RIDER'S VOLUME XVI

1.

HOW IT WORKS

AND

COMPLETE INDEX

John F. Rider Publisher, Inc.

404 Fourth Avenue

New York 16, N.Y.

RIDER'S VOLUME XVI

HOW IT WORKS

AND

COMPLETE INDEX



John F. Rider Publisher, Inc.

www.americanradiohistory.com

404 Fourth Avenue

New York 16, N.Y.

TABLE OF CONTENTS

1

F-M RECEIVING ANTENNAS

Voltage and Current Distribution — 1. Antenna Resistances — 2. Resonance and Impedance Relations — 2. Impedance Matching — 3. The Folded Dipole — 4. Orientation of F-M Receiving Antennas — 5. Dipole With a Reflector — 6. Length of Half-Wave Antenna — 7. Maximum Voltage Input — 8. Noise Reduction — 8. Indoor F-M Antenna RCA Model 68R1 — Farnsworth Model GK-140 — 9. F-M Antenna in G. E. Model 417 — 9.

TELEVISION PICTURE MALADJUST-MENT OR INTERFERENCE 10

THE SELENIUM RECTIFIER 13.

Installing Selenium Rectifiers — 14. Rectifier Tube Replacements in A-C Receivers — 14. Rectifier Tube Replacements AC-DC Receivers — 14. Rectifier Tube Replacements AC-DC Battery Receivers — 16.

PRE-EMPHASIS AND DE-EMPHASIS 17 Montgomery Ward Model 74WG-2505A — 19.

SPECIAL AVC CIRCUITS

Magnavox Model CR-183 — 20. Montgomery Ward Airline 74BR-1812A — 21.

TUNING INDICATORS FOR F-M RECEIVERS 23

Types of Tuning Indicators — 23. The Meter Indicator — 23. Operational Difficulties — 24. Stromberg-Carlson 1135-A — 25. Transfer of Tuning Indication Voltage — 26. Operation of Tuning Indication System — 26.

TELEVISION H-V POWER SUPPLIES 28

Circuit Functions - 28.

BATTERY CHARGING CIRCUITS 31

A Rectifier Tube Battery Charger — 31. A Copper-Oxide Battery Charger — 34. Battery Economizer Circuit — 35.

Copyright 1947 by John F. Rider

All rights reserved including that of translation into the Scandinavian and other foreign languages.

Printed in the United States of America

20

F-M RECEIVING ANTENNAS

The advantageous features of f-m over a-m receivers in giving better reception and eliminating noise interference are quite well known. However, these favorable features can only be wholly realized if the proper f-m receiving antenna is employed. Some may dispute this point about the *necessity* of an f-m antenna. due to the fact that with straight pieces of wire very good reception of f-m has been attained. These cases are only of a special kind wherein the f-m receiver itself happens to be located in a very favorable region with respect to some of the f-m broadcasting antennas where the signal strength is high. In most other installations it has been shown that with the proper type of f-m aerial, f-m reception is definitely improved. If you are in doubt whether or not to use an f-m antenna in your locality and if you do not know too much about the surrounding terrain and where the f-m broadcasting antennas are located, then by all means it is definitely advisable to use an f-m receiving antenna.

The antenna generally used for f-m reception is a single half-wave dipole. In using such an antenna it is necessary to understand some of the important features relative to its proper orientation and hookup so that the correct type of reception can be obtained. In other words, the antenna has to be oriented in a certain direction in order to pick up the maximum amount of signal energy, and it has to be properly "impedance-matched" to the f-m receiver's r-f input section for the maximum transfer of energy. In order to understand the reasons why a half-wave dipole is used and why it is oriented in a special direction, it is necessary to understand something about current and voltage distribution and impedance matching in such an antenna, some other fundamental factors, and also about the radiation from f-m transmitting antennas.

Voltage and Current Distribution

In choosing the type of antenna for f-m reception, as well as other types of reception, something should be known about how the voltage and current are distributed along the antenna. In this respect let us examine the voltage and current distribution along a fullwavelength straight wire antenna as seen in Fig. 1.

The distribution is such that at the ends of the wire the current is a minimum and the volt-



FIG. 1.—Voltage and current distribution along a full-wavelength straight wire antenna.

age a maximum. Since the voltage and current are represented by sine waves, it is evident that they change polarity at certain points along the full-wavelength wire. From the illustration, however, it is noticed that these changes in polarity of current and voltage do *not* occur at the same points.

The current is a maximum and the voltage zero at one-quarter of a wavelength from either end of the wire. Since the full wavelength of wire represents one complete cycle or 360 degrees of electrical length of either voltage or current, then under the circumstances of how the voltage and current is distributed these standing waves are said to be 90 degrees out of phase. Choosing any point along the wire and comparing the voltage and current waves, the 90-degree phase difference is the same as saying that the reversal of polarity of the current and voltage occurs $\frac{1}{4}$ of a wavelength apart.

Now, let us just consider a half wavelength of wire or just half of the picture of Fig. 1. This half-wave wire is illustrated in Fig. 2 and is generally representative of the current and voltage distribution of the half-wave dipole antennas as used with many f-m receivers. A half-wave antenna is often referred to as being just a dipole antenna. The terminology of the word dipole originated from the fact that voltage distribution along the half-wave antenna is such that at the ends of the antenna the voltages are of opposite polarity (i.e., positive and negative charges). This is readily evident by the half cycle of voltage in Fig. 2.

Since the half-wave dipole antenna is the



basic type used in f-m receivers, let us examine some of its characteristics as shown in Fig. 2. The current is seen not to change polarity and there is, ideally, zero current at the antenna ends with maximum current at the center of the dipole at $\frac{1}{4}$ wavelength from either end. It is the voltage which changes polarity, and the change is such that there is, ideally, zero voltage at the center of the dipole or at $\frac{1}{4}$ wavelength from either end. At the ends of the dipole the voltage is a maximum, but the voltage at one end is of opposite polarity to the voltage at the other end.

Antenna Resistances

All the power input to a transmitting antenna is dissipated in one form or another. The socalled *resistances* of an antenna determine how this power is dissipated. Any antenna, whether it is used for receiving or transmitting, contains two types of antenna resistance. One type is the usual ohmic resistance of the antenna often called the real resistance. The other type is often called the imaginary or radiation resistance. In other words, we are concerned with two types of power.

There is the power dissipated due to the actual ohmic resistance of the antenna and the power radiated from the antenna. The former power is readily understandable and from this the ohmic resistance is conceivable, but the resistance dissipating the latter portion of the power is not, in reality, a physical resistance in the sense that the other one is, and hence it is often known as the imaginary or radiation resistance of an antenna. Consequently, when there is talk of power dissipation of an antenna, the I^2R total power loss should be understood to encompass both types of resistances. In other words, resistance R is the combination of the ohmic resistance of the antenna and the radiation resistance of the antenna.

In most types of antennas the ohmic resistance is much smaller than the radiation resistance, so that for practical purposes most of the power is considered to be dissipated through the radiation resistance. For a half-wave antenna the radiation resistance is often measured at the point of current maximum and for a halfwave dipole antenna in free space (i.e., no intervening objects including ground effects, building, mountains, etc.), the radiation resistance is found to be equal to approximately 73 ohms. This is only an ideal value which is never achieved and actual value varies somewhat away from 73 ohms depending on the exact length of the dipole and presence of other physical factors.

Resonance and Impedance Relations

Considering the simple half-wave dipole antenna that is center tapped, the antenna behaves like a series resonant circuit at this tap. This is shown in Fig. 3 where L, C, and R represent the inductive, capacitive, and resistive components respectively. The resistive component is primarily the radiation resistance of the antenna, since the real or ohmic resistance is very small



FIG. 3.—Center-tapped simple half-wave dipole antenna and equivalent series circuit.

even at the increased value it has at high frequencies.

If the dipole is approximately a half wavelength long, or about $\frac{1}{4}$ wavelength on either side of the center tap, the antenna will act as a series resonant circuit to the frequency for which it is a half-wave antenna. For a series resonant circuit the impedance is a minimum

and purely resistive, the current a maximum, and the voltage a minimum. This is also seen in Fig. 2, where at the center point of the halfwave antenna, the current is a maximum and the voltage a minimum. At other points along the antenna the impedance is not purely resistive because it encompasses some reactance; therefore the impedance is greatest away from the center point, being a maximum at either end of the half-wave antenna, because of the minimum value of current and maximum value of voltage. The impedance of the antenna is a very important factor in the proper matching of the antenna to the transmission or feeder lines for the maximum transfer of energy from the antenna to the receiver input.

Impedance Matching

In order to make sure that the maximum amount of energy pickup is transferred from the half-wave antenna to the receiver input, the antenna has to be properly impedance matched to the receiver input. A fair idea of impedance matching can be seen in Fig. 4. Looking in the direction of the input tube of the f-m receiver through the primary of the input transformer, we see an impedance equal to Z_1 and, looking in the direction of the transmission line and antenna, we see an impedance of Z_2 . For maximum energy transfer, Z_1 should equal Z_2 . Under these conditions, the maximum amount of energy possible, not *all* the energy, will be transferred to



FIG. 4.—How a half-wave antenna is impedance matched to the receiver input.

the grid of the first f-m tube. For the complete match to occur, the transmission line should first be impedance matched to the antenna and then these units should match the input impedance of the first tube. The input transformer is the unit that takes care of this latter match. If there is any mismatch, there will be a loss of energy and the maximum amount of energy possible will not be transferred.

As we have pointed out, the input impedance at the center of the half-wave dipole is a pure resistance and ideally equal to 73 ohms. In





practice, this value of input impedance of the dipole can vary anywhere from 50 to 100 ohms due to varying physical factors, such as the construction of the antenna, the obstacles near the antenna, and its height. A very simple impedance match to such an antenna is made by using a twisted pair of transmission wires (usually, ordinary rubber-insulated wire) for the feeder section, as shown in Fig. 5. The so-called characteristic impedance of such a transmission line is approximately 75 ohms. By choosing different types of wire for the twisted line and by being able to vary the physical hookups to the antenna somewhat, the impedance of this transmission line can be varied on her side of this 75 ohms, for the desired impedance match. In addition to giving a good impedance match, this type of line minimizes pickup by the lead-in due to closeness of spacing between each individual wire, and thus noise pickup by the transmission line is reduced.

Under these circumstances where the antenna and line are properly matched, the input transformer of the receiver should have an impedance approximately equal to that of the line or antenna. That is, if the antenna resistance and characteristic impedance of this line is about 100 ohms, then looking *into* the primary of the input transformer, toward the first tube of the receiver, the impedance seen should also be 100 ohms. Under these circumstances the maximum

w.americanradiohistory.com

amount of energy transfer will be made from antenna to receiver.

Really, almost any good type of transmission line, in addition to the simple twisted pair, can be used to match the antenna as long as the characteristic impedance of the line is close to the radiation resistance of the antenna. Many receivers use f-m antennas supplied by outside manufacturers, and some receivers are not directly supplied with an f-m antenna, stating that an f-m antenna can be bought. Under these circumstances, the knowledge of the input impedance of the input transformer of the receiver is necessary in order to secure the proper impedance match. Many f-m receivers today have an input impedance equal to about 300 ohms, so that the transmission line and antenna used have to be properly matched to this 300ohm impedance for proper energy transfer. Under these circumstances, transmission lines with a characteristic impedance of 300 ohms would normally be used to match the line to the transformer, but the 300-ohm line would be mismatched to, say, a 100-ohm simple half-wave dipole. In some instances, the f-m set may have an extra r-f stage or some other means where greater amplification can be attained and this amount of mismatch therefore can be tolerated.

There are, however, variations of the simple half-wave dipole antenna and variations in transmission line hookup so that impedance matching can be closely attained. There are folded dipoles, dipoles with reflectors, folded dipoles with reflectors, and specially constructed simple half-wave dipoles that change the effective radiation resistance. The analysis of some of these different types of f-m receiving antennas will be discussed later.

