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UHF ANTENNA AND TRANSMISSION LINES

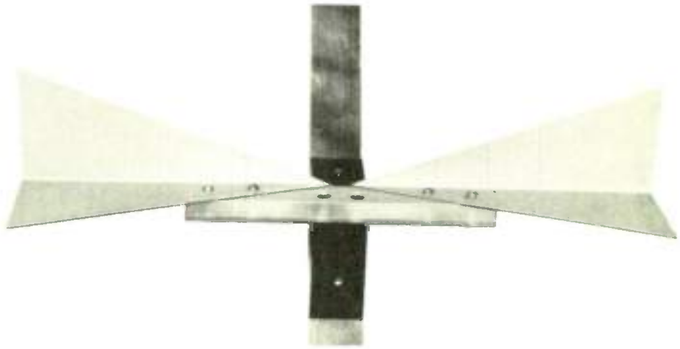

FIGURE 1

THE UHF BAND OF FREQUENCIES is of such high frequency that the action of the transmitted signals closely approximates the characteristics of light. Due to this, the choice of an antenna, transmission line and installation of this equipment for UHF reception requires

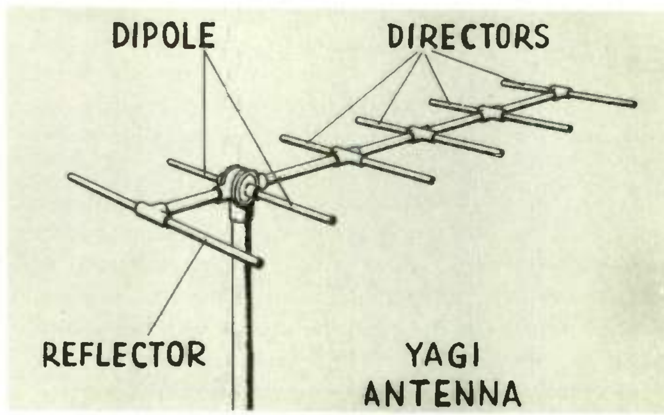

FIGURE 2

a much greater amount of forethought and skill. Incorporated within this article are a number of charts and graphs, based on information obtained from engineering and practical experience, which can be of assistance in choosing the proper antenna and transmission line for each individual installation.

The coverage area of a television station will vary as the frequency on which the station is operating changes. The average coverage area, for the lower channels in the VHF band is approximately 100 to 110 miles. The upper channels in this band have only approximately 80 to 90 miles coverage. There is a relatively high jump in frequency between the uppermost channel of the VHF

(Continued on Next Page)

World Radio History

UHF Antenna and Transmission Lines

(Continued from Front Cover)

band and the lowest channel in the UHF band. This results with a coverage area of only 55 to 65 miles for the lower channels of UHF. The area which can be served by a television station operating on the upper channels of UHF is not definitely known because there are no stations actually operating on these frequencies; however, it is anticipated that the coverage provided by the upper channel stations will be definitely less than the 55 to 65 mile area which is being experienced for the lower UHF channels.

The effect of terrain on television signals also varies with the increase in frequency. The higher the frequency, the greater is the effect of terrain upon the signal. To elaborate more on this condition, compare the effect of terrain on the VHF and UHF bands. The lower channels in the VHF are only slightly affected by terrain. The upper channels of this band are affected considerably more. The entire UHF band is extremely affected. This means that the higher the channel, the more extreme is the effect of the contours of the earth, tall buildings, large bodies of water and so forth.

There have been many types of antennas designed for the reception of UHF transmission. Among these are some which are designed to receive, equally as well, both UHF and VHF signals. The simplest of the UHF antennas is the "Bow Tie" antenna, figure 1. This antenna is to UHF reception as a simple dipole is to VHF reception. It is of main consequence in metropolitan areas only. Even then, it is restricted to locations where ghosts and reflections are not excessive. The Yagi Antenna (figure 2) has been very useful and effective for VHF reception; however, the Yagi antenna is so frequency conscious and directive that it also has its limitations. An antenna which has

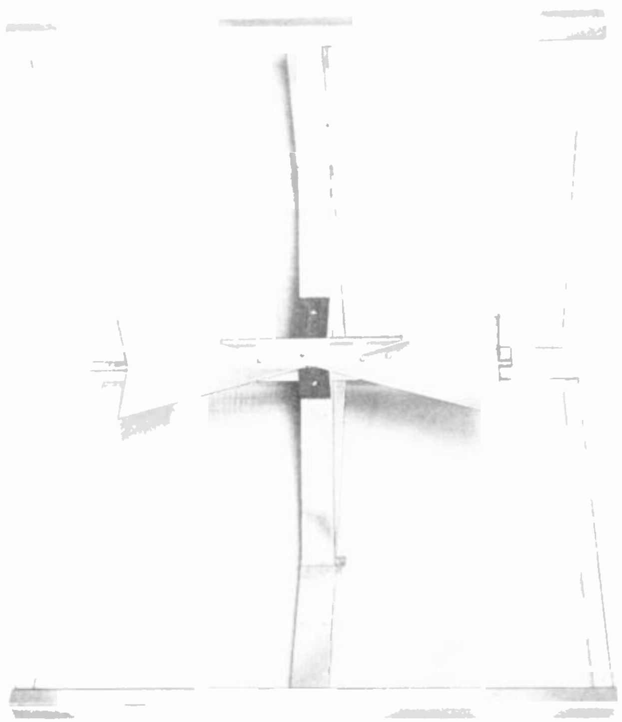

FIGURE 3

proved to give excellent results under adverse conditions is the corner reflector antenna. The corner reflector antenna which is shown in figure 3, is an engineering model. The commercial antennas of this type will have the reflecting surfaces made of a number of parallel pieces of tubing. This will result in much less weight and wind resistance. The corner reflector is relatively directional and has excellent gain charac-

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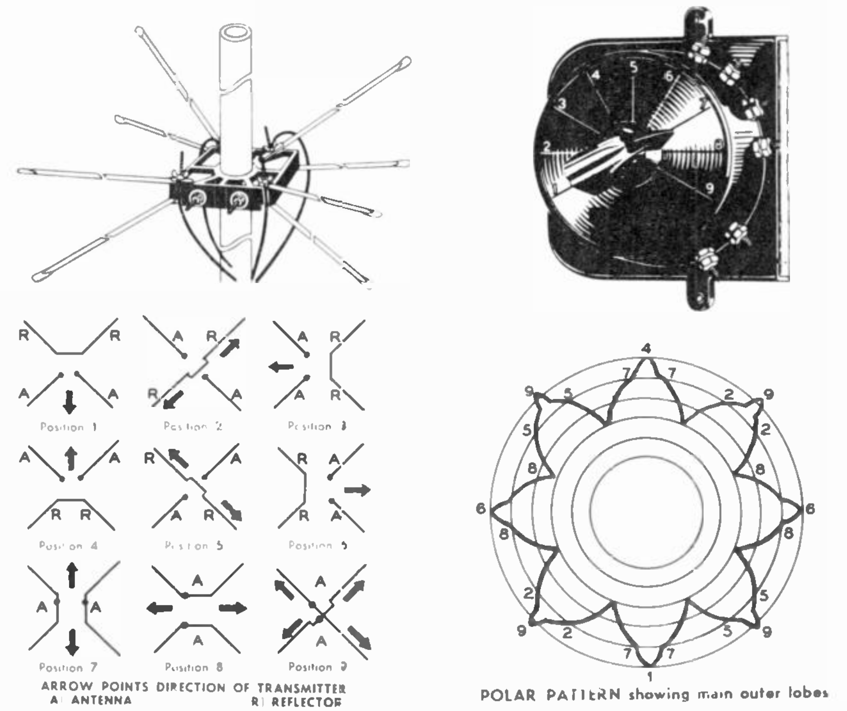

FIGURE 4

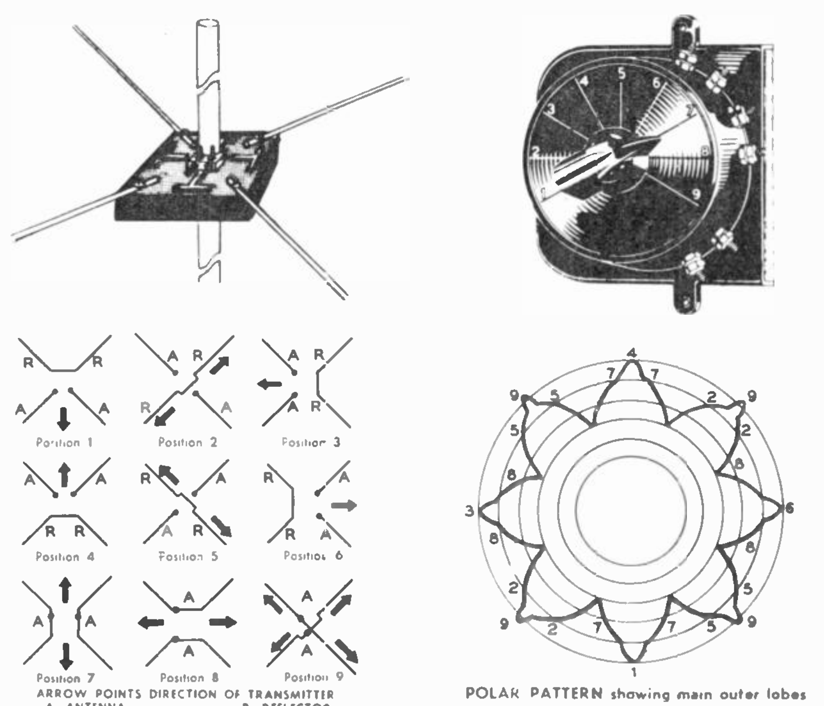

FIGURE 5

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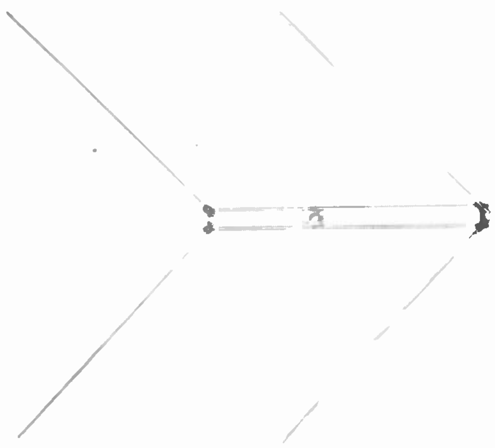

FIGURE 6

teristics over the major portion of the UHF frequency spectrum.

