We know you will join us in extending to Russ heartiest congratulations and best wishes.

In my opinion . . .

. . . there are many cracker-jack service technicians in our ranks who will never reach the top of the ladder of success. Why? Simply because their whole approach to the service routine is the technical approach; they completely overlook the business side of our industry, the sales side, and the all important point of human relations with customers. Many of you will say—this doesn't mean me! No, maybe it doesn't—or perhaps it does?

The electronic and appliance service business *today* is an important phase of a gigantic industry. It is a business operating within a business—and to be a successful operation, your service shop, or service department must be operated like any retail business. We, too, must have facilities—a store or a shop, materials, equipment, capital, price schedules, operating policies and management, billings, and collections! Yes, large or small, one man or many, *we must have these tools to operate successfully.* Of still greater importance, we must sell—sell—sell! Even though we have good internal organization, the nicest looking store, the best of equipment, still we cannot succeed if we don't sell. Conversely, we can't sell if we don't have a supporting organization. The two go together—hand and foot.

Let's face the facts . . . we are all in the business for one reason and one reason alone . . . to make a buck . . . and as easily as possible. Maybe you are riding a gravy train right now with the easy bucks coming in. But listen, what will happen to you when the gravy is all gone? Will you be prepared to face competition? To sell yourself and your shop?

We are looking at a brand new year—1954. A year that promises to be a bigger and a better year than ever before! So let's take 15 minutes—an hour, or more and review our own positions! What can we do—what should we do for improvement . . . to make more money? Analyze yourself—your business—your position—your background—your community—your competition, and your over-all potential for the coming year. *Think! Plan!* Then roll up your sleeves and go to work!

But remember—you'll need three heads if you are going to moved forward: the business head, the technical head, and the sales head. Acquire a business head, talk things over with friends in other businesses . . . read service business success stories and apply the service systems and ideas that are proving profitable to others. You've got a good technical head—use it. Keep abreast of new service developments (and there will be many in 1954) by reading and studying the information given you in your monthly P.F.S.S. mailings. Apply the new techniques—for better use of time . . . and easier bucks. Keep your sales head level. If nothing else, resolve to apply these rules every time you face a customer in 1954: (1) Smile; (2) Be genuinely interested in your customers; (3) Be friendly at all times; (4) Be a good listener; (5) Never forget a customer's name—and use it frequently; (6) Never complain; (7) Make the customer feel extremely important—as if he is your only customer; (8) Never argue with a customer nor tell him that he is wrong; (9) Try always to see the customer's side of the story; and, (10) Express sincere appreciation for the customer's business.

So let's go to work . . . look ahead to another great year, a bigger year, a more profitable year. Good luck, and, oh yes, have a very Happy New Year, too!

PHILCO *Factory-Supervised* Service

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