No matter what type of transmission line is used with any antenna, the smaller the length of the line, the fewer will be the line losses, no matter how well it is impedance matched. If the line *must* be long because of the location of the antenna, a low-loss transmission line should be used in order to prevent excessive reduction in the signal reaching the receiver.

The Folded Dipole

The folded dipole has a great advantage over the simple half-wave dipole antenna in that it exhibits a much higher input impedance. A folded dipole is nothing more than a simple half-wave antenna as seen in Fig. 3, to which has been added another half-wave antenna section, joined at the ends.

A typical half-wave folded dipole is shown in Fig. 6. From this figure the folded dipole is seen



to be a full wavelength of wire (or appropriate tubing) but in such a manner that it approximately takes on the shape as seen in Fig. 6. The two open end parts are the effective center points of the folded dipole to which the transmission line is attached. This folded dipole is similar to an autotransformer in which the primary of the transformer is analogous to that part of the folded dipole which has the transmission line attached, and the secondary of the transformer is analogous to the other half-wave section of the folded dipole. According to this similarity, it is readily seen that a mutual impedance exists between the half-wave sections of the folded dipole in the same way that mutual inductance exists between the windings of a transformer. Since the folded dipole is center tapped, as shown, and since at this point the input impedance of this half-wave section is also considered as a resonant section, the impedance which is reflected into the center fed section from the other section, under this specific criterion, is resistive also. There are a few factors in the makeup of the folded dipole, as well as the simple dipole, which must be taken into account in order to make sure of this resistive input impedance. This will be seen later, but for most practical purposes the input impedance is considered to be predominantly resistive.

Now, since these two half-wave antenna sections of the folded dipole are attached to each other at the end points and since the distance d separating the two half-wave sections is much smaller than half-wavelength of the antenna section, the mutual impedance is considered to approach the maximum possible value. In other words, using the analogy of the transformer

4

again, the coefficient of coupling of the halfwave sections of the folded dipole is said to be approximately unity. Since each individual halfwave section has its own so-called self-impedance similar to the self-inductance of the windings of a transformer, the total *self*-

wave sections of the folded dipole is said to be approximately unity. Since each individual halfwave section has its own so-called self-impedance similar to the self-inductance of the windings of a transformer, the total self*impedance* of both antenna sections (since they are connected) is equal to the sum of their individual self-impedances. The total self-impedance is not the complete impedance of the antenna because the antenna impedance, as a whole, takes into account the mutual impedance besides the total self-impedances. The type of wire or tubing used for each half-wave section is almost always the same material, so that the self-impedances of both half-wave sections are about the same, neglecting the small difference brought about by the slight spacing of that halfwave section to which the transmission line is attached.

For an autotransformer that has its windings wired in series aiding, the total inductance of the unit is equal to the sum of the individual self-inductances, plus twice the value of the mutual inductance. If the individual selfinductances are equal and if the coefficient of coupling is unity, then the value of the mutual inductance will be the same as either selfinductance. Under these circumstances, the total inductance of the autotransformer is equal to four times the self-inductance of one part of the winding.

The same thing is true, for most approximations, of the folded dipole. The individual selfimpedances of the half-wave sections are about equal and the coefficient of coupling between these sections is considered to be unity, so that the mutual impedance is the same as either individual self-impedance. The total input impedance for this folded dipole is the sum of the individual self-impedances plus twice the mutual impedance. This means that the total input impedance of the folded dipole is equal to four times the value of either self-impedance. For the half-wave folded dipole these impedances are resistive, and thus it is said that the total input resistance of the folded dipole is equal to four times the input resistance of a single halfwave section of the folded dipole. Since a simple half-wave dipole antenna has approximately the same input resistance as a single half-wave section of the folded dipole, the input resistance of a folded dipole is about four times as great as that for a simple half-wave dipole.

Under very favorable idealized conditions the input resistance of a half-wave dipole is equal to about 75 ohms. This means that under similar conditions the input resistance of the folded dipole is equal to 4 times 75 or 300 ohms. Thus we see that for f-m receivers having a 300-ohm input impedance, a 300-ohm transmission line can be used to match the folded dipole to the receiver for maximum energy transfer.

Orientation of F-M Receiving Antennas

According to the regulations of the FCC, the f-m broadcasting transmitting antenna must be horizontally polarized. Since the frequency of transmission is quite high, radiation from the transmitting antenna must be horizontally directive because of the bad effects of the atmospheric sky layers and ground which absorb and attenuate high-frequency signals. Because of the horizontally directive properties of radiated f-m signals, the f-m receiving antenna should be oriented in as best a horizontal position as possible in order to pick up the maximum amount of signal energy. There are special cases where the FCC allows polarization other than directly in the horizontal plane, but these cases are few in number. If such a transmitting station does exist in your neighborhood, then the receiving antenna should be oriented in a slanting or diagonal manner so that both horizontally polarized and vertically polarized signals can be picked up adequately.

For horizontal polarization, the electric field (electrostatic lines of force) of the transmitting signal is parallel to the ground or horizontal. This means that the receiving antenna has to be horizontally positioned in order that the passing signal may induce the maximum possible voltage in it. Horizontal polarization is more favorable than vertical polarization because certain interference phenomena, such as ignition interference, is often polarized very strongly in a vertical direction. This means that the use of horizontal polarization enables the f-m receiving antenna to have a better signalto-noise ratio. In other words, the horizontal orientation of the antenna helps the antenna discriminate against noise in favor of the signal pickup.

The receiving antenna should be oriented in

the direction of the f-m transmitting antenna to be able to receive the maximum adequate signal pickup from the directive antennas. Since a number of f-m stations cover the same area but are located in different places, the amount of signal pickup by the receiver antenna will differ for the various f-m stations. The receiving antenna should be placed broadside to the directed rays of the transmitting antennas for which the signal pickup is the weakest. In this way the receiving antenna serves its most useful purpose in trying to obtain as best as possible equalized signal pickup on all of the f-m stations in its area.

Dipole With a Reflector

In many localities where the receiver is located, the f-m signal pickup required for proper reception is greater than that of a half-wave dipole or folded dipole antenna so that something has to be done to increase the signal pickup. Since the antenna is in an area where the signal horizontally surrounds it, one can well realize that signal energy exists at points other than just around the dipole itself. This is a natural understanding and leads us to the idea that if some of this signal energy from the surrounding area could be effectively directed toward the antenna itself, then the antenna would effectively have a greater signal input. This is especially necessary when the receiver is located a great distance away from the transmitting antennas and when the signal pickup is weak for the half-wave dipole.

In order to increase this signal pickup effectively the antenna employed is equipped with a "reflector" element. This is shown in Fig. 7

FIG. 7. — Simple halfwave dipole equipped with reflector element to increase signal pickup.



where a simple half-wave dipole is used, and placed behind this dipole and in the same plane of the dipole is the reflector element. This reflector conductor is usually of the same material as the dipole itself, and in practice it has been found that the reflector should be slightly longer than the length of the dipole used. The reflector should be placed on that side of the receiving dipole *away* from the transmitting antenna whose signal it is desired to receive. This means that the desired signal will be approaching the antenna dipole in the direction indicated in Fig. 7. That part of the signal that passes the dipole and hits the reflector conductor will be reflected back to be picked up by the dipole.

The distance d that the reflector is spaced from the dipole is a criterion in the amount of increased signal pickup, and it will usually be somewhere from $\frac{1}{10}$ to $\frac{1}{4}$ of a wavelength away from the feed-in dipole element. Most manufacturers specify the spacing in their service instructions accompanying the antenna. The reason for the certain amount of spacing is to make sure that the reflected signal that is picked up by the receiving dipole is *aiding* the signal directly picked up by the same dipole so that the maximum possible total energy pickup is available.

The way in which the signal is increased can also be explained in the manner of transformer action. In other words, there also exists a certain amount of mutual impedance between the dipole and reflector determined primarily by the distance separating the elements and selfimpedance of the elements. In brief, then, when the signal hits the reflector a voltage is induced in it which causes a corresponding current in the reflector. This reflector current by analogous transformer action induces a voltage into the lead-in dipole element, the exact amount depending upon the mutual impedance, and the phase relation of the voltage depending upon the spacings between the elements, which is often $\frac{1}{4}$ wavelength apart. Thus it is seen how the receiver antenna with a reflector can have an effective increase in signal pickup over a half-wave antenna without a reflector.

Since the mutual impedance exists between the elements and since the signal pickup is increased, the effective input impedance is also increased. The exact value of increased input impedance depends upon the degree of coupling and hence the value of mutual impedance between the elements. When used with a simple half-wave dipole antenna or folded dipole, the reflector will increase the input impedance, so that in addition to increasing the signal pickup the reflector can change the input impedance for perhaps a better impedance match. When used with a reflector, the half-wave antennas become unidirectional in that there is very little signal pickup from the reflector side of the arrangement.

Length of Half-Wave Antenna

So far we have described the length of the antenna as a half-wavelength and similar nomenclature. What is most desired to be known is the actual physical length of the antenna and why the particular length is chosen. If only one frequency is going to be picked up (i.e., for a fixed frequency f-m receiver) then the antenna length is easy to calculate and is based on that signal frequency. However, we are mainly concerned with broadcast f-m receivers. The f-m broadcast band of today is between 88 and 108 mc and the antenna length must be chosen so that it will be responsive to all frequencies in this band. Since in many instances some transmitting signals are much stronger than others, the design length should favor the weaker stations. For most practical purposes, however, the half-wavelength of the antenna is designed at the center frequency of the band of frequencies it is to receive. This means that in the f-m broadcast band the design of antenna is made at 98 mc.

It is well known that a 10-meter wavelength means a frequency of 30 mc, but the simple formula used to derive it is often forgotten. The wavelength of a specific frequency is found by dividing this frequency into the *velocity of radio waves*. The velocity of radio waves is equal to 300,000,000 meters per second and thus with the frequency, f, in cycles per second, the wavelength in meters is given by the following:

Wavelength
$$=$$
 $\frac{300,000,000}{f}$ in meters

This is for one full wavelength. If we change the units of this formula and divide the right hand side by 2, we will find that

$$L = \frac{492}{f(mc)}$$
 in feet, or
$$L = \frac{5904}{f(mc)}$$
 in inches

where L is equal to the length of a half wave-

length in free space and f is the frequency in megacycles per second.

In half-wave antennas there is a so-called "end effect" due to the material supporting the antenna and other physical construction which makes a true half-wavelength antenna actually electrically longer than it is. In order to make sure that the electrical length of the antenna used is *effectively* one-half wavelength long, the actual physical length is made less than that for a half wave in free space which has no end effects. The effective length of the antenna increases with increase in frequency because the end effect also is increased. From about 5 to 30 mc, the physical length of the half-wave antenna should be reduced by about 5 per cent to make it effectively operate as a half-wave antenna. Since the frequency of operation of the f-m band today has a center frequency of about 100 mc, the effective length would increase, which means that the physical length should be reduced by more than 5 per cent. For most practical purposes at these high f-m frequencies and taking into account other factors, the physical length of the half-wave antenna should be reduced by about 7.5 per cent. This means that the preceding formulae have to be multiplied by 92.5 per cent to give the correct effective half wavelength. Thus,

$$L = \frac{492 \times .925}{f(mc)} = \frac{455}{f(mc)} \text{ in feet, or} \\ L = \frac{5904 \times .925}{f(mc)} = \frac{5460}{f(mc)} \text{ in inches}$$

where L is equal to the effective length of a *half-wave antenna*.

Therefore, for most center lead-in half-wave antennas each half of the dipole is approximately equal to half the values of L found in the foregoing formulae. For instance, in the f-m broadcast band the center frequency is 98 mc. This means that the length of the halfwave dipole antenna should be as follows:

L =
$$\frac{455}{98}$$
 = 4.64 feet, or
L = $\frac{5460}{98}$ = 55.7 inches

Since each section of the dipole is *effectively* a quarter wavelength long, the actual physical

length is $\frac{4.64}{2}$ or 2.32 feet, or $\frac{55.7}{2}$ or 27.85 inches long. In actual practice the lengths of the individual sections of the half-wave dipole will be somewhat smaller than that computed above due to the gap occupied by the transmission line.