Thus far, the antennas mentioned have only been good for UHF reception. In many locations throughout the country, areas will be served by both UHF and VHF channels. This, therefore, necessitates an antenna which is capable of receiving both UHF and VHF television stations. A new antenna has just been designed to handle this situation within metropolitan or primary signal areas. This antenna in two designs is shown in figures 4 and 5. This antenna, when stacked, is capable of delivering up to 22 db gain in the VHF band. The antenna may be electrically rotated through a 360° arc without the use of any mechanical device. This is achieved by a multiple switching arrangement as can be seen in figures 4 and 5. Another antenna which has been designed for both UHF and VHF operation is the U-Vee antenna (figure 6). The angle included between the Vee elements is adjustable to three positions: 90°, 60°, and 45°. The 90° angle for UHF operation, the 60° angle for UHF-VHF operation and the 45° angle for UHF operation only. This antenna provides exceptionally high gain at UHF frequencies, while maintaining very high gain at VHF frequencies. It has relatively good directivity with a high front to back ratio. The trombone antenna (figure 7) has all of the advantages of the U-Vee antenna but has higher gain, better front to back ratio and greater directivity.

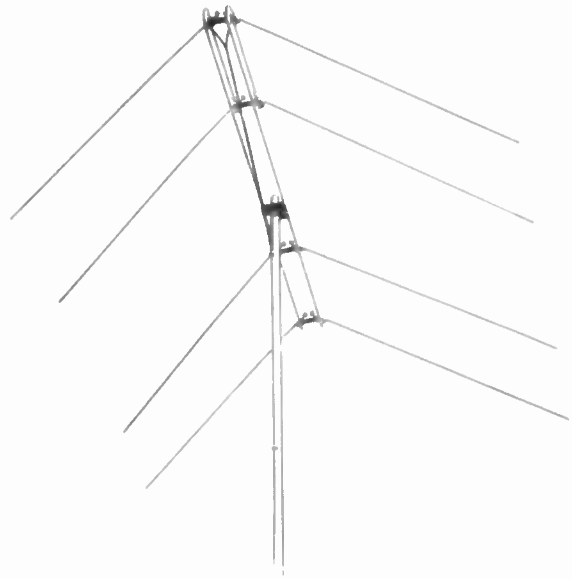

FIGURE 7

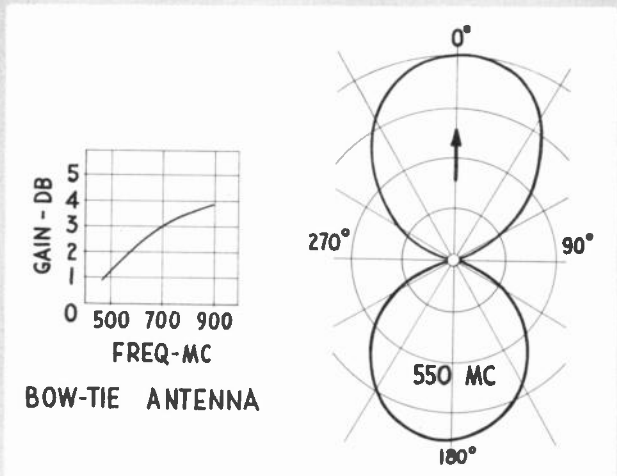

FIGURE 8

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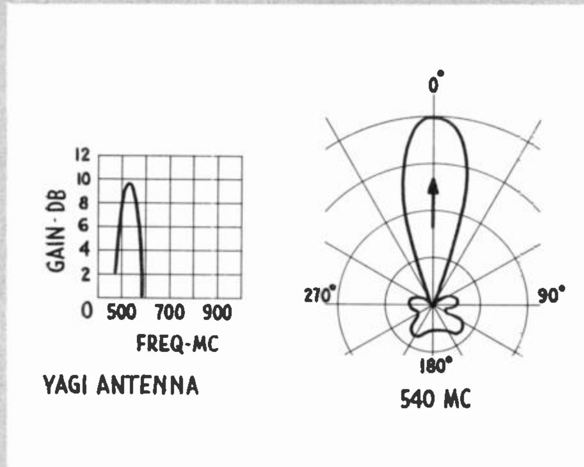

FIGURE 9

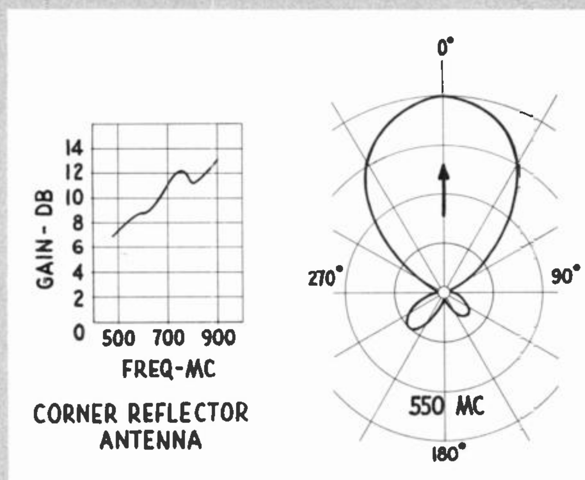

FIGURE 10

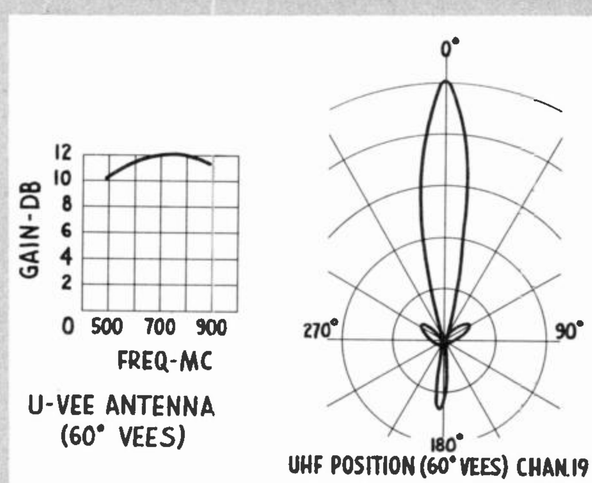

FIGURE 11

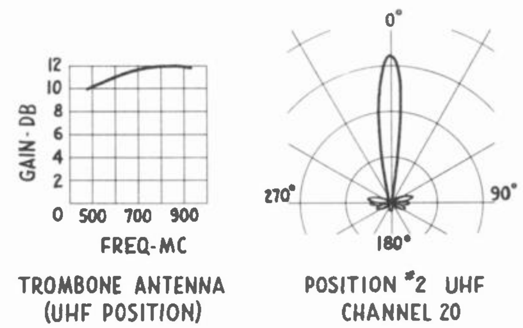

FIGURE 12

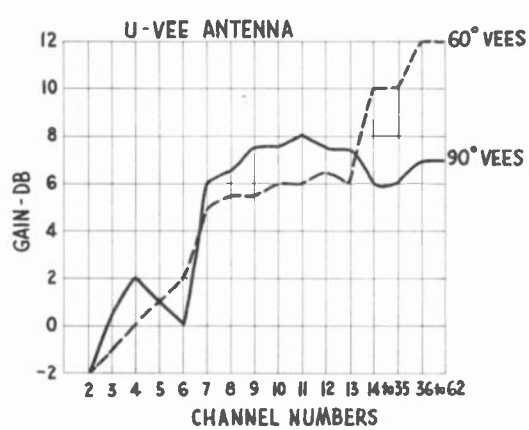

FIGURE 13

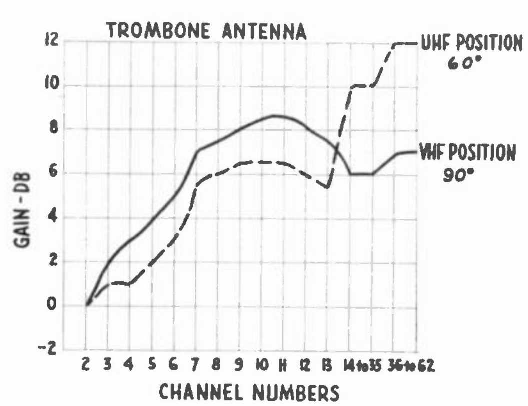

FIGURE 14

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This antenna in conjunction with 300 tubular twin lead satisfied a very large percentage of the UHF installations in Portland, Oregon. The Vee elements of this antenna are also adjustable in the same manner as those of the U-Vee antenna. Figures 8, 9, 10, 11 and 12 show the radiation patterns and db gain of all of these antennas at UHF frequencies. The relative db gain over the entire television frequencies from channel 2 VHF to channel 62 UHF for the 60° and 90° Vee angles, of the U-Vee and trombone antennas, is shown in figures 13 and 14. The db gain on these charts is representative of the gain of these antennas as compared to a simple dipole.

Of equal importance to the proper antenna, is the proper transmission line. There are four possible types of transmission lines which might be used in the reception of UHF frequencies in conjunction with the aforementioned antennas. These transmission

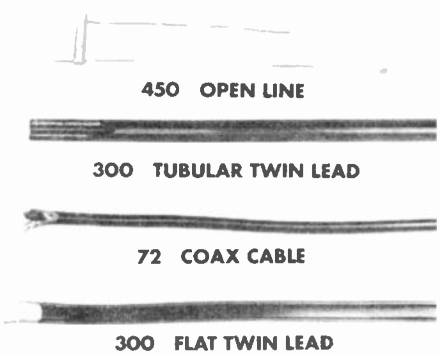

FIGURE 15

lines are illustrated in figure 15. Based on engineering information and actual experience in the field, is the chart in figure 16 which shows the results of these various transmission lines when used on UHF frequencies. The 300 ohm flat twin lead was limited in its usefulness due to the effect of weather conditions and proximity with near-by objects radically changing the characteristics of this line. The tubular 300 ohm twin lead however, provided excellent results. It is easy to handle, has relatively low db loss and is not appreciably affected by weather conditions. It is no more sensitive to near-by objects than is the 300 flat lead when used on VHF frequencies. On the installation of the tubular twin lead, a drain elbow should be made just prior to where the transmission line enters the home. This is illustrated in figure 17. The arrow points out the spot at which a small hole should be cut into the tube. This will permit condensation, which will normally form within the transmission line, to drain out of this small opening and prevent it from impairing the operation of the transmission line. The end of this transmission line which is attached to the antenna should be sealed so as to prevent rain, snow or moisture of any kind from entering the open end. Coaxial cable provided only fair results when used to receive UHF frequencies. This is undoubtedly due to the relatively high db loss at these frequencies. The 450 ohm open line is theoretically the finest type of transmission line which can be used. It has the lowest db loss and is not too greatly affected by weather conditions. This line provided good reception when used on UHF; but due to its mechanical nature, it is a bit difficult to handle when making an installation. With reasonable care and patience however, this type of transmission line can provide excellent results.