Maximum Voltage Input

It is well known that a maximum voltage input to the receiver is desired but yet the feed-in to the half-wave antenna or folded dipole is center driven and at this point the *current* is effectively at a maximum. How then can we conceive of a maximum voltage to the first f-m tube? There are numerous ways of explaining this, but one of the simplest methods is through the understanding of the impedance of a parallel circuit.

In Fig. 8 a dipole antenna and input circuit to an f-m receiver is illustrated along with the



FIG. 8.—Dipole antenna and input circuit to an f-m receiver with current and voltage curves effective at the dipole.

current and voltage curves effective at the dipole. Since the center point of the antenna is at the loop of the current curve, a maximum amount of current will flow through the primary of the input transformer. This maximum amount of current sets up a maximum magnetic field which causes a maximum flow of current in the secondary due to induction. Since the parallel tuned secondary circuit is resonant at the frequency of operation, it will offer a maximum amount of impedance, which is purely resistive. Since the current flowing in the secondary is a maximum and the impedance also a maximum, the voltage drop across the grid of the input tube will likewise be a maximum because the voltage is equal to the

product of the maximum current and maximum impedance.

Noise Reduction

In many f-m antenna systems the primary of the input transformer often has its center point grounded in order to reduce noise interference through the medium of the transmission line. Many of the f-m circuits appearing in the Rider Manual Vol. XVI, as well as other Rider Manuals such as Vol. XV, contain this arrangement. This was illustrated in Fig. 8 but the left hand side of this figure is redrawn in Fig. 9 to make this system of noise reduction somewhat clearer. Since the transmission line used (no matter what type) covers a greater area than the antenna itself. it has a tendency to pick up noise voltages. This is especially so if the transmission line is quite long. In order to reduce this noise pickup and hence increase the signal-to-noise ratio to the input to the f-m receiver, the center tap of the primary is grounded. It effectively does away with this noise in the following manner:

The noise signal when it hits the transmission line induces equal voltages in each lead of the transmission line which in turn produces noise current that flows in the same direction in the transmission line as indicated in Fig. 9. By center tapping the primary of the input transformer to ground, the circuit becomes symmetrical and the noise currents both flow toward this ground connection. This effectively makes the individual currents out of phase, and since they are equal in magnitude they effectively produce magnetic fields which

FIG. 9.—Grounding the center point of the primary of the input transformer reduces noise interference through the medium of the transmission line.



cancel each other. Hence, the total noise voltage induced in the secondary of the input transformer is effectively zero.

This reduction in noise pickup is only in reference to that picked up by the transmission line and not that noise inherently picked up by the dipole itself. This latter noise finds its way into the receiver as well as the desired signal input, but accordingly this noise is small and if it just changes the amplitude of the received signal, the f-m receiver will take care of these amplitude variations in the f-m signal by either limiting their variations or not responding to them at all.

Indoor F-M Antenna RCA Model 68R1— Farnsworth Model GK 140

Although it is best to have the f-m receiving antenna mounted on top of a building or structure, and as high as possible, there are instances where using an outdoor antenna is not possible or is impractical. Due to such circumstances, many f-m receivers are manufactured with f-m indoor antennas similar to the way loop antennas are used in a-m sets. These antennas are in one form or another similar to those previously discussed. For instance, in the RCA Model 68R1, etc., which appear in Rider's Vol. XVI, a folded dipole is inserted inside the cabinet. However, it should be remembered that the f-m signals are directional and in many instances it may be necessary to orient the cabinet until the best reception is heard on all stations. If reception is weak and noisy using this indoor antenna, RCA manufactures an outdoor f-m antenna of the dipole and reflector type (stock No. 225) which will afford much better reception than the indoor antenna.

In the Farnsworth f-m receivers Models GK 140 to GK 144 also appearing in Rider Vol. XVI, an indoor antenna modified in the form of a folded dipole is now used. A diagram of this folded dipole arrangement is shown in Fig. 10. To make this antenna arrangement about 5 ft of Amphenol 300-ohm twin lead is used with some of the polyethylene plastic insulator stripped away from the ends. Next, the two leads on each end are twisted together and then soldered as shown in Fig. 10. The next step is to cut away a portion of the insulation around one lead in the middle of the dipole, equal to the width of the twin lead and then cut and bend the bare lead so that two bare pieces of the wire protrude. This part of the antenna represents the folded dipole. Next, take another piece of the same Amphenol 300ohm twin lead and strip off some of the plastic insulator at one end so that the two leads are

bare. Solder these two bare leads to the two of the center part of the folded dipole as shown in Fig. 10. This latter twin lead represents the



FIG. 10.—Farnsworth indoor antenna modified as *e* folded dipole.



FIG. 11.—Schematic diagram for the G. E. Model 417 dipole antenna to the r-f input circuit.

transmission line, and it should be the length that will make its wiring to the receiver input most favorable.

This type of a folded dipole construction is more suitable for indoor antenna use and not outdoor where the construction must be more rigid.

F-M Antenna in G.E. Model 417

The majority of f-m receivers as seen in Rider's Vol. XVI (and also Vol. XV) use or make mention of the need for an outdoor f-m antenna. In the General Electric Model 417 a simple half-wave dipole antenna is used, to which is connected a 300-ohm twisted-pair transmission line. The schematic for this is shown in Fig. 11 and is easily noticed in the 88 to 108 mc f-m band of the "clarified schematic," General Electric page 16-19 of Rider's Vol. XVI. The dipole and transmission line used give a good impedance match to the input receiver circuit for the desired energy transfer for good reception.

TELEVISION PICTURE MALADJUSTMENT OR INTERFERENCE

The reproductions of the test pattern as seen on a television receiver screen in the following illustrations, will serve as a guide to the serviceman for the correct installation of antenna systems, or when he is ready to install a receiver, to make a final check of any service work he has done.

As will be seen, some of the patterns (Figs. 1 through 4) result from incorrect adjustment of the tuning control which are operated by the owner of the receiver. Figs. 5 through 10, are due to some misadjustments of pre-set controls,

which are under the control of the installer or the serviceman. Figs. 11 through 15 are due to incorrect placement of the receiving antenna, incorrect adjustments of components in the receiver, or strong local interference.

The typical abnormalities of the test pattern which are shown in these illustrations, are common to all television receivers, and the measures used to correct these troubles will be similar in all cases.

These figures are reproduced through the courtesy of the General Electric Company.



FIG. 1.—Normal picture: The separation between the lines of the resolution wedges is sharp and four gradiations from white through gray are well defined, the circles in the center of the pattern are symmetrical.



FIG. 2.—Contrast too low: Note that due to the too high brightness the clear definition in the wedges is lost and all the blacks have grayed out.



FIG. 3.—Contrast too high: Too low brilliance destroys the definition, deepens the blacks so that only black and white are seen.



FIG. 4.—Focus control misadjusted: The whole pattern becomes fuzzy and except at the outer edges there has been a graying of the entire pattern.

TELEVISION PICTURE



FIG. 5.—Vertical hold misadjusted: This causes the pattern to travel so that it is seen moving up or down the screen and overlapping.



FIG. 8.—Horizontal hold control misadjusted: The test pattern leans to right or left on the screen.



FIG. 6.—Vertical linearity control misadjusted: The test pattern is out of true and is bunched at the top or bottom of the viewing screen.



FIG. 7.—Vertical height control misadjusted: The test pattern is elongated vertically and the circles are cut at the top and bottom of the screen.



FIG. 9.—Horizontal linearity control misadjusted: The pattern is unsymmetrical and the circles and wedges are elongated either to the right or left.



FIG. 10.—Horizontal width control misadjusted: The test pattern tends to bulge to either side and appears to flatten out at the top and bottom.

RIDER'S VOLUME XVI "HOW IT WORKS"



FIG. 11.—R-F interference pickup on antenna: This is indicated by an overall fuzziness caused by bars of alternate black and white angling across the screen—re-location of the antenna may be indicated.



FIG. 12.—Weak diathermy interference: This interference pattern is shown as a band of small interwoven circles across some portion of the screen. Re-location of the antenna may clear this up—if not the offending equipment must be located and isolated.



FIG. 13.—Strong diathermy interference or hum in video i-f, detector, or video output: This interference is seen as a very intense black smudge of varying width across the body of the pattern—re-location of the antenna may clear this up—if not the offending equipment must be located and isolated. The hum may be caused by leakage in one or more of the power supply circuits.



FIG. 14.—Sound bar interference or microphonics: This pattern appears the same as the interference shown in Fig. 11 with the exception that it will be in horizontal lines. This may be bad tubes, disarrangement of dressed leads—also may require re-location of antenna.



FIG. 15.—Ion trap or focus coil not properly adjusted: A black area will be seen in one of the corners of the screen or the entire test pattern will be at an angle. Deflection coils not properly centered on vertical and horizontal plates—ion trap is not adjusted properly to remove all stray electrons due to secondary emission from the graphic coating of cathode-ray tube.

THE SELENIUM RECTIFIER

The selenium rectifier is gradually replacing the familiar rectifier tube in ac-dc sets, and unless some unforeseen difficulty arises, its numerous advantages should make for universal replacement. In a new receiver the selenium rectifier is very small, light, and easy to install; for an old receiver requiring the replacement of a burned out rectifier tube, it has the selling point of long life (the claim being for the life of the receiver) and rugged allmetal construction. In both cases, there is also the advantage of cool operation and the elimination of the warm-up period. It is not affected by temperature or altitude extremes, or by shocks and vibrations. There are no moving parts or chemicals, and it is absolutely silent in operation.

The operation of the selenium rectifier is easily understood. Its rectifying action depends on a property often found at a junction of two dissimilar metals, i.e., that electrons flow more readily in one direction than in the opposite direction.

The typical unit found in new receivers consists of several small plates, usually square in form, stacked together at their centers, and utilizing two lugs for connection to the circuit. Each element is simply a supporting aluminum plate, coated on one side with selenium, and then having a metallic coating over the selenium. This selenium "sandwich" ensures adequate electric contact with both sides of the selenium. By proper heat processing, a rectifying film is formed between the selenium and the metallic coating. The metallic coating has a great number of free electrons that can flow through the selenium, and into the aluminum plate. However, the selenium has very few free electrons available, so that the electron flow in the opposite direction is very limited.

FIG. 1.—The electron flow through a selenium rectifier is from the metallic coating-selenium surface towards the aluminum plate, as indicated by the arrow.



If the negative terminal of a power source is connected to the metallic coating, the flow of current toward it is very small, for we have seen that there are few free electrons available. Consequently, the electron flow in Fig. 1 is from right to left. The symbol used to represent the selenium rectifier and similar types, shown in Fig 1, was adopted before the electron flow theory was accepted, but has never been revised. Therefore, when a selenium rectifier replaces a diode rectifier in a circuit diagram, the corresponding terminals are as indicated in Fig. 2.

FIG. 2.—In the schematic symbol for the selenium rectifier at the right, the electron flow is from 2 (identified by a red dot) upwards to 1 (identified by a yellow or no dot).



The selenium rectifier most commonly met with today is the Federal Type 403D2625, which has a maximum d-c output of 100 ma and a drop of 5 volts across it. The two lugs may be marked positive and negative, or they may be color coded; positive is indicated by a red dot, negative by a yellow dot or blank, as in Fig. 2. Care must be taken that the proper polarity connections are made, remembering that B_+ is obtained from the *cathode* of the rectifier tube and so the positive lug (red dot) must be where the cathode was formerly connected.

If the selenium rectifier is inserted in a circuit where the tube resistance is needed, it is necessary to supply additional series resistance to compensate for the low resistance of the rectifier. Further, since the tube filament is no longer used, a circuit utilizing it (such as most ac-dc sets with filament strings) must have a resistor added as well as the selenium rectifier. The succeeding paragraphs illustrating the replacement of a rectifier tube take these factors into consideration.

A typical installation for an ac-dc battery receiver may be found in the General Television Model 23A6, shown on page 16-6 and in Fig. 3, where two selenium rectifiers are used to provide filament voltage and the B+ supply.

Selenium rectifiers are now to be found in voltage doubling, tripling, and quadrupling circuits, in half-wave, full-wave, and bridge type rectifiers, and for recharging 2-volt wet batteries in portable receivers.



Installing Selenium Rectifiers

When replacing a rectifier tube, it is usually necessary to add leads to the selenium rectifier lugs; it is recommended that a red lead be added to the positive (red) lug and a yellow or black lead to the negative (yellow) lug. The selenium rectifier may be installed in any convenient location. The rectifier plates will short out if they touch any other components. A cool location is preferred, near the r-f end of the set and away from dropping resistors. The eyelet in the center is insulated from the plates and may be used for mounting if the extension leads are not steady enough for that purpose. A protective cover over the selenium rectifier is advisable if it is not otherwise safeguarded.

The selenium rectifier, like any other rectifier, has two different values of resistance depending on whether it is conducting. When conducting there is a flow of current and its resistance is low. When not conducting there is no flow of current and its resistance must be high. This means that an ohmmeter may be used to determine the polarity of the selenium rectifier terminals in the event of doubt, for a small direct current can flow from the meter through the rectifier.



The meter is connected as shown in Fig. 4 and the resistance is read. The meter leads are reversed and another reading is taken. If the second reading is less than the first, terminal X should be marked positive (red), but if the second reading is greater than the first, terminal Y should be marked positive. The reason for this is that an ohmmeter is so constructed that an increased resistance reading indicates a decrease in current flow, thus indicating the correct direction of current flow through the

www.americanradiohistorv.com

selenium rectifier. Actual measurements taken on a Federal Type 403D2624 gave readings of 8000 ohms and 500,000 ohms respectively.

Rectifier Tube Replacements in A-C Receivers

A serviceman desiring to take advantage of the selenium rectifier when replacing burned out rectifier tubes may utilize Table I and the accompanying diagrams. The tube being replaced is shown in Fig. 5. The first column in



Table I lists the type rectifier tube installed in the set. The second column indicates which wiring diagram (Figs. 6, 7, or 8) is to be followed. The third and fourth columns give the





values of the circuit components. Receivers utilizing voltage multipliers (250 volts and 350 volts) are seen to use the same size components, but different wiring diagrams (Figs. 7 and 8 respectively).

Rectifier Tube Replacements AC-DC Receivers

When a selenium rectifier is used to replace a rectifier tube in an ac-dc receiver, it is neces-

TABLE I. RECTIFIER TUBE REPLACE-
MENT CHART USING FEDERAL TYPE
403D2625 SELENIUM RECTIFIERRTubeUse FigureC(1 watt)5T47 for 250 volts5058 for 350 volts5U47 for 250 walks

	ð	10r	390	voits			
5U4	7	for	250	volts	50	5	
	8	for	350	volts			
5V4	7	for	250	volts	50	5	
	8	for	350	volts			
5W4	6				50	10	
5X4	7	for	250	volts	50	5	
	8	for	350	volts			
5Y3	6				50	10	
5Y4	7	for	250	volts	50	5	
	8	for	350	volts			
5Z3	7	for	250	volts	50	5	
	8	\mathbf{for}	350	volts			
5Z4	6				50	10	
6X5	6				50	10	
6Y5	6				50	10	
6X5	6				50	10	
7Y4	6				50	10	
12Z5	6				50	10	
25Z5	6				20	0	
35Z6	6				20	0	
50Y6	6				20	0	
50Z7	6				20	0	
80	6				50	10	

sary to supply a resistor to take the place of the tube filament, thus maintaining filament continuity and providing a potential for the pilot light. Fig. 9 shows the tube to be replaced.



FIG. 9, left, FIG. 10, right.—The numbered receptacle terminals of a vacuum-tube rectifier socket are shown in Fig. 9 and in Fig. 10 are the selenium rectifier and resistor connected to these terminals.

Figure 10 shows that the selenium rectifier is connected to the receptacle terminals formerly used for plate and cathode, while a resistor is connected to those terminals that were used for the heaters. The pilot light is tapped across from terminal 1, using 10 to 25 ohms thereof. The actual tap point depends on the current used in the filament string. The size of the resistor placed across the former heater terminals depends upon the rectifier tube being replaced. In Table II values are listed which have been compiled by the Federal Telephone and Radio Corporation.

TABLE	II.	RECI	FIFIER	TUBE	REPLACE-
MENT	CH	ART	USING	ТҮРЕ	2 403D2625
FEI)ER.	AL SE	ELENIU	M REC	TIFIER

Tube	Resistor	Watts
25Z5	85	15
25Z6	85	15
35W4	230	10
35Y4	230	10
35Z3	230	10
35Z4	230	10
35Z5	230	10
45Z5	300	10
50Y6	330	15
50Z7	330	15

The rating of the resistor connected in place of the heater may also be calculated. The filament voltage for each of the tubes is added together (not including the rectifier tube) and the sum is subtracted from the rated line voltage. The difference must be dropped across our resistor; since the filament current is given in the tube manual (each tube usually draws the same current, if not, the effective value of filament current must also be calculated), the resistance is calculated by Ohm's law: R=E/I. The resistor should be rated at least twice the number of watts given by the product of E and I.

Several alternative connections for the pilot light shown in Fig. 10 are suggested by Federal: (1) A 110-volt bulb may be placed across the line, Fig. 11, thus providing excellent illumination and isolation from the rest of the circuit. However, one connection must be to the dead



FIG. 11.—Alternate connections for one or more pilot lights are possible; see also Fig. 10.

side of the on-off switch or the light will burn continuously. (2) A number 47 pilot light in series with an 800-ohm 15-watt resistor across the line, Fig. 11. (3) Two number 47 pilot lights in series with a 775-ohm 15-watt resistor, Fig. 11. (4) The original method of



FIG. 12.—The complete schematic of a selenium rectifier and pilot light; see also Fig. 10.

Fig. 10 expanded into a full circuit diagram, Fig. 12.

Rectifier Tube Replacements AC-DC Battery Receivers

The replacement of a rectifier tube with a



Fig. 13.—A typical rectifier circuit of an ac-dc receiver in which the internal tube resistance must be considered when replacing the tube with a selenium rectifier.

selenium rectifier in this type of receiver is complicated by the importance of the internal tube resistance. A typical circuit, such as shown in Fig. 13, requires two d-c voltage measurements: B+ (point 1 to 2) and filament voltage (point 3 to 4). The tube is now replaced with a Federal 100-ma selenium rectifier and a 27ohm 1-watt resistor, as shown in Fig. 14. The positive lead (red) is connected to the cathode lug on the tube socket; the negative lead (yellow) is connected to the 27-ohm resistor, which in turn is connected to the plate lug of the tube socket.

The same two d-c voltage measurements are made, and if they are not within 10% of the



FIG. 14.—How a selenium rectifier is connected when replacing a vacuum-tube rectifier in an ac-dc circuit.

previous values, the 27-ohm resistor must be changed until they are within this limit. The final resistor value can be used in similar receivers without the need for voltage measurements. When determining this resistor value, time will be saved if it is placed in the circuit by means of clip leads until the final value is determined.

PRE-EMPHASIS AND DE-EMPHASIS

In the audio systems of transmitters the level of the higher audio frequencies is relatively low as compared to the rest of the audio-frequency spectrum. Because of this inherently small amplitude, noise interference will be more evident at the high audio frequencies than at the lower. In other words, the signal-to-noise ratio at the high audio frequencies is lower than that at the low audio frequencies. In systems where the maximum amount of audio frequencies are put to use this effect is definitely undesired. Since in f-m broadcast transmitters the audiofrequency range is as high as 15,000 cycles, a system wherein the amplitudes of these high frequencies are accentuated is necessary for the faithful reproduction of the higher range of audio frequencies. This is exactly what is done in all of the broadcast f-m transmitters as a regulation of the FCC.

In the audio system of the transmitter, special circuits called *pre-emphasis* (or accentuation) networks are included to boost the amplitude of the high audio frequencies. The circuits involved may differ somewhat from each other but in most cases they are very simple. The pre-emphasis networks must have a special characteristic in which the gain increases with audio frequency.

The pre-emphasis characteristic curve as set down by the FCC is shown in Fig. 1. The solid



FIG. 1.—Pre-emphasis characteristic curve established by the FCC.

curve is that which is supposed to represent ideally the pre-emphasis characteristic of the pre-emphasis network used in f-m broadcast transmitters. The stipulation is that the gain for audio frequencies from 50 to 500 cycles is to be constant and that from 500 to 15,000 cycles the gain should increase with frequency. The increase is such that at 1000 cycles the gain rises almost 1 db, at 5000 cycles the gain rises approximately 8 db, at 10,000 cycles the gain rises 13.5 db, and at 15,000 cycles the gain rises about 17 db. See the solid curve of Fig. 1. This curve shows that although the noise characteristic increases at the high audio frequencies, the gain at the high audio frequencies also increases in order to maintain a high signal-tonoise ratio.

The dashed curve in the same figure shows the limitations of the audio-frequency response that is allowable for f-m transmitter design. In other words, if the frequency response of the audio system of f-m broadcasting transmitters falls within the two curves of Fig. 1, then it will be acceptable by the FCC. It is preferable, however, that the audio system have a response characteristic resembling the solid curve as much as possible.

Now when an f-m signal is transmitted, it bears this pre-emphasis characteristic of the audio frequencies somewhere between the limits of the curves of Fig. 1. Some may think that since the high audio frequencies are increased to such an extent there may be the possibility of overmodulation. However, since the high audio-frequency components of the actual audio signal, before it enters the preemphasis network, have a much smaller amplitude than the low audio frequencies, there is very little chance of really overmodulating the f-m transmitter to a point where it will be considered serious. It should be remembered that we are dealing with f-m and that 100-per cent modulation is equivalent to a peak deviation frequency of the carrier equal to 75 kc. Thus by overmodulating we mean that the amplitude of the high audio frequency may make the final peak deviation of the carrier greater than 75 kc.

The primary reason for this pre-emphasis network is to make sure that the high-frequency

www.americanradiohistory.com

components of the transmitted intelligence are not blocked out by the inherent noise characteristics at these frequencies. Now when this f-m signal is picked up by the receiver it will have this same pre-emphasis characteristic in the intelligence it bears.

To be certain that the audio frequencies are all, more or less, brought down to the same level before audio amplification in the f-m receiver, a de-emphasis network is usually inserted in the receiver between the f-m detector and audio amplifier. This de-emphasis network has a frequency characteristic just the opposite of the pre-emphasis network; that is, its high-frequency response is *decreasing* in the same way the pre-emphasis network was increasing. In this manner the high frequencies will be brought down to their proper relationship to the level of the low frequencies for a more constant voltage input to the audio system of the receiver for the complete range of audio frequencies. In other words, the characteristic curve of the de-emphasis network should be as nearly as possible a mirror image of the preemphasis characteristic curve.

Now in order to make sure that the deemphasis network in the receiver is the inverse to that in the transmitter the FCC has set a standard of a 75 microsecond *time constant* for the pre-emphasis network in the transmitter. (It formerly was 100 microseconds.) Consequently the de-emphasis network in the receiver must also have a time constant equal to 75 microseconds in order to have the de-emphasis curve be the mirror image of the pre-emphasis curve.

The reason a time constant of 75 microseconds is established by the FCC as good engineering practice is that the most satisfactory frequency-response characteristic will be obtained by that time constant. In order to understand what determines the time constant let us examine some typical pre-emphasis and de-emphasis networks.

In Fig. 2, two pre-emphasis networks are illustrated. In either case as the audio frequency increases the proportion of the input voltage impressed across the grid of the tubes also increases. For instance, in Fig. 2(A) the total impedance to the audio voltage is given by the series combination of R and L. Now as the frequency increases the inductive reactance also

increases. This means that a relatively greater voltage drop will exist across the inductance at the higher frequencies than at the lower frequencies. Consequently, the relative voltage



FIG. 2.-Two typical pre-emphasis networks.

across the grid of the tube increases with increase in frequency.