TYPE OF TRANSMISSION LINE	RESULTS ON UHF	DB LOSS/100 FT. @ 530 MC
300 Ω FLAT TWIN LEAD	POOR TO FAIR	3 db
300 Ω TUBULAR TWIN LEAD	VERY GOOD	3 db
72 Ω COAX CABLE	FAIR	9.5 db
450 Ω OPEN LINE	GOOD	approx. 1 db

FIGURE 16

The installation of antennas for UHF or combined UHF-VHF reception is not difficult. It can not be stressed too strongly, however, the importance of care and common sense when planning and making an installation. Each time an installation is made, you should survey the situation in your mind and determine which antenna and transmission line would be best. Take into account the distance from and the number of television stations, the noise to signal ratio in the area, and ghost and shadow problems. All of these factors determine and contribute toward the perfect installation.

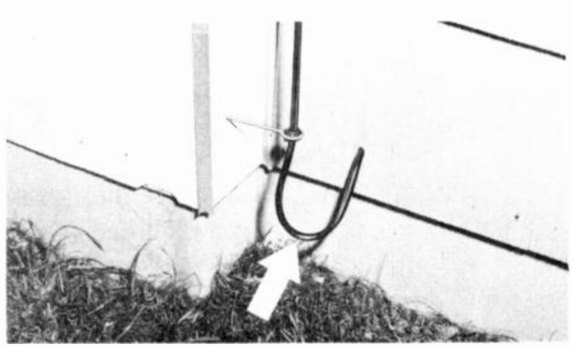

FIGURE 17

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That Fuse Problem!

One of the most frequent complaints, as all auto radio repair men well know, is the auto radio that blows fuses. Fortunately, in most cases, an obvious reason is pretty apparent, such as, the vibrator with stuck contacts or a direct short in the set that will blow a fuse as fast as it is replaced, but there is always a set that shows no apparent reason for this complaint, and it plays and plays on the test bench without trouble developing. When this condition is encountered it should not be ignored, fuses just don't burn out of their own accord—barring the normal per cent of component failure that might be expected of a fuse as well as any other part.

There are several tests that should be made in such cases. First, the radio should be operated on a voltage most nearly similar to that in the car. It is not generally apparent but it requires only a very small change of voltage in the primary circuit of a 6 volt auto radio power supply to result in a correspondingly large change in the high voltage output. For example, if the vibrator power supply is designed to provide 240 volts of "B" with an input of 6.3 volts and the input voltage is decreased 1 volt, the output will be only about 200 volts. If, on the other hand, the input voltage is raised to 8 volts the output voltage will be about 300 volts.

Breakdowns may occur only at a higher voltage that may result in fuse blowing which might not show up at a normal 6.3 volts. Therefore, one test should be that of operating the set on a varying voltage from the minimum that it would operate on a car (about 5½ volts) up to the extreme limits of the voltage regulator on the car (about 7½ volts). This can be accomplished either by using an AC operated supply with variable output or by using two storage batteries and tapping off at different cells to give you different voltage range or by using a variable resistor in series with two storage batteries.

While making this test an ammeter should be in series in the "A" lead and a voltmeter connected to the output of the set, first checking the set at 6.6 volts. Note the input current as compared to the rating of the set in the service manual for that model. If, for example, it is an 8 tube set, and the input current is 8.6 amperes, and the current exceeds this value by more than 1 ampere on this particular set, additional testing should be made before passing the set as satisfactory.

While the fuse normally used with the set is large enough to carry this current without burning out, the abnormal amount of current during the warm-up time (charging current consumed by the power transformer, etc.) may exceed the rated value of the fuse and cause it to burn out. If this condition exists a check of several components is in order.

No. 1 Check the two secondaries of power transformer. Note whether the DC resistances are nearly equal. There is a normal variance of a few ohms but any great difference probably indicates shorted turns in one section which would result in higher input current. For example, if the total transformer secondary resistance is 850 ohms the normal resistance of each section would be 425 ohms and allowable difference would be 430 ohms and 420 ohms but if one section should read 400 ohms and the other 450 ohms this would be a questionable difference and the power transformer should be suspected.

No. 2 Replace the rectifier tube with another tube known to be good and check whether or not the input current becomes normal. Check the electrolytic condenser for short circuits. While it would be obvious that the input condenser was shorted, the output condenser with a partial short could cause heavy current drain and not be so noticeable from hum standpoint.

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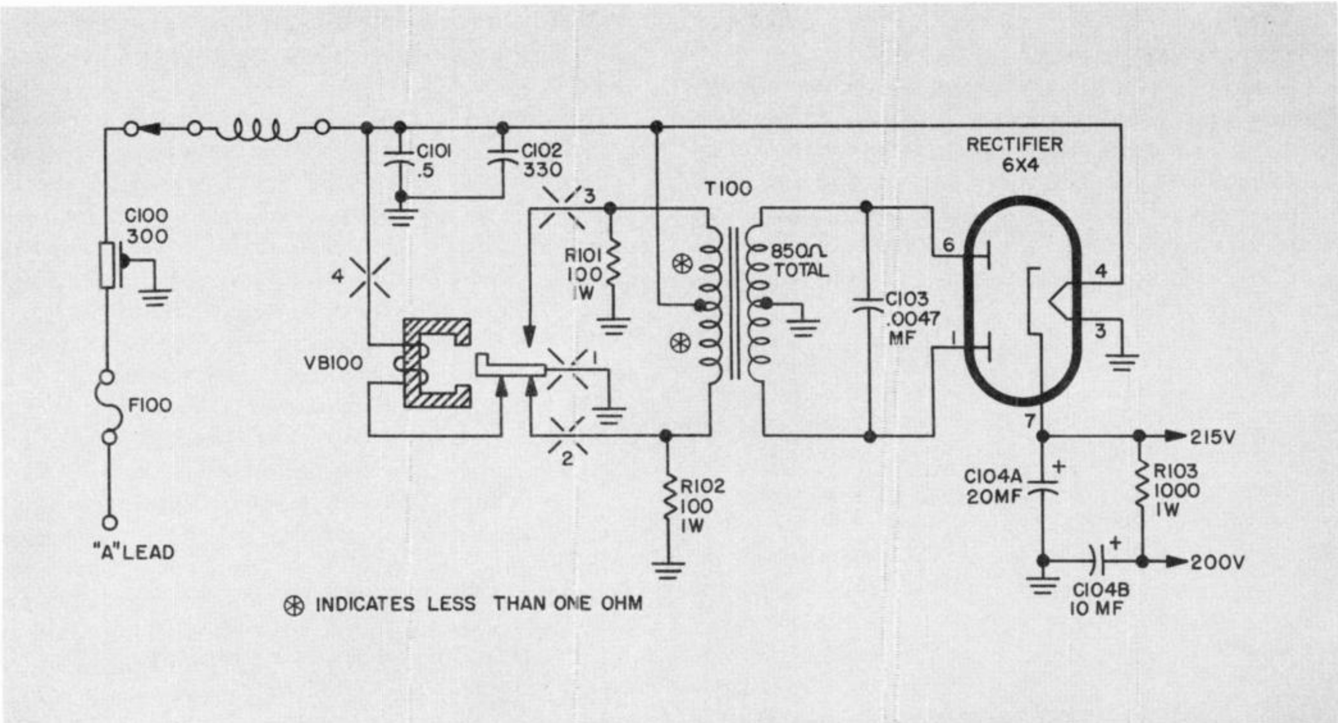
No. 3 Check tubes for shorts especially the output tubes.

No. 4 An intermittent shorted feed through condenser will also give trouble. One side of this condenser is riveted to the case and may be mechanically abused if the "A" lead is pulled for any reason.

No. 5 Check the buffer condenser for shorts, particularly, an intermittent short. A light tapping may show up an intermittent short. Many servicemen, as a matter of routine, replace the buffer condenser with a new one when the vibrator is changed as an added precaution, especially where the vibrator has been replaced for suspected fuse blowing. However, this isn't usually necessary as a shorted buffer condenser is pretty obvious.

In connection with the replacing of the buffer condenser it cannot be overemphasized that the correct value of the buffer condenser should be used as a replacement. Always use the part number buffer condenser as shown in the service manual. An incorrect buffer condenser can shorten the life of a vibrator as much as 50%. In this connection also the replacement of vibrators should be made with the same type as originally used in the radio because it is a combination of the power transformer, buffer condenser, and vibrator that brings about the proper operation of the power supply, and, therefore, the value of any one of these should not be changed from original engineering specifications.

Do not be misled by bargain priced vibrators. We have had called to our attention some cases where fuse blowing vibrator replacements were made, and we found the serviceman had made the mistake of using bargain priced vibrators. Such vibrators cannot possibly have the good contact material found in the original vibrator used in our radios, and, particularly, when used in connection with 8 tube sets where the current through the vibrator points is greater than in 6 tube sets.



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Receiver Gain Check (Part II of a Series)

There are some details which must be observed while setting up the equipment and running the gain check.

When checking the gain of all but audio stages, the volume control must be turned completely off. With the audio stages operating, false indications may be observed due to variations of B+ caused by its modulation by the audio or by stray pickup. Also, if any piece of the equipment shows signs of microphonics, the voice coil should be removed from the circuit and replaced by a 2 watt resistor between 3 and 5 ohms (a standard value of 4.7 ohms will do well).

After connecting the input and output probes, hum and/or distortion or r-f oscillation may result. Try reversing the line plug of the set, generator or scope. On sets using a floating B— it may be necessary to short the B— to chassis with a jumper during the tests.

During the audio stage tests, it is suggested that an attenuating probe be used. There are two reasons for this. Direct coupling to the scope with the regular scope lead will cause undue attenuation, especially at the first audio grid which may be an extremely high impedance. Secondly, the voltages now present in the audio system will have to be attenuated, possibly to a greater degree than the scope attenuator is capable. The audio attenuator shown in Figure 1 presents a very high impedance to the circuit under test, isolates the scope from the DC voltages of the circuit, and provides an attenuation of 100:1.

Care should be exercised during the checks to avoid overloading. Watch the scope presentation for flattening of the sine wave, or other forms of distortion. These overload conditions can be caused in any stage of the radio under test, in the scope pre-amplifier when used, or in the scope amplifiers. The obvious correction is to decrease the signal into the unit causing the distortion.

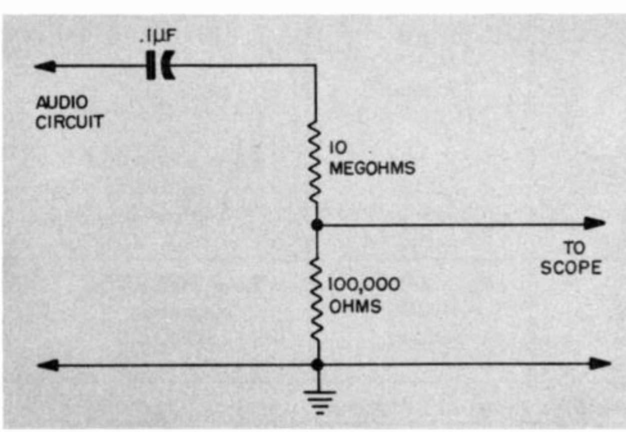

FIGURE 1

Caution should be used when constructing the r-f crystal probe and the audio attenuator and isolating probe. The leads from the probe to the connecting points at the chassis should be as short as possible. Coaxial cable should not be used between the chassis and the probe as its capacity will cause an excessive amount of circuit de-tuning and loading.