In Fig. 2(B) the pre-emphasis network, consisting of C and R in parallel and R_c has the same effect. The impedance offered to the audio voltage is effectively that of the parallel combination of R and C only because the resistance of the grid resistor R_c is small in comparison to either R or the reactance of C at the audio frequencies. Therefore, as the audio frequency is increased the capacitive reactance of C decreases, allowing a ready path for the higher frequency currents as compared to the resistance of R. This means that the signal current increases with increase in audio frequency, which results in a greater voltage drop across the grid resistor R_c .

A typical de-emphasis network as used in most f-m receivers is shown in Fig. 3; it functions in a reverse manner to the pre-emphasis network. The effective impedance offered to the audio voltage is the series combination of C and R. As the frequency of the audio signal increases, the reactance of the capacitor C decreases. Thus, as the frequency increases, the reactive voltage drop decreases. Consequently, the audio voltage across the grid of the tube decreases with increase in frequency and the reverse effect of the pre-emphasis circuit is seen.

In order to make sure that the pre-emphasis and de-emphasis effects follow each other in respect to the increasing and decreasing amplitude of the high audio frequencies, the time constants, as mentioned, should be equal to each other. It is a relatively simple procedure to determine the time constant for the networks shown in Figs. 2 and 3. In the resistance-



capacitance networks the value of the time constant is given by $R \times C$, where R is in ohms and C in microfarads and the value of the time constant will be in microseconds. Thus for a resistance of 30,000 ohms and a capacitance of .0025 mf the time constant will be 30,000 \times .0025 or 75 microseconds. In the resistanceinductance network the time constant in microseconds is given by L/R, where L is in henries and R in megohms. Thus for an inductance equal to 7.5 henries and a resistance equal to .1 megohm (100,000 ohms) the time constant will be $\frac{7.5}{1}$ or 75 microseconds.

Montgomery Ward Model 74WG-2505A

In the Montgomery Ward f-m Models 74WG-2505A and 74WG-2705A a typical de-emphasis network is readily evident from the "clarified schematic," page 16-23 of Rider's Vol. XVI. That part of the circuit of interest is illustrated in Fig. 4. Between the audio output circuit from the 6AL5 discriminator and the first audio tube (6AT6), a simple RC network is placed, similar to that of Fig. 3 to perform the functioning of de-emphasis. These components are



FIG. 4.—The RC de-emphasis circuit of Montgomery Ward Model 74 WG-2505A.

shown by the heavy lines indicating the resistance and capacitance circuit, labelled **R** and C respectively in Fig. 4.

Basically, the f-m signal appearing at the input to the f-m discriminator has the preemphasis characteristics of the f-m transmitter. Consequently, the audio output from the discriminator will have its high frequencies accentuated in comparison to its low frequencies. For proper audio amplification the audio input to the audio amplifier must be flat for all audio frequencies. The RC de-emphasis network accomplishes this flattening out of the audio frequencies. Therefore, the audio input to the 6AT6 first audio amplifier will have approximately the same characteristics as the audio input to the microphone at the f-m transmitting studio.

The time constant network for this deemphasis network is equal to R multiplied by C. Since R is equal to 27,000 ohms and C equal to .0027 mf, the time constant will be $R \times C$, or 27,000 \times .0027, or 73 microseconds. Since the tolerance of the resistors and capacitors is usually 10 per cent, this calculated value of time constant is considered fairly good design in conforming with the regulated 75-microsecond time constant for the f-m transmitters pre-emphasis network.

SPECIAL AVC CIRCUITS

The use of avc in superheterodyne receivers is well-nigh universal today. Avc has been employed for well over a decade since its first commercial appearance. It is natural that in this time many modifications and variations of the basic circuit have appeared. Some of these have been designed for special purposes, and so are not widely encountered. Others, which appeared to be promising as improvements, were shown by experience not to live up to expectations, and as a result have fallen into disuse. Then again, certain variations have proven very valuable, and have stood the test of time. One of these is delayed avc, or davc.

The word delayed, in the term delayed avc, is well chosen, for it accurately expresses the essential feature of this particular type of avc. In a receiver having dave the operation of the ave feature is delayed until the input signal reaches a certain level. That is, for very weak signals the set behaves as though it had no avc, but for stronger signals the avc is operative. The desirability of davc lies in the fact that a receiver without avc has an inherently higher sensitivity than a set having avc, all other factors being equal. In other words, if two sets were designed along the same lines, except that one was equipped with simple avc and the other was not, the one without avc would be more suitable for receiving very weak signals. On the other hand, the set with avc would show up to great advantage whenever the received signal exceeded a small value. The reason for this is that in a simple avc system the action begins as soon as a signal is received, and thus for even a very weak signal there is some reduction in receiver sensitivity because of the ave bias produced by the rectification of this weak signal.

The usefulness of davc stems from this condition, for it offers the advantages of no avc for very weak signals, while it retains the advantages of avc at higher input levels. This is accomplished by the use of a bias in the avc system, which prevents the operation of the avc action when very weak signals are received. However, stronger signals can overcome the effect of the bias, and thus produce normal avc action. As a result, the use of davc gives a receiver an effectively higher sensitivity than a simple, unmodified avc system.

Because of the benefits offered by davc it is used in many of the more expensive receivers. (The extra parts naturally required by a system more complicated than simple, unadorned ave add to its cost. In many cases, particularly in broadcast receivers not intended for longrange reception, the additional complication of davc is a disadvantage not sufficiently compensated for by its operational advantages, and so it is not used.) Two examples of the use of davc in recently designed receivers are found in the Magnavox Model CR-183 found on pages 15-13, 14 of Rider's Vol. XV and the Montgomery Ward Airline 74BR-1812A found on page 16-18 of Rider's Vol. XVI. The davc systems used in these sets are described below.

Magnavox Model CR-183

In the Magnavox Model CR-183 an additional resistance-capacitance-coupled i-f amplifier stage and a separate diode are used to obtain davc. The avc amplifier, V5 (see Fig. 1), is a 6SG7, a pentode having a semi-remote cutoff characteristic. When no signal is received, the cathode of this tube is 11.5 volts positive with respect to ground. At the same time the grid potential is approximately that at the junction of resistors 220-2 and 212-1, since no appreciable current flows through resistors 205-1 or 201-5 under this condition; this potential is about 6 volts positive with respect to ground. Thus, when no signal is received, the grid of V5 is biased approximately 5.5 volts negative with respect to the cathode. At the same time, the cathode (pin 8) of the avc section of the duo-diode, V4, is also about 6 volts positive with respect to ground (since the cathode is connected through resistor 205-1 to the same junction point of resistors 220-2 and 212-1), and the avc diode plate (pin 5) is approximately at ground potential.

Because the cathode of the avc diode is thus about 6 volts positive with respect to its plate, no rectification will be produced by this tube unless the peak voltage of the i-f signal applied through capacitor 117-2 to the diode plate is sufficient to overcome the effect of the voltage

americanradiohistory com



FIG. 1.-Detector and avc system of Magnavox Model CR-183.

on the cathode. The 6-volt bias applied to the cathode (pin 8) is thus known as the delay voltage, since it delays avc operation until a signal sufficiently strong to overcome it is received.

When a sufficiently large signal is received to produce current flow through the avc diode, the end of resistor 204 connected to the plate (pin 5) goes negative with respect to the other end (ground), thus providing a source of avc voltage. At the same time the end of resistor 205-1 connected to the cathode (pin 8) of the avc diode goes positive with respect to its other end, raising the voltage on the control grid of V5 above 6 volts and thus decreasing the bias on this grid. This produces a reverse avc action on V5 because of its semi-remote cutoff characteristic. As a result, large signals fed through V5 are amplified more than small signals, and this has the effect of increasing changes in signal level before the signals are rectified to provide avc voltage. For example, if the signal input to V5 is doubled, the output is *more* than doubled; and if the input is halved, the output falls to less than half. This effect increases the changes in avc voltage produced by changes in signal input to the receiver. As a result the avc system is more sensitive and has a greater leveling effect on variations in the input signals than if V5 with its reverse avc were not used.

Montgomery Ward Airline 74BR-1812A

à

A 6AL5 duo-diode tube employed as a ratio detector is used in the Montgomery Ward Airline 74BR-1812A as an f-m detector. This convenient source of avc supplies a control voltage through R32 to the avc-controlled grid of the first i-f amplifier, as shown in Fig. 2. In order to obtain maximum sensitivity for very weak signals, davc is employed. The delay voltage is obtained from B+ through resistor R8 in conjunction with one of the diode sections of the 6AT6.

Resistor R8 and the diode form a voltage divider, with the diode having a very low resistance, when there is no avc voltage, because the



FIG. 2.—Avc delay voltage network used in Montgomery Ward Airline 74BR-1812A.

positive voltage applied through R8 causes it to conduct. As a result the avc-controlled grid is virtually at ground potential. When a signal is received, a negative avc voltage is produced. This also is impressed across a voltage divider, of which the same diode is a part. The other arm of the divider is resistor R32. If the signal is very weak, the avc voltage is very small, and is not sufficient to prevent the positive voltage applied through R8 from maintaining conduction through the diode. The effective resistance of the diode therefore remains low, and the avc is virtually shorted to ground.

When a stronger signal is received, however, a larger avc voltage is produced. Since this is applied to the diode through a much smaller resistor (R32-470,000 ohms) than that (R8-5.6 megohms) through which B+ is applied, it has a relatively greater effect. Hence, as the signal strength increases, the diode conduction decreases, since the positive voltage from B+is partially or, for large signals, entirely cancelled by the negative avc voltage. This reduction, or complete cessation (when the positive voltage effect is entirely cancelled), of diode conduction is equivalent to an increase in the effective resistance of the diode. When the diode resistance increases, the avc is no longer shorted to ground. Thus by taking advantage of the variable resistance characteristic of a diode, it is possible effectively to eliminate the avc for very weak signals, and to bring the avc into play for stronger signals.

TUNING INDICATORS FOR F-M RECEIVERS

It is quite feasible to tune an f-m receiver by ear, just as it is in the case of an a-m receiver. At the same time, a visual tuning indicator is desirable in an a-m receiver so that optimum results may be obtained. In an f-m receiver this need is even more pronounced, because it is less easy to tune accurately by ear for f-m reception than for a-m reception. The greater difficulty in the f-m case is due to two of the inherent differences between f-m and a-m receivers. One of these is the broad flat-topped i-f pass-band used in f.m.; the other is the use of balanced detector circuits (such as the Foster-Seeley discriminator and the ratio detector), which are employed almost universally.

The i-f pass-band of an a-m receiver is relatively peaked, as compared with that of an f-m receiver. Because of this, there is a very noticeable peak in the audio output of an a-m receiver when the receiver is tuned so that the actual i-f center frequency coincides with the proper operating center frequency. This peak can be, and frequently is, used as an audible indication of proper tuning. In an f-m receiver this effect is very slight, if it exists at all. This is particularly true of receivers employing one or more limiters.

The use of a balanced detector circuit in an f-m receiver makes it less susceptible to a-m interference (including noise) *if* the receiver is properly tuned. The reason for this is that the balanced circuit tends to balance out signals (such as noise) which affect both sides of the balanced system equally. This equality of effect on both sides of the balanced detector is fully true only when the actual i-f center frequency is the same as that to which the detector is tuned. Therefore, any mistuning will increase the noise and other interference present in the output. In addition, mistuning engenders distortion, particularly at high modulation levels.

Types of Tuning Indicators

Having seen the desirability of a tuning indicator in an f-m receiver, we can now consider the types of indicator that may be used. The simplest indicating system is that used frequently in a-m receivers, namely, a tuning indicator tube whose shadow angle is controlled by the avc voltage. Some f-m receivers employing the Armstrong limiter-discriminator combination do not have avc, but the first limiter grid voltage varies in accordance with the strength of the received signal reaching it. This grid voltage may therefore be used to control the tuning-indicator tube. When a ratio detector is used, an avc voltage can be obtained from this stage.

Although the great simplicity of this system is an advantage not to be overlooked, it has a definite disadvantage that causes many radio designers not to use it. This disadvantage lies in the fact that the avc (or first limiter grid) voltage may not be a maximum at exactly the same frequency as that which is optimum for operation of the detector. This condition should not be found in a set which has just been aligned; but when some time has passed since a set was last aligned, it is natural that drifts will have occurred. Consequently, it may not be possible to obtain exactly this tuning by means of the avc voltage-controlled tuning-indicator tube, because the avc voltage depends upon the over-all i-f amplifier tuning, and not upon the tuning of the detector.

The Meter Indicator

Another indicator is a meter, preferably of the center-zero type. The Foster-Seeley discriminator and certain forms of the ratio detector have a d-c component in their audio outputs. This voltage is zero when the actual center frequency of the i-f signal is at the frequency on which the detector is aligned. If the frequency is off, but still within the operating range of the detector, this d-c component will have a polarity depending upon whether the frequency is high or low and an amplitude depending upon the extent to which the frequency is off. If a meter is connected to read this voltage, it can be used as a tuning indicator, with correct tuning shown by a zero reading. This method of indication has the obvious advantage over the avc voltage-controlled tuning indicator tube of showing optimum tuning directly and definitely. However, it, too, has its disadvantages, perhaps even greater than those of the method described first.

To begin with, meters are expensive, particularly the more sensitive types such as are required for this service. This would not be a serious objection in a laboratory or in some types of test instruments; but in a typical home receiver the cost would be out of proportion to the utility. Another objection is that many people would find the cold austerity of a meter out of place in what is, after all, a decorative piece of furniture as well as a useful electronic device, and might also object to the space occupied on the panel by the meter. Again, most home receiver owners who have had any experience with tuning indicators are used to the tuningindicator tube, and would probably prefer to retain a type to which they are accustomed.

Operational Difficulties

Aside from these non-technical drawbacks, there is an operational difficulty of some importance. This lies in the fact that the usual type of d-c meter has a linear scale. It is therefore just as sensitive to the d-c voltage produced by a badly detuned signal as to that associated with a slightly detuned signal. On badly detuned signals, the meter indication is of little importance, for these can be spotted easily by ear. However, when the set is almost exactly tuned, the slightest error should be clearly defined by the swing of the meter needle. To overcome this drawback, a special type of centerzero d-c meter may be used. The permanent magnets in this type of meter are so shaped that the meter is much more sensitive at the center of the scale than at either end, with a gradual change of sensitivity throughout the range.

As an example of this type of meter, suppose one were used which would give a *half-scale* deflection either side of zero (depending on polarity) for a 1-volt signal, while a 10-volt signal would be required for *full scale*. On such a meter a 0.1-volt signal could be read as easily as on a 2-0-2-volt linear-scale meter. This same meter would be unharmed by a 10-volt signal, which would probably burn out a 2-0-2-volt meter. At the same time, a 10-0-10-volt linearscale meter, which would be unharmed by a 10-volt signal, would give a barely readable deflection for a 0.1-volt signal.

A final difficulty in tuning with a meter,

though not one of great importance, is the possible uncertainty attendant upon its use. The reason for this is that when no signal at all is received, the d-c signal from the detector to the meter is zero, just as when a station is properly tuned in. Thus, in a quiet location there may sometimes be reason to wonder whether a tuning-meter zero indication signifies an unmodulated carrier properly tuned in or no signal at all.

To summarize the above, it may be said that the tuning indicator tube controlled by avc voltage has these advantages over the tuning meter:

- 1. Economy, which benefits all concerned, from the manufacturer to the final set owner.
- 2. Familiarity, which makes the tube easier for the average set owner to use.
- 3. Certainty, which enables the set owner to distinguish between an unmodulated carrier and absence of signal under quiet reception conditions.

On the other hand, the meter is superior to the avc voltage-controlled tuning indicator tube on the following counts:

- 1. Sensitivity, which causes the meter needle to deflect more than the tube shadow in the tuning region immediately around optimum tuning.
- 2. Accuracy, which stems from its control by the detector, so that a true indication is obtained, regardless of alignment drifts.

From the foregoing comparisons, we may attempt to deduce the desirable characteristics of a tuning indicator for a home f-m receiver. The following list is such an attempt:

- 1. Economy
- 2. Familiarity
- 3. Non-linearity, which gives sensitivity where *it* is needed, and overload protection where *that* is required
- 4. Certainty
- 5. Accuracy
- A sixth characteristic may be added:
 - 6. Flexibility, which enables the user of an am-fm receiver to use the same indicator in the same way for tuning to either type of transmission, a-m or f-m.

The six requirements just outlined can be met with a good measure of success by the use of a conventional tuning indicator tube in con-

www.americanradiohistory.com

junction with a special circuit which permits the simultaneous application to the tube control electrodes of both avc (or first limiter grid) and detector tuning indication voltages. (The detector tuning indication voltage is the d-c component that appears in the audio output; this voltage was discussed in connection with the subject of meter tuning indicators.)

In an arrangement such as this, there may be some doubt as to how well the first requirement is met, but the extra components and labor involved should be considerably cheaper than a meter. The second requirement is obviously met by the use of a conventional tuning indicator tube, while the third can be satisfied by the use of a remote cutoff tube in the indicating system. The fourth and fifth are obtained by the use of the avc and detector tuning indication voltages, respectively. The sixth can be taken care of by providing a switch section in the am-fm switch which will permit application of the a-m avc voltage to the tuning indicator tube in conventional fashion when an a-m program is being received.

Stromberg-Carlson 1135-A

An f-m tuning indication system is used in the Stromberg-Carlson Model 1135-A appearing on pages 16-11, 12 of Rider's Vol. XVI, which exhibits the characteristics discussed in the preceding few paragraphs. It may be noted in passing that the indicator tube used in this system is also used for a-m tuning in the conventional fashion. Switch Section 8R (see Fig. 1) makes the necessary connection when the switch is in the a-m position.

The 6SQ7 and 6SL7GT tubes shown in Fig. 1 function as transfer devices to apply both the first limiter grid and detector tuning indication voltages to the indicator tube in the manner necessary for its operation, and without causing interaction between the first limiter and the discriminator. The 6SQ7 is simply a buffer, which prevents the other voltages in the system from affecting the first limiter grid voltage and possibly interfering with the action of the limiter.

When no signal is received, the grid of the 6SQ7 is virtually at ground potential, because there is no rectification at the limiter grid. When a signal is tuned in, a negative voltage from the limiter grid is applied to the 6SQ7 grid. The amplitude of this voltage varies just as an avc voltage does, in accordance with the strength of the received signal and with the tuning. When the i-f center frequency coincides with the i-f amplifier peak, this negative voltage has its peak value. The application of this negative voltage to the 6SQ7 decreases its plate current, thereby raising its plate voltage.

Since the plate of the 6U5G is tied to the 6SQ7 through R38, its voltage also rises (the effect of the 6SL7GT will be described later). This is exactly what would happen if a negative voltage were applied to the 6U5G grid. Therefore, the application of the voltage from the first limiter grid has the same effect as applying this voltage to the grid of the 6U5G. If it were not for the 6SL7GT, this indication system would operate in the same fashion as the simple avc voltage-controlled tuning indicator tube described above. That is, the "eye" would be open when no signal is received, and would reach maximum closure when the i-f center frequency corresponding to a received signal, is at the i-f peak.

Before considering the functions of the 6SL7GT, we should recall two facts important in the operation of this indication system. For one, we must remember that the tuning indica-



FIG. 1.—The tuning indicator tube, 6U5G, is used for both a.m. and f.m. in the Stromberg-Carlson Model 1135-A. The 6SQ7 and 6SL7GT tubes act as transfer devices to apply the first limiter grid and detector tuning indication voltages to the 6U5G indicator.

www.americanradiohistory.com

tion voltage derived from the discriminator may be either positive or negative when the received signal is mistuned. The other fact is that to indicate mistuning, we must not apply a negative signal to the 6U5G grid. The reason for this is that a negative signal to this grid causes the "eye" to close, but we desire that maximum closure be obtained when the set is tuned so that the actual i-f center frequency is the same as the frequency on which the discriminator is centered. Under this condition, the detector tuning indication voltage is zero, not negative.

Now, since it is desired that the closure of the "eye" be less than maximum when the set is mistuned, it is necessary that the *effect* of the detector tuning indication voltage on the "eye" be that of a positive voltage at the grid of the "eye," *regardless* of the true polarity of the indication voltage. This effect can be obtained by applying a positive signal to the grid (which causes the plate of the 6U5G to go negative that is, become less positive—because of the increased IR drop across R38 and R39) or a negative signal to the plate.

Transfer of Tuning Indication Voltage

It is the purpose of the 6SL7GT to transfer the detector tuning indication voltage to the 6U5G in such a way, that, when the set is mistuned, it has the effect of a positive signal at the grid of the 6U5G. This is accomplished as follows: the left triode of the 6SL7GT is biased approximately to cutoff, so that a negative tuning indication voltage will have no effect on it. However, if a positive signal is applied to the grid, plate current will flow. Since this plate current flows through R39, the IR drop across that resistor must increase, thereby lowering the plate voltage of the triode section of the 6U5G. As was pointed out above, this has the same effect as a positive voltage on the grid of the 6U5G; that is, it reduces the extent to which the "eye" closes. R34 and C69 constitute an audio filter, so that only the tuning indication voltage output of the discriminator affects the left triode.

The right triode operates with zero fixed bias. Now, if the tuning indication voltage is positive, grid current will flow in this section. When grid current flows, the effective gridcathode resistance drops to a value very small compared to one megohm. Since the gridcathode resistance and R35 form a voltage divider, virtually all of the positive signal will appear across R35. Thus the grid-cathode voltage will remain almost unchanged, and so a positive signal has no significant effect on the right triode. In addition to the function just described, R35 acts with C68 to form an audio filter just as R34 and C69 do.

On the other hand, if the tuning indication voltage goes negative, no grid current will be drawn in the right triode. The grid-cathode resistance under this condition is very many megohms, so that R35 has a negligible voltagedividing effect. Thus a negative signal will reduce the plate current, causing a decrease in the IR drop across R77. This raises the grid voltage of the 6U5G, decreasing the closure of the "eye."

The cathode of the 6U5G is connected to a point positive with respect to ground, since otherwise the grid of this tube would be positive with respect to the cathode. The cathode voltage is therefore chosen such that the grid has a negative bias when no signal is applied to the 6SL7GT.

Operation of Tuning Indication System

Briefly, then, the operation of this tuning indication system is as follows: When a signal is received by the radio, but is not tuned in correctly, a small negative voltage due to rectification appears at the grid of the first limiter. This voltage, acting through the 6SQ7. causes the "eye" to close slightly. At the same time, a positive or negative tuning indication voltage from the discriminator acts through one of the sections of the 6SL7GT, depending upon its polarity. Regardless of the polarity, however, its effect is in opposition to that of the limiter grid voltage, so that the closure of the "eye" is not very great. When the receiver is tuned somewhat better, the limiter grid voltage will increase, while the detector tuning indication voltage will decrease; the "eye" will therefore close further.

Finally, when the receiver is tuned correctly, the limiter grid voltage will be at, or very near, its maximum value. The detector tuning indication voltage will be zero, and therefore the "eye" will be at maximum closure. If the receiver is slightly detuned, the limiter grid volt-

www.americanradiohistory.com

age will be only slightly affected, if at all, because of the broad i-f band-width. However, the detector tuning indication voltage will follow any tuning change, and thus the "eye" is very sensitive to tuning errors in the range where this sensitivity is needed.

TELEVISION H-V POWER SUPPLIES

A television picture tube requires a source of high d-c voltage; the tube 10BP4 used in the G.E. Model 801 shown on pages 16-25, 26 of Rider's Vol. XVI requires 8000 volts. Normally, we obtain a high d-c voltage by applying 60-cycle a.c. to a step-up transformer, rectifying, and then filtering the output; above 4000 volts, however, a transformer is heavy, bulky, and expensive. The use of an r-f power supply is a recent development that not only simplifies transformer and filter design but provides more safety for servicemen.