After the equipment has been allowed to warm up, the first operation is to establish the voltage or relative scope screen divisions of the generator output. This is performed as follows:

Set the signal generator to 1500 KC (if modulation percentage is adjustable, set to 30%), and tune receiver to this frequency. Connect the equipment as shown in Figure 2. Set the scope attenuator to the most sensitive position, the scope gain control full on, the generator step switch to a relatively high output, and adjust the gain until a measurable scope deflection, indicated by a small number of screen divisions, is obtained. Record the setting of the generator step switch. The two variable gain controls are not to be touched during the tests.

Now, connect the generator ground lead to the radio chassis and the output lead to the top of the antenna tuning condenser. This is not the most accurate method, nor does it allow the antenna circuit to enter our checks, but it is the easiest and simplifies the procedure by eliminating such factors as a standard generator antenna, standard coupling of generator antenna to the set, etc.

The ground lead of the crystal probe is next connected to the radio chassis. Maintain a high generator output voltage. The probe tip is placed on the r-f amplifier plate and the number of scope divisions is recorded. The number of divisions here, divided by the number obtained in the original, straight through setup (without radio) is the relative gain of this stage. If there was any attenuation of either generator or scope, this must be taken into consideration.

The next stage to be measured is the converter. The probe is placed at the converter plate and the number of divisions of scope deflection is recorded.

Mention should here be made concerning the gain indications obtained and the necessary high input voltage when checking the r-f and converter stages. Even though we used an oscilloscope pre-amplifier with a gain of 500, it was still necessary to feed an abnormally large signal into the set to obtain a measurable signal at the r-f and converter plate. When signals of this magnitude are fed into a vacuum tube circuit, the law of diminishing returns enters the scene. The tube's operating point is changed, a-v-c

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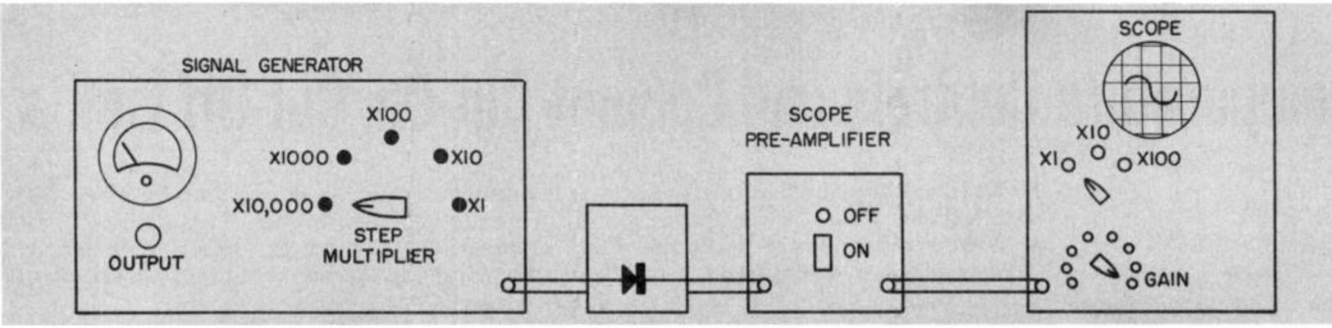

FIGURE 2

tends to nold down the amplification so that a great change of signal is necessary to cause an increase in output signal. The values given for the r-f plate and converter plate are merely representative of the model and should not be construed as actual gain figures.

The probe is now moved to the i-f plate, the generator output is decreased to a value approximating the average signal input strength of the receiver, and the deflection noted. The number of actual scope deflections should be multiplied by all factors affecting generator output and scope sensitivity. Thus, if the generator output was reduced by a factor of 100, the scope attenuation reduced by a factor of 10, and the scope deflection is two divisions, the effective number of deflection divisions is 2000.

For the audio stages the crystal probe is removed and the audio probe used. In the tests we performed, it was found that the characteristics of the radio detector and the crystal probe were so similar that no conversion factor was necessary when going from the probe at i-f on the detector plate to audio through the detector. The scope pre-amplifier is removed from use while checking the first and output audio plates since there is quite sufficient signal present to give good scope deflection. During the audio checks it should be remembered to include the attenuation of the audio probe as a multiplying factor of 100 and the gain of the scope pre-amplifier as a multiplier of (in this particular case) 500.

In the following chart covering test data for the models 53-656 and 53-950 several items are worthy of note. The apparent discrepancy between the required input for the 53-656 and that for the 53-950 is due to different reactions with high input signal and not to that great a difference in sensitivity. The total number of scope divisions is equal to the scope presentation, times scope attenuation, if any, times external attenuation such as audio probe and removing the pre-amplifier. The reduction in input signal is not used as a multiplying factor.

Model Number	53-656		53-950	
Stage	Input	Scope Division	Input	Scope Division
RF Tube Plate	37,000 MV	2.5 Div.	3700 MV Osc. Off	2 Div.
Converter Plate	37 MV	2 Div.	3700 MV	8 Div.
IF Plate	37 MV	55 Div.	37 MV	80 Div.
1st Audio Grid (Full Volume)	37 MV 100:1 Attenuator	27 Div. x 100 2700 Div.	37 MV 100:1 Divider	6 Div. x 10 x 100 6000 Div.
1st Audio Plate	37 MV 100:1 Attenuator	25 Div. x 100 equals 2500 x 100 equals 250,000	37 MV 100:1 Divider	16 x 100 x 100 equals 160,000
Audio Output Plate Removed Scope Pre-Amp	37 MV 100:1 Attenuator	21 Div. x 500 x 100 equals 1,050,000	37 MV 100:1 Divider	23 x 500 x 100 equals 1,150,000
Standard Deflection of 2 divisions requires input of 37,000 MV				

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Temperature Controls and Cabinet Cut-On, Cut-Off Limits

In servicing the modern refrigerator, it is important that the serviceman be given test data for checking the cut-on and cut-off limits for a given model. This data will enable the serviceman to determine if the Temperature Control is operating properly. To use the test chart given below, the following procedure should be adhered to:

1. Set the Temperature Control to Position 1.
2. Freeze the bulb of a thermometer in the evaporator, at the bottom-center.

REFRIGERATOR MODEL	TEMPERATURE CONTROL	ALTERNATE CONTROL	REFRIGERATOR TEMPERATURE LIMITS			
			Cut-On Temp. °F.		Cut-Off Temp. °F.	
A411	5530-42		28		14	
A620	5530-42		28		14	
A621	5530-42		28		14	
A622	5530-42		28		14	
A721	5530-42		28		14	
A731	5530-42		28		14	
A750	5530-42		28		14	
A751	5530-47		23		8	
A752	5530-47		23		8	
A931	5530-42		28		14	
A950	5530-47		23		8	
A951	5530-47		23		8	
B773	5530-54	5530-62	28		14	
C680	5530-42		19	29	8	15
C780	5530-42		19	29	8	15
C781	5530-62	5530-55	7	14	—3	5
C782	5530-62	5530-55	7	14	—3	5
C882	5530-62	5530-55	9	19	—4	5
C883	5530-62	5530-55	9	19	—4	5
C885	5530-62	5530-55	9	19	—4	5
C887	5530-62	5530-55	9	19	—4	5
C1085	5530-62	5530-55	14	20	3	12
C1087	5530-62	5530-55	14	20	3	12
C1100	5530-62	5530-55	7	17	—3	5
D792	5530-78		12	22	2	12
D793	5530-65		12	22	2	12
D794	5530-65		12	22	2	12
D795	5530-68	5530-69	12	22	2	12
D891	5530-68	5530-69	8	18	0	10
D892	5530-68	5530-69	8	18	0	10
D893	5530-68	5530-69	8	18	—2	8
D894	5530-68	5530-69	10	20	0	10
D897	5530-68	5530-69	8	18	—2	8
D991	5530-75		12	22	—2	8
D1093	5530-70	5530-71	9	19	2	12
D1095	5530-70	5530-71	9	19	2	12
D1191	5530-70	5530-71	9	19	—5	5

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3. If the system is operating efficiently, as indicated by uniform frost distribution over the evaporator and by normal "cut-on" and "cut-off" temperature, as indicated in the following chart, the Temperature Control is operating satisfactorily. Readings should be taken through several cycles, to obtain average conditions. The effect of the elevation with respect to sea level should also be taken into consideration.

If the refrigerator will not start, check Temperature Control as follows: Loosen the feeler-tube clamp at the evaporator, then remove and grasp the feeler tube in the hand. The heat from the hand should cause the Temperature Control contacts to close and start the unit.

If the unit does not start, turn the control several times from OFF to Position 1. If no clicking sound is heard to indicate the operating or closing of the contacts, replace the control.

REFRIGERATOR MODEL	TEMPERATURE CONTROL	ALTERNATE CONTROL	REFRIGERATOR TEMPERATURE LIMITS			
			Cut-On Temp. °F.		Cut-Off Temp. °F.	
E702	5530-87		19	29	14	24
E703	5530-80		19	29	14	24
E704	5530-80		19	29	14	24
E903	5530-81	5530-82	19	29	8	18
E904	5530-81	5530-82	19	29	8	18
E905	5530-81	5530-82	17	27	3	13
E906	5530-81	5530-82	17	27	3	13
E1102	5530-81	5530-82	19	29	8	18
E1103	5530-81	5530-82	15	25	5	15
E1104	5530-81	5530-82	16	26	10	20
E1107	5530-81	5530-82	15	25	5	15
F712	5530-87		21	31	8	18
F713	5530-80		19	29	10	20
F818	5530-95		19	29	10	20
F912	5530-88		21	31	13	23
F913	5530-80		19	29	10	20
F915	5530-82		19	29	10	20
F916	5530-82		19	29	10	20
F1018	5530-95		19	29	10	20
F1112	5530-82		19	29	13	23
F1115	5530-82		19	29	13	23
F1116	5530-82		19	29	13	23
F1218	5530-97		19	29	10	20
F1312	5530-91		19	29	10	20
F1315	5530-91		19	29	10	20
G722	5530-100		21	31	6	16
G723	5530-100		21	31	6	16
G724	5530-100		21	31	6	16
G726	5530-100		21	31	6	16
G828	5530-100		20	30	8	18
G923	5530-100		20	30	6	16
G924	5530-100		20	30	6	16
G925	5530-100		20	30	6	16
G926	5530-107		20	30	0	10
G927	5530-100		20	30	6	16
G928	5530-108	5530-107	20	30	0	10
G1028	5530-100		20	30	8	18
G1124	5530-100		20	30	8	18
G1125	5530-100		20	30	8	18
G1228	5530-109		20	30	8	18

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Air Conditioners Models 80JL and 80JS

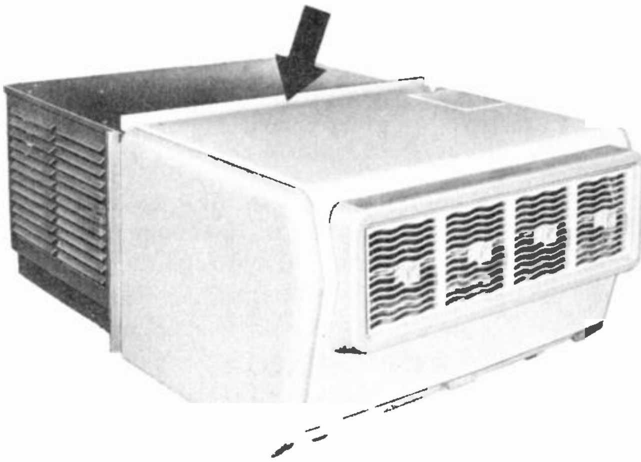

FIGURE 1

Due to the abnormally high demand for room air conditioners in the past summer season, it was impossible for our production facilities to fulfill all domestic, commercial, and industrial requirements for new air conditioners. Since purchasing and installation of equipment for industrial organizations is normally done during the off season, the Philco Corporation has made an early announcement of two of its 1953 line of ¾ ton air conditioners.

The model 80JL which is illustrated in figure 1 is housed in an all metal two tone cabinet. The Arctic Dawn colors will harmonize perfectly with the furnishings in most modern offices and homes.

The model 80JS is also available in an all metal cabinet. This air conditioner is housed in a beautiful tan colored cabinet which our consumers' survey shows is the type most requested to blend into a room or office furnished in the more conservative styles.

SPECIFICATIONS:

These two air conditioner models have exactly the same mechanical and electrical features. They will cool, dehumidify, filter, and circulate up to 300 cubic feet of air per minute. Outside air may also be drawn into the room where it is cooled, filtered, and circulated. Under high humidity conditions, the unit will extract 2.4 pints of water per hour from the room air. The pump out control will exhaust stale air at the rate of 50 cubic feet per minute. For ventilation without cooling, 240 cubic feet per minute of fresh, filtered outside air may be pumped into the room. Draft free air circulation is controlled through the four way adjustable wave type grills (fig. 1). Each grill is adjustable in four positions. In addition to directing the conditioned or fresh air up or down, it can be directed to the right or to the left or any combination of the four directions as may be desired. The air is filtered for dust, dirt, soot, and pollen through the use of a three-quarter horse power sealed unit assembly. The motor compressor is hermetically sealed in oil for quiet efficient operation. The sealed unit motor is a two value capacitor motor which develops high starting torque employing a starting capacitor and a running capacitor. The starting capacitor gives a high starting ability, but is designed for short time operation. It is cut out of the circuit by a centrifugal switch (starting relay) when the motor reaches 85% of operating speed (1725 RPM). The running capacitor aids to give the motor higher efficiency at full running speed, thus reducing the amount of current being drawn from the AC source. This motor is built to the highest standards of efficiency and economy of operation. It is especially engineered to conform to the newest power requirements as specified for three-quarter ton air conditioners which operate on 115 volts, 60 cycle power.

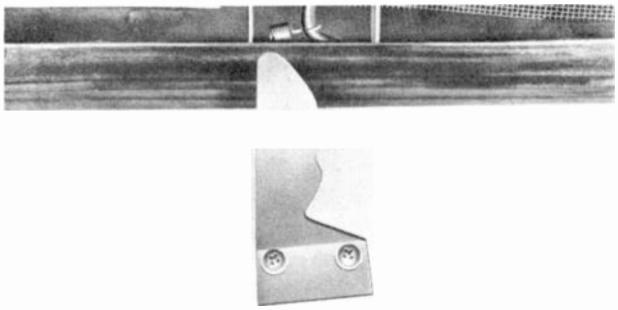

FIGURE 2

CONVENIENCE FEATURES:

The models 80JL and 80JS have been designed with convenience features for both the consumer and the serviceman. The power switch has been located in the center of the top mounting angle (arrow in figure 1) for convenience to the consumer. This switch is mounted in the top cover of the starting relay and capacitor mounting box for ease of service. The air circulation control damper has been designed for positive positioning to better control of the amount of fresh air that will be conditioned for circulation; therefore, a notched retainer bracket and hook (fig. 2) has been used to position the damper. The damper

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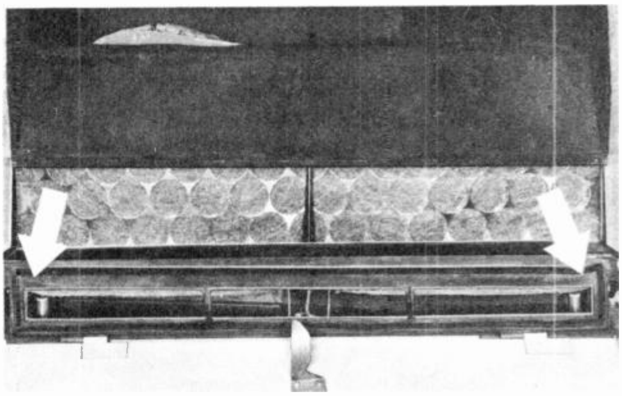

FIGURE 3

when pulled fully forward, admits 100% fresh air to be filtered and circulated in the room. When it is closed to the first notch a mix of approximately 30 to 40 per cent room air and 60 to 70 per cent fresh air is cooled, dehumidified and circulated. With the damper positioned to the second notch approximately 60 to 70 per cent room air and 30 to 40 per cent fresh air will be passed through the unit for comfort air conditioning. If completely closed or pushed all the way in only room air will be conditioned. To prevent air leakage into the room when the air conditioner is not being used, or in extremely warm and humid weather, when no outside fresh air should be admitted until comfort conditions have been established in the room, a V type cushion ridge seal gasket has been installed (fig. 3). When the damper is adjusted all the way in, it is firmly seated against this V type gasket sealing off the outside air. When the air circulation control damper is adjusted to circulate all outside air (damper all the way out), the damper handle with the words FRESH AIR imprinted on it is visible to the person adjusting it. When positioned to circulate room air, this handle is not visible.

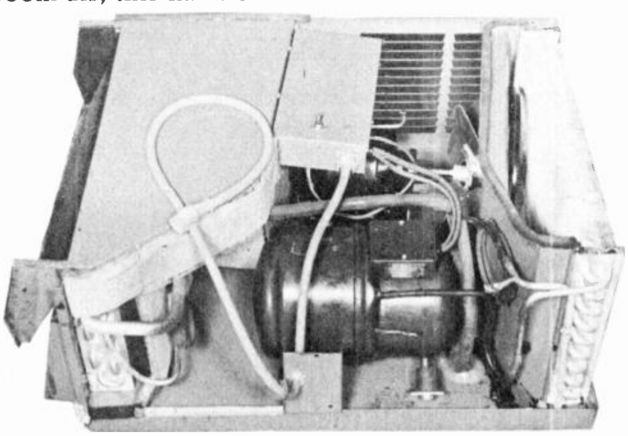

FIGURE 4

TESTING AND SERVICING:

By referring to figure 4 it can readily be seen that the accessibility of components is such that the model 80J air conditioner may be checked without removing the unit from its mounting cradle. Before removing the decorative cabinet and top panels, the standard preliminary checks should be made to determine if the source voltage is adequate or if the fuse is blown. Check the filter (fig. 3) to see if it is permitting a maximum amount of air to pass through the unit. This may be done by pushing the air damper all the way in and then reaching up into the damper opening. Grasp the filter and move towards the front of the cabinet approximately ½" to clear it from its retaining lips, then move it downward through the cabinet opening. A visual inspection will show if the filter should be replaced. After determining that the malfunctioning of the unit is not caused by external troubles, a volt wattmeter should be connected into the service cord and a wattage and temperature check of the air conditioner should be made.

CHECKING FOR PROPER OPERATION

The refrigerating system includes the motor-compressor, the evaporator, the condenser, and all the parts containing refrigerant.

All necessary tests on the refrigerating system can be made by using a Philco Pocket Psychrometer, Part No. 8040-28, Philco Pocket Thermometer, Part No. T-33-1, a Philco Thermometer Holder, and a wattmeter.

CHECKING EVAPORATOR AIR-INLET TEMPERATURES

Without disturbing the air-conditioner installation, use a Philco Psychrometer to check the temperatures at the evaporator air inlet. Prepare the psychrometer by thoroughly wetting the wick that covers the bulb, with clean water (preferably distilled). It is important to keep the wick clean, and to replace it as soon as it becomes dirty from handling or other causes. To obtain correct readings, it will be necessary to place the psychrometer with the bulbs in the air-inlet stream, preferably near the center of the grill opening. Record the temperatures when the lowest wet-bulb readings are obtained. The wet-bulb thermometer will not maintain a reading very long, since the wick dries quickly. The wick must still be wet when the wet-bulb temperature is recorded.

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CHECKING THE AIR FROM THE EVAPORATOR

When taking the temperature of the conditioned air from the evaporator, the bulb from the Philco Dry-Bulb Thermometer should be placed in the conditioned-air stream. NOTE: The conditioned air should be checked at various positions to obtain an average temperature.

TEST TABLE FOR CHECKING COOLING EFFECT

When testing the refrigeration unit in Philco Air Conditioners, the information in the test tables for the particular model under test must be used.

The COOLING RANGE column of TABLE 1 gives the allowable minimum and maximum cooling of the air passing through the evaporator, for the conditions shown in the EVAPORATOR AIR-INLET TEMPERATURE column. The values in this column were obtained by taking the difference between the dry-bulb temperatures at the evaporator air inlet and the conditioned-air outlet.

When test data is to be taken, close all dampers so that no fresh air is admitted or room air exhausted. If the air conditioner is equipped with automatic temperature control, turn the A-T-C knob to position 6.

Example: Assume that Model 80JL is under test, and that the temperature readings indicated below have been taken. Note that in this and subsequent examples, the values selected are underlined in the tables.

Evaporator air inlet, dry-bulb temperature: 85°

Evaporator air inlet, wet-bulb temperature: 67°

Conditioned-air outlet, dry-bulb temperature: 65°

Proceed as follows:

1. In the left-hand column headed D. B., find the 85° value.
2. In the column headed W. B., find the 67° value adjacent to the 85° mentioned above.
3. Read to the right from this 67° value and find the values 17—22 in the COOLING RANGE column.

This data shows that if the temperature of the air passing through the evaporator is reduced at least 17° but not more than 22°, the unit is operating normally for the existing conditions. Remember that the 17° dry-bulb temperature is the minimum allowable difference for these conditions.