The unusual feature of the G.E. Model 801 high-voltage power supply is that the rectifier plate voltage is obtained from the horizontaldeflection system during the retrace or flyback of the sweep, rather than from the a-c line. To analyze this operation, we must see how the horizontal output tube, an 807, and the damping tube, a 6AS7G, generate a pulse that excites the step-up transformer, T9, thus providing a high voltage which is rectified by the 8016, as shown in Fig. 1.

The 807 is a well-known beam tetrode, capable of handling heavy current; its main function is to supply the power current waveform to the horizontal-sweep coils so that a horizontal trace of proper length is applied to the viewing tube. The 6AS7G is a dual triode, hav-



FIG. 1.—Block diagram of high-voltage rectifier and associated circuits in G. E. Model 801.

ing an amplification factor of only 2.1 and a plate resistance of 140 ohms when the two sections are connected in parallel. This tube damps the high-frequency oscillation set up during the flyback period of the electron beam.

The usual high-voltage rectifier, such as an 878, requires considerable heater power and is not designed for r-f operation. The 8016 diode was developed for this purpose and requires only a quarter of a watt for the heater. Fig. 1 shows the heater voltage for the 8016, is obtained by a very small secondary winding on transformer T9.

The 10BP4 picture tube is scanned by a magnetic coil system, but only the horizontal sweep coils enter our study of the h-v power supply. For proper scanning, the current in the



sweep coil must have a saw-tooth form, such as shown in Fig. 2, the forward trace across the screen occurring during period a-b and the retrace or flyback during the much shorter period b-c. The forward trace must be as linear as possible so that distortion is prevented.

Circuit Functions

The sweep trace takes place when the output of the 807 tube is applied to the horizontalsweep coils, and T9 is so designed that a proper impedance match exists between the tube and coils. When the 807 stops conducting, the components to the right of T9 (see Fig. 3) are excited into violent oscillation, and the oscillation is used to obtain the rapid flyback, b-c in Fig. 2. Any oscillation beyond the first half cycle is undesirable, as it will affect the linearity of trace a-b in Fig. 2, and the 6AS7G is used to damp it out. Very little of the magnetic energy is consumed by the flyback, and the collapsing field produces a positive voltage pulse on the primary of T9; this pulse is stepped up by the additional winding shown on the primary; it is then rectified by the 8016 and delivered to the viewing tube.

The detailed functioning of each component may now be examined, keeping the previous discussion in mind.

The input to the 807 is obtained from a multi-

www.americanradiohistory.com



FIG. 3.—Circuit diagram of high-voltage supply of G. E. Model 801.

www.americanradiohistory.com

vibrator (6SN7GT), which is a two-tube oscillator that normally produces a rectangular output. However, the network composed of R42, R44, C57, and C58 (see Fig. 3) is so designed that we obtain a saw-tooth waveform with a negative pulse, such as shown in Fig. 4. This is the input that is applied to the 807 grid.

The collapsing field in the horizontal-deflection coils produces a positive voltage pulse on the primary of T9 and consequently on the 807 plate. The negative pulse on the 807 grid, *a-b* in Fig. 4, ensures that the 807 is cut off during the flyback period, in spite of the high plate voltage.

During the trace period (*c*-*a* in Fig. 4) when the 807 is conducting, the sawtooth grid voltage produces a sawtooth plate current. The effective plate load is the horizontal-deflection coils, T9 being used only as an impedance transformer to match the coils to the tube. Since the plate load is inductive, if a sudden change in current takes place we obtain a highvoltage pulse, this sudden change taking place during *a*-*b* of Fig. 4. During *c*-*a* of Fig. 4 the energy supplied to the yoke builds up, and continues to do so until the negative pulse occurs.

At this instant, when the 807 is cut off, the components between T9 and the 6AS7G are shocked into violent oscillation (L7, horizontal-deflection coils, part of T9 and distributed capacitances). During the first half cycle, which is negative, the current in the horizontal-deflection coils has reached a maximum in the direction opposite to which it was flowing and

the flyback has consequently taken place. At the end of the first half cycle the voltage starts to go positive. The 6AS7G now conducts, since its plate is positive, and the oscillation is rapidly damped.

Transformer T9 has four functions. Its main function is to transform the inductance of the horizontal-deflection coils to a value that meets the operating conditions of the 807. A small



secondary tap supplies heater voltage for the 8016. It also takes the inductive "kick" voltage from the collapsing magnetic field during flyback and places it on the primary. Finally, this voltage pulse on the primary is raised by autotransformer action to 8000 volts and applied to the 8016 plate. (In an autotransformer the input is applied to a portion of the winding, terminals 1-2 of Fig. 3, and the output is taken across the entire winding, terminals 1-3. It has these advantages over the ordinary two-circuit transformer: better voltage regulation, greater efficiency, and smaller size; it does have disadvantages, such as lack of d-c separation, which prevent its more universal use.)

The 8016 rectifies this high-voltage pulse.

Due to the high frequency at which this takes place, a 500-mmf capacitor, C66, is sufficient for filtering, and as its small value means small energy storage, there is consequent reduction of

danger when servicing the high-voltage supply.

The 8000-volt output is now applied to the viewing tube through the filter section C66 and R97.

BATTERY CHARGING CIRCUITS

A battery, consisting of two or more cells, supplies direct current by means of chemical action, which is the result of the changing of chemical compounds into another form. While the life of a battery is inherently limited, proper use will prolong it considerably. In the *storage* battery, the chemical process can be reversed by putting electric energy into the battery, thus converting the chemicals to their original condition. The familiar dry-cell must be discarded when fully discharged, for reversing the current flow will not return the chemicals to their original condition.

The dry-cell battery generally employed in portable receivers consists, basically, of a negative zinc plate and a positive carbon rod immersed in a pasty mixture containing ammonium chloride and other chemicals. The entire unit is sealed in a container to prevent escape of gases or the entrance of external substances. When the battery delivers current, ammonium chloride combines with the zinc to form zinc chloride and free hydrogen ions. These free hydrogen bubbles travel toward the carbon rod and tend to collect around it, decreasing its effective area and thereby increasing the internal resistance of the cell. This accumulation of hydrogen on the carbon rod is termed "polarization" and the greater the polarization the less current the cell can supply. If the cell is permitted to rest for a while, one of the chemicals in the pasty mixture (manganese dioxide) will absorb the hydrogen, and the cell will again furnish a large current. This action is familiar to anyone who has had to use a flashlight for several hours, until the light was too dim to be of any use, only to find the original brilliance restored the following evening. With the lapse of time, or continued use, the dry-cell deteriorates due to loss of moisture or the using up of the zinc; this is shown by a decrease in the current it will supply and not by a drop in rated voltage—in fact, voltage will remain fairly constant during the life of the dry-cell.

The amounts of the basic constituents (zinc, carbon, manganese dioxide) are sufficient to permit the depolarizing effect to stay in line with the liberation of hydrogen, as long as the battery is operated at its *rated* drain. If the maximum permissible current discharge rate is exceeded for any great period of time, the battery will be ruined.

The action of the dry-cell battery is a function of the chemicals, and when completely exhausted, not just polarized, it is necessary to replace the chemicals, i.e., get a new dry cell. The storage battery utilizes an entirely opposite action, for it is composed of plates and chemicals that *store* electric energy but do not create it. Consequently, the storage battery can be recharged after it has been used for a length of time, without the costly replacement of chemicals.

During the discharge, the chemical composition of the storage battery changes and the amounts of the original constituents decrease. The battery can be recharged by breaking up the compounds formed during discharge and permitting the elements of the broken-up compounds to return to their original state. The process necessary to accomplish this recharging is to pass a current through the battery in a direction opposite to normal current flow, thus causing the water formed originally by the combination of hydrogen and oxygen to be broken up into free hydrogen and oxygen. The hydrogen and oxygen then recombine with other chemicals in the battery and thus reverse the original process of discharge. Since sufficient time must be given for these recombinations to occur, the process must be done at a rate which will permit the water to be changed into hydrogen and oxygen. The charging rate of the battery charging circuit should fall to zero automatically when the battery has been recharged completely. If the rate of recharging is too rapid the gases will form so rapidly that the battery unit will swell, breaking the pitch or wax sealing and permitting the gases to escape. If the charge continues after all of the water is broken up into hydrogen and oxygen, it will cause other chemical reactions harmful to the battery.

A Rectifier Tube Battery Charger

In the Stewart Warner Model 9007, page 15-42 of Rider's Vol. XV, they employ an A-B

dry-cell battery pack (90 volts B supply and 9 volts A supply). In order to prolong the life of these dry cells they use a unique batterycharger circuit for this dry cell. In other words a dry cell can have energy somewhat restored for a certain amount of time by a process of recharging so that its life can be extended. The circuit for this is illustrated in Fig. 1. The 35Z5GT tube marked with the numeral 1 supplies the usual direct current for the receiver. The basic battery charging circuit makes use of the 35Z5GT rectifier tube designated with the numeral 2 and a resistor voltage-dividing network, as shown in Fig. 2. The circuit is designed so that the current through resistors 49A and 49B is large in comparison to the charging currents Ia and Ib. Variations in charging current therefore will not affect the voltages E1 and E2 greatly, so that the "A" and "B" battery voltages will be substantially constant. This charger recharges all four batteries regardless of whether the batteries are part of a single unit pack or are individual units. The circuit design is such that the charging rate is approximately one-third of the discharge rate, this ratio producing the best results. Resistors 45 and 47 are current-limiting resistors to prevent the charging currents from exceeding a value which might cause the battery to produce too much gas.

A simplified representation of the flow of charging and discharging electron currents appears in Fig. 3. The discharging electron current A flows from the negative terminal of the battery, through load R and back to the positive side of the battery. The charging



FIG. 2.—The basic battery-charging circuit, incorporating rectifier 2 of Fig. 1.

electron current B flows from the negative side of the d-c charging source (in this case, a 35Z5GT rectifier tube), through the battery in opposition to the discharging current, and back to the positive side of the charging source. As explained previously, the passage of a current through a battery in a direction opposite to normal electron current flow causes it to charge.

FIG. 3.—Simplified circuit showing electron flow during discharge and charge, A and B respectively.



It had been stated that the charging rate should fall to zero when the battery has been completely recharged. That the charger used in this receiver does this may be seen from an examination of Fig. 4. These graphs illustrate the manner in which the charging current for both the "B" and "A" batteries depend upon





FIG. 4.—Graphs showing how the charging current of the batteries falls as they approach a charged condition.

the voltage output. When the battery voltage is low, the charging current is high and therefore the charging rate is high; when the battery is fully charged, the charging current is almost zero and the charging rate is negligible.

When a fully charged storage battery is first used in a set, it will operate at maximum efficiency for only a few hours. If it is kept properly charged, its life will not only be lengthened greatly but receiver performance will remain at a high level. The sensitivity of a radio receiver will decrease if the supply voltage decreases; proper charging means that the batteries will always operate at a sufficiently high level so that maximum receiver sensitivity is obtained.

The results of a life test run on two 45-volt "B" batteries is shown by the three graphs in Fig. 5. The manufacturer of these batteries claims that if they are discharged six hours a day they will last for 115 hours before reaching the limiting value of 67 volts. However, Fig. 5 shows that periodic charging tremendously lengthens the useful life of the battery.

The left hand graph shows that the batteries are charged up to 92 volts when first inserted in the set. After nine hours of discharging the voltage has dropped to 85 volts and the battery is charged for 15 hours. Each succeeding discharge cycle of ten hours results in a slightly lower end voltage, and after 500 hours the battery has been reduced to 78 volts. However, the application of regular periods of charge still results in an adequate battery voltage. Even after a thousand hours of operation the batteries could still be charged to 83 volts, although the drop in voltage after ten hours of use is down to the limiting point of 67 volts.