For the unit under test, the evaporator dry-bulb cooling range was 20° (85° at the evaporator inlet, minus 65° at the outlet). Since this value is within the listed range, 17°—22°, this unit may be considered to be operating normally.

TABLE 1

EVAPORATOR AIR-INLET TEMPERATURE		COOLING RANGE OF (AIR TEMP. IN, MINUS AIR TEMP. OUT) MODELS 80JS and 80JL
D. B. (° F.)	W. B. (° F.)	MIN.—MAX.
100	79	18—22
	75	20—24
95	79	16—20
	75	18—22
	71	20—24
	67	20—25
90	79	13—17
	75	16—20
	71	18—22
	67	19—24
85	79	9—13
	75	13—16
	71	15—19
	67	17—22
80	75	9—13
	71	12—16
	67	15—20
	63	17—22
75	71	8—12
	67	12—16
	63	14—19
	59	17—22
70	67	8—11
	63	12—15
	59	14—19

CHECKING THE TEMPERATURE OF THE AIR TO THE CONDENSER

If a wattage check is to be made, the following temperature check must be made, along with the wattage readings.

To 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, but not closer than 6 inches from 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 obstructions to the flow of air across the bulb of the thermometer. If the air conditioner is installed in a casement window, or if the above suggestions cannot be followed, place the thermometer outside the nearest window, on the same wall.

TABLE 2

CONDENSER AIR INLET	TOTAL POWER CONSUMPTION OF UNIT IN WATTS MODELS 80JS and 80JL
D. B. (° F.)	MIN.—MAX.
115	1310—1670
110	1270—1590
105	1240—1510
100	1180—1430
95	1110—1390
85	1060—1350
80	900—1240

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WATTAGE CHECK

Proceed as follows, taking all test readings at the same time, or as nearly as possible:

1. Read the dry-bulb temperature at the condenser air inlet, as explained above.

2. Insert the power plug of the air conditioner into the receptacle of a wattmeter, and plug the power cord from the wattmeter into the nearest wall receptacle. Allow the air conditioner to operate at least 15 minutes.

3. Read the total power consumption of the air conditioner, in watts.

4. Referring to the left-hand column of TABLE 2, select the condenser air-inlet dry-bulb value nearest to the test temperature obtained in step 1 above.

5. Read to the right from this value to determine the maximum and minimum wattage for the model under test.

Normal operation is indicated if the test results are within the wattage indicated in the table.

Example: Assume that Model 80J is under test, and that the dry-bulb temperature of the air entering the condenser is 100°.

1. In the column headed CONDENSER AIR INLET D. B., find the 100° value.

2. Read to the right from this 100° value, and find the maximum and minimum wattage of 1180—1430.

If the wattage reading obtained in the test is within this range, the power consumption may be considered to be normal. If the power consumption of the air conditioner is abnormal the cabinet and top panel should be removed to check for:

1. Insufficient air flow through the evaporator and condenser, due to lower than normal fan speed which might be caused by the wrong pitch of the fan blades caused by rough handling. Insufficient lubrication (too much oil can also cause motor trouble) or a defect in the fan motor windings.

2. Restricted air flow through the evaporator and condenser due to dirt or lint obstructing them, dirty fan blades or dirty screens (a vacuum cleaner is ideal for cleaning these components).

3. A clogged condenser drain tube.

If the forementioned conditions have been checked and the power readings are still abnormal, the electrical components should be checked.

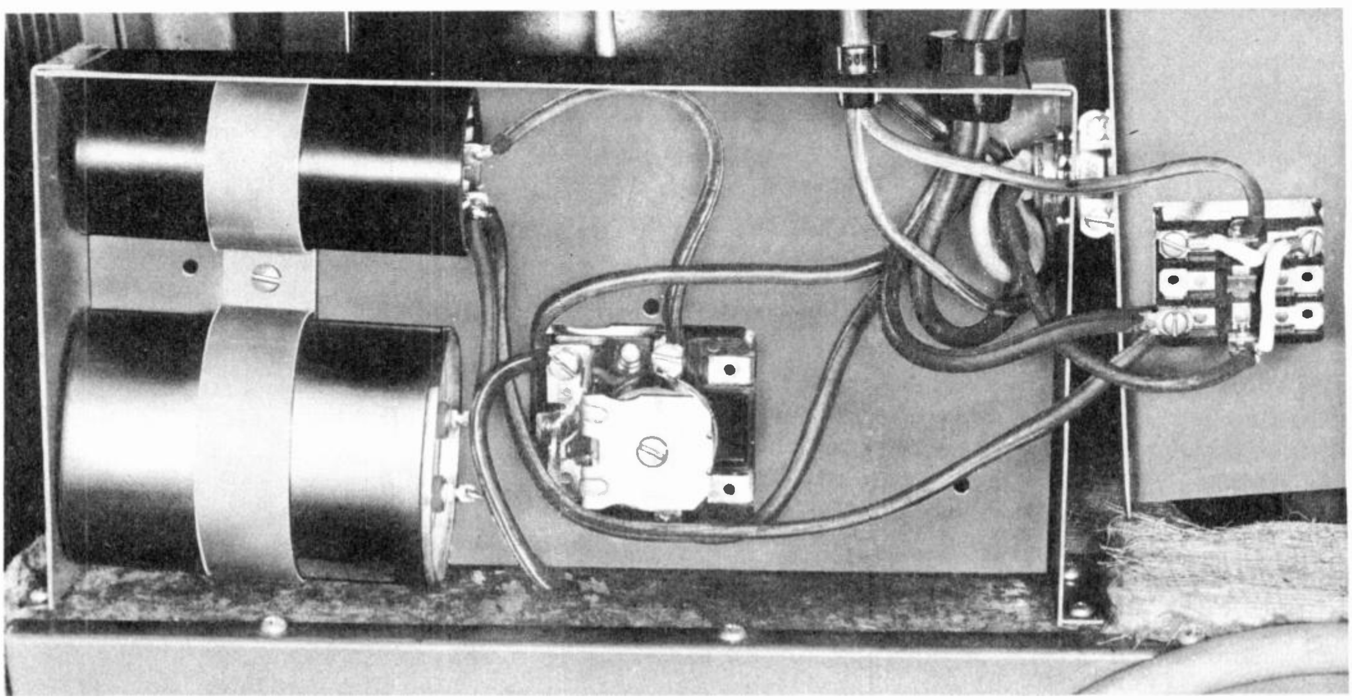

FIGURE 5

ELECTRICAL COMPONENTS

Before making any individual electrical checks the starting relay and capacitor mounting box should be opened (fig. 5) to expose the wiring center of the 80J models. A check should then be made to determine if all electrical connections are firm and correct. The wiring diagram on the side panel of the air conditioner or the one shown in figure 6 will assist in determining if all connections are correct.

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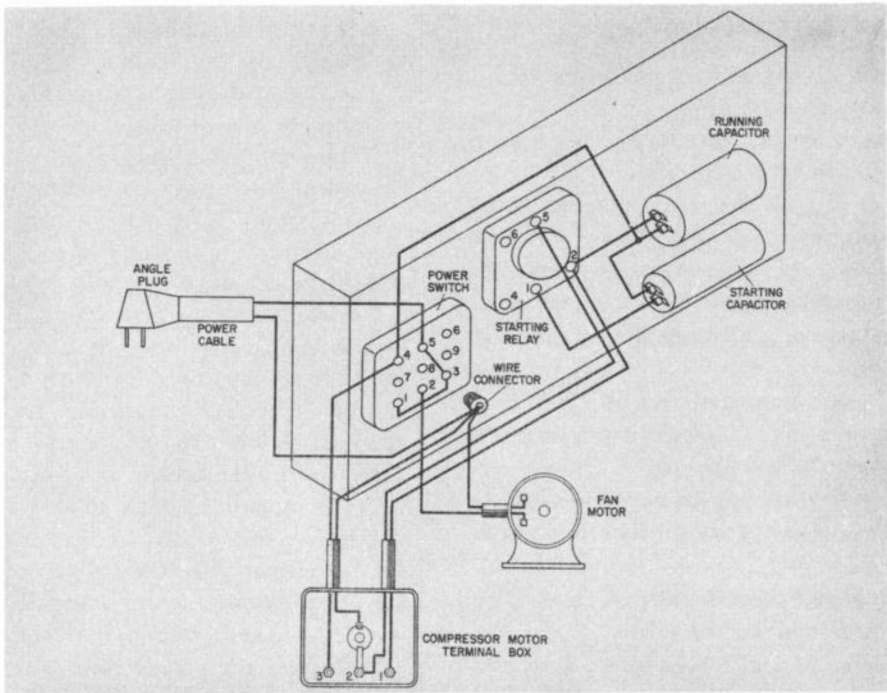

FIGURE 6

SERVICE CORD

With the service cord plugged into the appliance outlet and the power switch in the "off" position, a voltage check from terminal 5 of the power switch and the exposed connection of the wire nut should indicate the line voltage for a good service cord.

POWER SWITCH

With the switch in the cool position a voltage check from the exposed connections of the wire nut to terminals 1, 2, 3, and 5 of the power switch will indicate line voltage. In the cool position a reading will be indicated from the wire nut connections to terminals 1, 2, 3, 4, and 5 of the power switch. The lack of an indication at any one of these forementioned test points would indicate a defective switch.

FAN MOTOR

Since the condenser and evaporator fans use a common motor, if the motor is accidentally shifted it is possible for either one or both of the fans to bind and impair or stop motor operation completely. With no power applied, the fans should be rotated manually to determine if the motor armature is rotating freely. If the fan motor is properly positioned on its mounting bracket and there seems to be a drag on the armature, a few drops of oil should be applied to the motor bearings. The motor should then be checked by applying the 115 volts AC to the motor terminals. If the motor fails to operate, it indicates that the motor is either open or shorted and should be replaced.

START CAPACITOR

The sole purpose of the starting capacitor is to supply the motor windings with an additional surge of power at the instant of starting; therefore, if the starting capacitor were faulty, the motor compressor would not start. To quickly determine if the capacitor is at fault, substitute it with one of the same part number known to be good. If normal motor operation is restored, the original capacitor is defective and must be replaced. If the motor does not start, the original capacitor is probably not at fault.

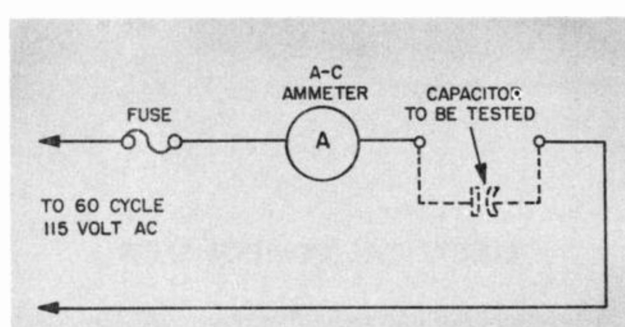

FIGURE 7

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BENCH CHECKING CAPACITORS

Follow the steps in sequence to avoid damaging the meter used in the CURRENT CHECK.

Short-Circuit Check

With an ohmmeter, check the internal resistance. Compare it with the resistance of an identical capacitor known to be good.

Open-Circuit Check

With an ohmmeter, compare the amount of needle swing obtained when the initial test-prod contact is made, against needle swing obtained on a capacitor of the same capacity, known to be good.

NOTE: It may be necessary to use a very high-range ohmmeter scale for this check.

Current Check

To test the capacitor for its approximate capacity in microfarads, connect a high-grade AC ammeter, fuse, and the capacitor as shown in figure 7. Compare the meter readings with the current values given in the chart. They should be within approximately 10% of the value given.

CAUTION: The meter must be an AC ammeter preferably with two scales covering a range of 0 to 25 amperes. A suitable fuse must be used to protect the meter, and the short-circuit test described above must be made prior to the capacity test. If these precautions are not taken, serious damage to the meter movement will result.

When a defective capacitor is replaced, it is extremely important that the new capacitor be of the same voltage and capacity rating. If a capacitor of too low a value is used, the motor will not start properly, and the capacitor will break down in a short time. If a capacitor of too large a value is used, it will not harm the capacitor, but the starting torque and operating temperature of the motor may be greatly affected. More voltage will be impressed on the winding, resulting in a temperature rise which may seriously damage the motor.

CAPACITY—CURRENT CHART

Capacitor Limits in Microfarads	Approximate Current Readings in Amperes at 115 volts, 60 cycles	Capacitor Limits in Microfarads	Approximate Current Readings in Amperes at 115 volts, 60 cycles
2— 3	.08— .12	86— 96	3.57— 3.99
4— 8	.16— .33	97—107	4.03— 4.45
9—12	.34— .5	108—120	4.49— 5
14—16	.58— .66	124—138	5.2 — 5.8
20—24	.83—1	161—180	6.1 — 7.45
26—30	1.08—1.25	189—210	7.85— 8.7
31—35	1.29—1.45	216—240	9 —10
39—45	1.62—1.87	270—300	11.2 —12.5
53—60	2.20—2.49	351—390	14.6 —16.2
64—72	2.65—2.99	378—420	15.7 —17.4
70—78	2.9 —3.24	430—480	17.8 —20
75—84	3.11—3.48		

RUN CAPACITOR

It should be kept in mind that the running capacitor's function is to reduce the power input to the motor compressor. The motor compressor will run even though the run capacitor is open though the current drain on the power source will be higher. If there is a short circuit in the run capacitor, the motor will draw excessive amounts of current causing the overload relay to trip and open the motor circuit. If the running capacitor is suspected of being shorted, it may be checked by removing the running capacitor lead from terminal 2 of the starting relay (fig. 6). If the removal of the running capacitor from the circuit permits the motor compressor to operate smoothly, it may be assumed that it is defective and should be replaced. A bench check of the run capacitor may be made by following the procedure as outlined under starting capacitor.

STARTING RELAY

The starting relay is a simple solenoid switch which momentarily connects the starting capacitor across the run and start windings of the motor compressor to provide the necessary starting torque for the motor.

The best method of checking the relay is to replace it temporarily with one of the same part number which is known to be good.

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Servicing the Apartment-Range Doors

The Philco Spacesaver or apartment-size ranges (Models 202-204-212-214-221 and 223) have oven doors that are mounted quite differently from the method of mounting the doors on the regular large-size Philco ranges. Most Philco range servicemen are familiar with the mounting and the service procedure on the doors of the large Philco ranges, but some may be unfamiliar with the apartment-size ranges. These oven doors are not as easy to service as the regular range doors, and this article will describe the service procedure on the apartment-size doors.

One of the reasons the apartment range door is harder to service, is that both the coil and latch springs are concealed above the range bottom panel, and access to them has to be through two hand-hole openings in the bottom panel. Also, on the large range, once the coil springs are unhooked from the hinges, the door can be lifted completely off the range. This is not so on the apartment range, because after the coil springs are unhooked from the door hinges it is still impossible to remove the door until the two adjusting brackets are removed. Another reason why servicing is more difficult, is that the apartment-size door pivots on a fixed hinge rod, which is concealed

FIGURE 1

and inaccessible behind the front panel. On the large range the hinge supports are accessible, being mounted on the outer side of the front frame, where they can be adjusted up or down or shimmed outward to align a door.

First, let us discuss the adjustment of the proper tension on the door coil springs. The purpose of these springs is to balance the door in its open position. They prevent the door from falling too quickly to the full open position, also they hold the door upward in the broil position. If they have too much tension, the door will not stay fully open and it may swing up gradually and burn a housewife's arms while she is removing some hot baking from the oven. If there is not enough tension, the door will not stay

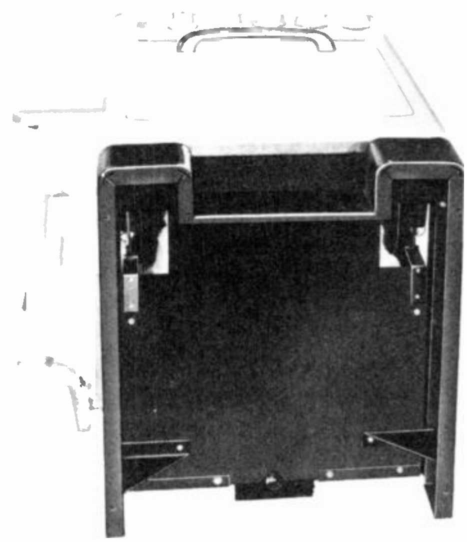

FIGURE 2

up in the broil position. On the large Philco ranges the springs can be adjusted by merely rotating them up or down on the threaded bottom hook bolt, but on the apartment-size range the brackets pictured above have to be moved back or forward in the slot in the door hinges.

These brackets are attached to each hinge by two nuts and screws of the carriage bolt type. The brackets have square holes to mount the carriage bolts in. When the nuts are loosened and tightened to make adjustments, these bolts will not rotate. This feature makes it much easier to adjust the bracket, especially in the close working space provided through the hand holes.

Before servicing the door springs, it is necessary to lay the range on its back or tip it over and rest it on some box or object. This photo shows a range resting on a padded kitchen stool.

Notice the two hand holes, through which the door hinges have to be serviced. Before shifting the adjust-

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ing bracket, the coil spring has to be unhooked from the bracket tab. Right here a word of warning is appropriate. After unhooking the coil spring from the adjusting bracket, do not let go of it while under tension. If the spring is allowed to snap back, the other end of the spring may jump out of the anchor bracket hole, and then the anchor bracket will drop out of place. If this happens it is very difficult to get the anchor bracket back in position without pulling the oven liner. When unhooking the coil spring from the adjusting bracket, ease it back until the tension is released and then let it lie beside the side panel. Later in this article we will show a picture of the anchor bracket and how the spring is mounted in it.

To proceed with shifting the adjusting bracket, once the spring is unhooked, both bracket nuts should be loosened slightly so that it can be moved to a new position. If the spring was too tight, move the bracket forward from a quarter to three-eighths of an inch; and if it was too tight, move it back about the same distance. After making the adjustment, the door cannot be checked until the range is set in its upright position. The spring adjustment cannot be checked without having the weight of the door in the open position, which affects the tension of the springs.

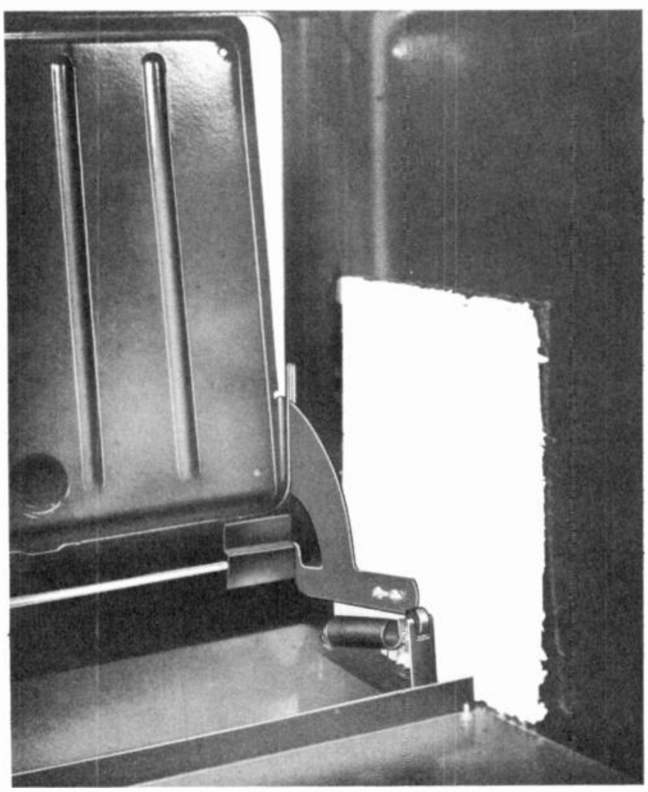

FIGURE 3

To remove a door, both coil springs should be carefully unhooked and set aside. Then both hinge adjusting brackets, plus the nuts and bolts have to be completely removed from the hinges. After this is accomplished the door can be lifted slightly upward, so that the hinge slots lift off the hinge rod, and then the door can be withdrawn forward through the front panel hinge slots. The door is installed in a reverse manner, and care must be exercised when replacing the door to see that the hinge slots are positioned over the ends of the hinge rod. Hold the door firmly until you are sure the hinges are pivoting on the rod before you release your hold on the door. Otherwise one corner of the door may drop and chip the porcelain, if the hinge slots are not positioned correctly.

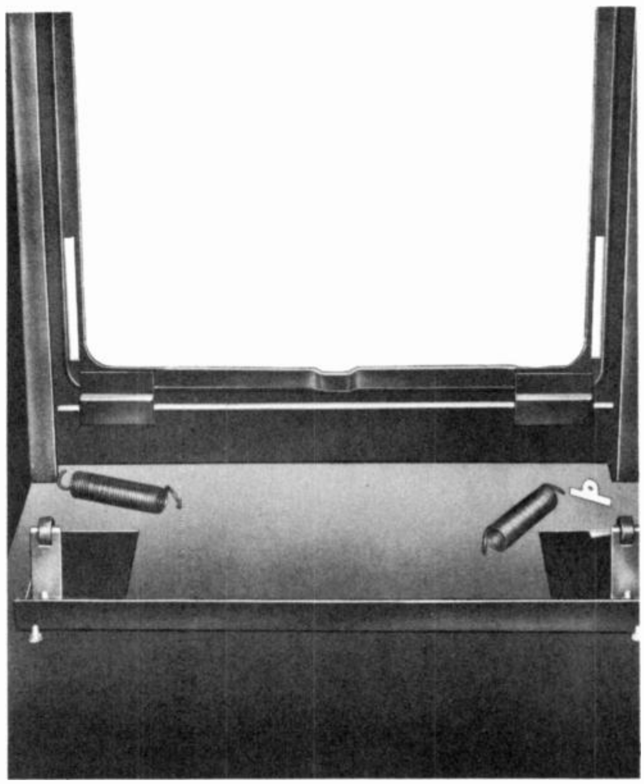

FIGURE 4

In order to see the hinge rod and anchor bracket, the oven liner would have to be removed. The hinge rod is mounted in two brackets which are welded to the front panel. A speed-nut type spring clip is pushed over the rod at each bracket, and these clips hold the rod from shifting out of position. Very rarely will a complaint be found, of a hinge rod shifting and falling

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out of the bracket. However, if this complaint should arise it would show up by the door sagging at one corner. Therefore, if a complaint is encountered where one corner or the other of the oven door sags down and cannot be seated on the hinge rod, then the only thing to be done is to pull the oven liner and reposition the hinge rod. After putting the rod back in place, new spring clips, of course, should be installed to hold the rod permanently in place.

If a new replacement door is installed and it does not center itself evenly in the door opening of the front frame, it may be necessary to install a washer over the hinge rod so that it will act as a shim between the hinge and the rod bracket. By installing one or two steel washers it is an easy matter to align the door so that it closes exactly centered in the door opening, which is necessary to give a good appearance to the front of the range.

In figure 4 photograph we have shown one anchor bracket in position and the other one lying loose on the bottom panel to show how it is shaped. It can be seen that if the spring is unhooked or should jump out of the bracket hole, the bracket would fall down out of the range and onto the floor. With the liner installed, and working up through the hand holes, it is very difficult to reach in far enough to hook the spring back into the anchor bracket, which has to be held up at the same time.

FIGURE 5

The two latch and broil stop springs perform two functions. When the door is closed they hold it in a snug position. Also, the hinge is so designed that when the door is at the broil position, the ends of the hinges rest against the rollers on the latch springs. As the door is pushed closed from the broil position, the hinge ends ride against the rollers under the tension of the spring, until the door is completely closed, and the rollers are then just slightly over the center curved section of the ends of the hinges.

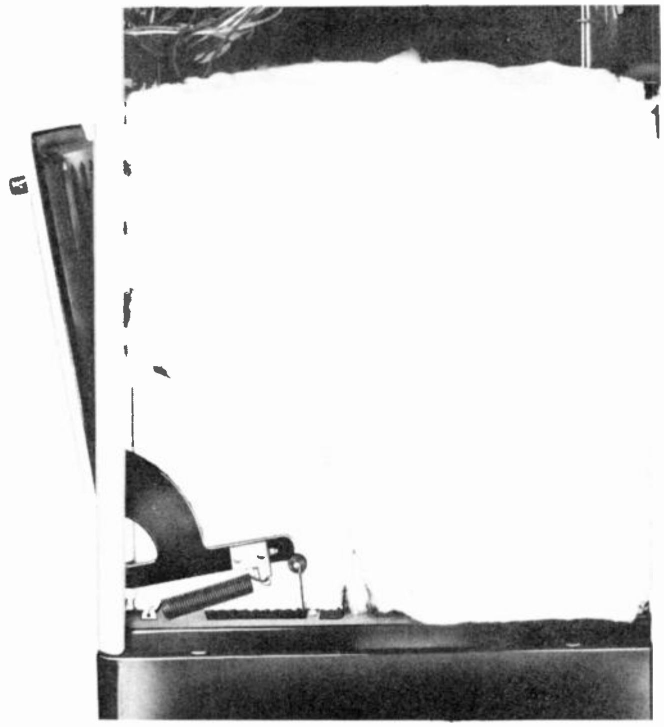

FIGURE 6

The latch springs can be adjusted somewhat by bending the spring forward or back to increase or decrease the tension of the roller on the hinge end. It is possible to do this, through the service hand holes from the bottom of the range, but if a latch spring has to be replaced, then it is necessary to remove the oven liner. When it is impossible to get enough tension by bending the latch spring, a fix can be made by installing shims between the body of the latch spring and the bottom panel. This service operation is very rarely required, but in a case where the roller will not exert pressure on the hinge when the door is closed, it may be necessary to shim the latch assembly downward until the roller comes in contact with the end of the hinge.

When working up through the hand holes, and without having the oven liner removed, the forward latch spring bolt is accessible. The rear one is not, because of an angle iron welded to the bottom panel. However, by loosening the front bolt and nut, a spacing washer can be forced between the latch body and the bottom panel. This will lower the latch roller the depth of the thickness of the washer. This fix is rarely needed, but in extreme cases where the spring cannot be bent down enough to make a good snug contact between the roller and the end of the hinge, it is practical to use it.

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Another service operation sometimes required on the apartment-size door is to spring the shape of the door, so that it closes evenly across the top. On a service call where the top half of the door fits snugly against the top flange of the oven liner, and the other half of the door is loose, quite often a serviceman will place a cloth rag or towel behind one side of the door and then spring the other side inward to make it fit. This usually results in a temporary fix only. After the door has been opened and closed a few times, it springs back to its natural shape and is again found to be loose at the same corner.

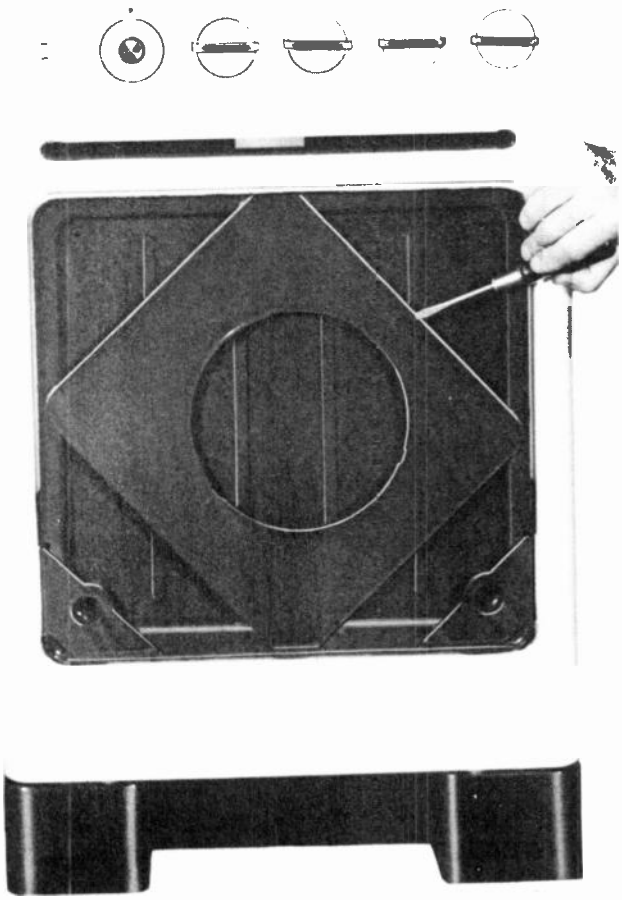

FIGURE 7

The best method to spring a door to the proper fit and shape is to remove the outer door panel, and then proceed to reshape the inner door panel only. The picture shown above with the outer door panel removed shows the center bracing piece which holds the door to shape. If the door requires reshaping, it is necessary to apply some tension on this center bracing piece at the place where the screwdriver in the photo points to. If this bracing piece is sprung out or in to match the necessary springing of the whole door, then a permanently aligned door will result. After the inner door panel is aligned properly to fit across the top flange of the oven liner, the outer panel can be reinstalled and the four screws tightened. In this way the tension between the two panels is even and the outer panel does not distort the new shape of the inner door panel.

The apartment-size door, like the large range door, requires a slight air gap across the bottom of the door between it and the lower liner flange. This gap has to be large enough to allow for the expansion of the oven liner when it is heated. On all Philco ranges where a door opens slightly when the oven reaches high heat, the first procedure is to see if the oven liner hook bolts are tight. If they are not snug, they should be tightened so that the oven liner is pulled tightly into the range frame. On the large Philco range if the bottom door gap is still too tight after drawing in the oven liner, the door can easily be shimmed out by adding a shim behind the door hinge support. This you are unable to do on the apartment-size range. Therefore, on this range, it is sometimes necessary to draw the oven liner in, tighter than the liner on the full size range.

There have been cases where an apartment-size door, when closed, would bind only at one spot, at the center of the bottom oven liner flange. In this case, the oven liner weld should be examined. If there is a slight bump in the liner weld, it may be possible to flatten it slightly, by tapping it sharply with a block of wood. This, of course, is only done after the liner can no longer be drawn any tighter in the range. If the bump is excessive or cannot be flattened, a new liner should be installed.

We hope that this article will prove helpful to you in your endeavor to provide your customers with good service. We will continue to bring you information which will make your job easier.

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This month . . .

JACK B. MATTINGLY, *Philco Service District Representative* for the Southwest Division, gives us his ideas on the common sense approach to servicing. During World War II Jack served with the Signal Corps and taught radar in France. He joined the Philco family in 1946 and following a stint with Philco's TechRep Division, he became an active representative of PFSS.

In my opinion . . .

Service is a business and like any other business it must be run efficiently to make it pay. The quicker a trouble can be located and repaired, the more money a service organization can make. The most important single thing one can do toward efficiency in servicing is to use a good common sense approach in locating a specific trouble. Too many men, when confronted with a problem, look for the difficult and hard to find troubles and, in a great many cases overlook the simple, obvious little things. In television, especially, is this true, and it becomes even more so when one is just getting into this phase of service work. Service records show that 80% to 95% of all troubles are very simple and in television a very great percentage of these troubles are just bad tubes.

Even the old experienced serviceman who knows all the symptoms will, in many cases, forget all the common causes of a certain type trouble and look for something unusual because he has recently heard of or read about such a case.

In a recent example, a distributor service manager was called in to help locate an odor in an automatic defrost refrigerator. The serviceman, an old timer, had changed just about every electrical component in the refrigerator but had forgotten about spoilage of food. In this case, milk had been spilled and had run down into the mold trim along the bottom of the food tank and had spoiled.

In common sense servicing, we must look at every problem logically and check the simplest and most common causes first. We must isolate the trouble to a certain section or part. We must then find the faulty component in that section or part and then it is merely a matter of changing to a good part.

We at Philco believe that the easiest way for a man to put himself in a position to use the common sense approach is to acquaint himself with the product he is to work on. This idea of efficiency in servicing and of knowing the product is one of the main objectives of Philco Factory-Supervised Service. For we know that only by knowing what makes a product tick can a person take a common sense approach to servicing it.

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