A means of indicating the battery condition is also provided in this circuit. A neon lamp (item 27 in Fig. 1) is connected to an R-C circuit (items 29 and 28). The neon lamp will light up at a certain voltage and be extinguished at a certain voltage, so that these three items constitute an oscillating circuit whose rate of oscillation depends upon the neon tube, the values of R and C, and the applied voltage. The constants are so chosen that the neon lamp will flicker about three times a second when the batteries are fully charged. (The true condition of the batteries is only indicated when switch 43 is in the "Battery" position. When it is in the "Charge" or "AC-DC" position, the neon lamp flashes rapidly but does not indicate whether or not the battery is fully charged.) The battery voltage decreases as the receiver is used, and consequently the number of flashes from the neon lamp will decrease. When the battery voltage has dropped to about 72 volts the lamp flashes about once a second. This is a warning that the receiver should not be operated from battery power and that recharging should be accomplished immediately.

The batteries should be charged for at least twice as long a time as they were in use, and as soon as possible after they have reached the point of one neon flash per second. For example, if the receiver was battery operated for four hours during the day, it should be recharged for about eight hours that same night. As the batteries age, it will be necessary to charge them for a longer period each time, and it will also be necessary to charge them more frequently. It should be remembered that a completely discharged battery cannot be recharged satisfactorily, and that only a small amount of charging takes place when the receiver is operated on a.c. or d.c. This small current is sufficient to prevent the batteries from deteri-





www.americanradiohistory.com

orating, but is not enough to recharge them; a battery will deteriorate if permitted to stand idle for several months, and this action prevents it. A separate charging position of the selector switch is provided for the regular charging operation, as shown in Fig. 1.

When the receiver is connected to a d-c line, the polarity of the connection should be checked, by turning the receiver on, before attempting to charge the batteries. From Fig. 1 it is seen that the batteries will discharge when the "ON-OFF" switch is left in the "ON" position, even when the power cord is not connected to a source of power.

The charging operation should be undertaken regularly, and not only when the battery voltage is low. The condition of the battery should be checked frequently, by noting the rate at which the neon lamp flickers when the selector switch is in the "Battery" position. If the receiver is not used for a long time, the battery should be charged for several hours every few weeks to prevent deterioration. The receiver should be operated from an a-c or d-c source of power, whenever possible, in order to save the battery.

A Copper-Oxide Battery Charger

The power supply and battery-charger circuit of the General Electric Model 250, page 15-32 of Rider's Vol. XV, is reproduced in Fig. 6. This receiver is operated by a 2-volt storage type built-in rechargeable battery (B1). The battery can be charged from an automobile or 6-volt storage battery by connecting a special charging cable from the two connector pins on the receiver to a 6-volt d-c supply. Provision is also made for charging the battery from a 115volt, 60-cycle line, as indicated in Fig. 6; when this is done the battery "floats" and is being charged at a slow rate.

The A+ power needed for the 1.4-volt tube filaments is obtained directly from battery B1, using R18 as a dropping resistor. The B+power required by the receiver tubes is obtained from the synchronous vibrator, V1, a step-up transformer, T5, and a filter circuit (C32, L6, C26-A, R17, and C26-B) in a fashion that will be discussed later.

The power switch is a three-position selector switch; in the "OFF" position, the receiver does not operate and the battery cannot be charged; in the "ON" position, the receiver operates from the battery, B_1 , and if it is connected to the a-c line, it is possible to maintain the battery charge from the rectified line current; in the "CHG" position, the receiver does not operate and the battery can be charged.

The operation of charging from the a-c line is similar to the action that takes place with an automobile receiver. If the car battery is run down, and the motor is not running, the receiver volume is low even though the volume control is at a maximum; if the motor is idling the receiver output will increase, and at normal motor speed the receiver volume will be greatly increased. However, if the auto battery is fully charged, it will be noticed that the motor speed has no effect on the receiver volume. When we speak of the motor speed we are referring to the generator or battery-charger output; actually what is taking place is that with a poorly charged battery the addition of the battery-charger voltage, when the motor is run-



FIG. 6.—Power-supply and battery-charging circuits of the General Electric Model 250. The set is operated by a 2-volt storage battery, which can be charged from an automobile battery or a 115-volt a-c line.

ning, acts to increase the battery voltage, thus increasing the B supply and consequently the receiver output. With a fully charged battery, the battery voltage is affected only slightly by the addition of the generator, and the battery is said to be "floating" in the circuit.

The reason for a fully charged battery being affected only slightly by the addition of a power source is that its characteristics are somewhat similar to a very-high valued electrolytic capacitor. A battery charger, battery, and load may be represented by the equivalent circuit shown in Fig. 7. The copper-oxide rectifiers,



X1 to X4, and associated transformer T4 of Fig. 6 are here represented as a battery; receiver battery B1 is shown as an electrolytic capacitor, and vibrator V1, with associated components, is shown as a resistor.

The discharge circuit of Fig. 7 consists of the capacitor and resistor, i.e., B1 and V1. Due to the high equivalent capacitance the circuit has a large time constant, which, in seconds, is obtained by multiplying the capacitance, in farads, by the resistance, in ohms. Therefore, a small change in voltage from the d-c power source (i.e., battery charger) would not affect the capacitor (i.e., B1) voltage until after the period of the large time constant.

From this description of the equivalent circuit, the effect of the a-c power line variations is seen to be minimized. Such variations are momentary, the battery-charger fluctuations will be momentary, and the large capacitive characteristic of B1 prevents any change in the battery voltage level, regardless of line and battery-charger variations.

The actual operation of the battery charger can be followed in Fig. 6. When the power cable is connected to the a-c line and the selector switch is turned to "CHG" or "ON," the step-down transformer, T4, "reduces the 117 volts to 5.8 volts. The full-wave copper-oxide rectifier circuit rectifies this voltage and supplies a charging current to battery B1.

The "B+" voltages are effectively obtained from battery B1. Its voltage is converted into pulsating direct current by one set of contacts of the synchronous vibrator, V1. The a-c com-

ponent of this pulsating voltage appears across the primary of T5, and is stepped up so that a high-voltage alternating current is available at the secondary. This high voltage is now fed back to the second set of vibrator contacts, which rectifies it and thus provides a highvoltage pulsating direct current to the center tap of the T5 primary. The T5 secondary output is filtered by C32, L6, C26-A, R17, and C26-B, thus providing the required high-voltage direct current used by the tubes. There is provided between the battery. B1 and the vibrator, V1, a filter network consisting of C30, L5, and C29-this prevents r.f., created by the sparking of the vibrator contacts, from being fed back from the vibrator circuit into the filament circuit of the tubes.

The actual operation of the vibrator is sufficiently interesting to call for closer examination. The battery output is impressed on the vibrator, which by its mechanical action alternately impresses this voltage on either side of the center-tapped primary. An alternating current is thus produced in the secondary, which can be readily rectified into a high-voltage direct current. The vibrator performs two functions, that of interrupting the direct current from the battery and that of rectifying the high-voltage alternating current from the transformer secondary. This type of vibrator is usually known as the synchronous type, because it interrupts and rectifies in synchronism. The synchronous vibrator is thus used to replace a rectifier tube, with a consequent reduction in cost.

Battery Economizer Circuit

americanradiohistory com

Some portable receivers which do not have rechargeable batteries make use of an "economizer" switch to prolong the life of the battery. In the Galvin (Motorola) Model 45B12, page 15-27 of Rider's Vol. XV, this switch is termed the "Battery-Saver Switch." It is placed in the "LD" (low drain) position when the battery is new, and in the "HP" (high power) position when the battery is run down; in either position it affects the drain on both the "A" and "B" batteries.

The components that concern the "B" battery are shown in Fig. 8. The 3Q5GT poweramplifier tube employs fixed bias, using R10and R11 which are in series with the grid resistor, R9. When the "Battery-Saver Switch," S-1, is closed, it shorts out R11 to ground. When the battery is new, S-1 is opened so that the output tube is strongly biased, thus reducing the plate and screen currents of all the tubes. This comes from R11 being in series with R10, which increases the voltage drop between B and ground and imposes a higher negative voltage on the 3Q5GT grid. The increased voltage drop across the output-tube bias resistor results in less current being drawn by the plate and screen.

The voltage available from the "B" battery decreases with use and time, and the closing of switch S-1 will short out R11 and thus reduce the total resistance of the self-biasing resistance. This means that the bias on the tube is decreased and therefore the plate current is increased. The power output of the receiver will increase, and less distortion will be present than if the switch was left open.

The life of the battery is greatly increased because of the reduced drain when it is new, for the battery can be used even after its output has been reduced. If the switch was not present, then the reduced plate and screen voltages would cause a decrease in sensitivity and a distortion of the power output, requiring earlier battery replacement. If R11 was not present, then the initial drain on the battery would be higher and it would have to be replaced in a shorter period than the "economy" circuit provides. Of course, when the battery is new and the switch is left open as recommended, the power output is less than it could be and more



FIG. 8.—Components of the Motorola Model 45B12 "battery saver" circuit.

www.americanradiohistory.com

distortion is present, but so far as the listener is concerned the operation is satisfactory. At least, the owner is offered the choice of maximum receiver performance and normal battery



drain, or satisfactory receiver performance and long battery life.

The components that concern the "A" battery are shown in Fig. 9. The 1.4-volt filaments of the various tubes are connected in parallel across the 1.5-volt "A" battery. The 3Q5GT has a two-section filament; connected in series when the tube is operated with a 2.8-volt supply, and in parallel when operated with a 1.5-volt filament supply; in either case the filament power is the same. When S-1 is open (for a new battery) the 3Q5GT tube in this receiver is operated with only one section of the filament, the other section being open. When the battery is old and the switch is closed, the second section of the filament is thrown in parallel with the first section, which is the normal method of connecting the filament for a 1.5-volt supply.

Operating the 3Q5GT tube at half this ratedfilament power when the battery is new, will not ruin the tube, since at the same time the plate and screen currents are reduced and the tube bias increased, as has been previously explained. The use of the "Battery-Saver Switch" lengthens the "A" battery life in the same fashion that it did the "B" battery life.

The design of the Galvin Model 45B12 receiver case, governed by portability considerations, requires that an "A-B" battery-pack be used. An "A-B" pack is an "A" battery and a "B" battery assembled in a single container. Since the two batteries are not removable separately, the one that becomes exhausted first determines the useful life of the entire pack. Thus the use of the "Battery-Saver Switch" in this receiver for lengthening the life of both batteries simultaneously, makes their discharge rates approximately the same, and therefore the "A" and "B" batteries will become exhausted at approximately the same time.

INDEX

ADMIRAL CHEVROLET

ADMIRAL CORP.

5

NOULL		PAGE
4B1. Chassis	See Model 7T06	
5H1, Chassis	See Model 7P32	
6L1, Chassis	See Model 7RT41	
OMI, Chassis 7Cl. Chassis	See Model 7C62 See Model 7C63	
9A1, Chassis	See Model 7C73	
7C62, Chassis 6M1	Schematic, alignment, dial data,	16-1
	Record Changer, Admiral	10-1
	Model 160Å RCD. CH	.15-17
	Parts list Voltage	16-2
7C63, Chassis 7C1	Schematic, voltage	16-3
	Record Changer, Admiral	16.1
	Clarified schematics	16-4
	Alignment, socket, trimmers,	16.5
	Parta list	16-5
7C73, Chassis 9Al,		
Preliminary	Schematic Clarified schematics	16-7
	Parts list	16-6
7P32, 7P33, 7P34,		16.0
Chassis 5HI	Alignment, socket, trimmers.	10-9
	dial data, antenna	
78T41 78T49 78T42	connections Schemetic cocket voltage	16-10
Chassis 6L1	dial data, trimmers	16-11
	Record Changer, Admiral	
	Model 160A HCD-CH. Parts list	16-2
7T06, 7T12, Chassis		
481	Schematic, socket, voltage,	16-12
	Alignment, socket, trimmers,	
	dial data, notes	16-10
	AIR CASTLE	
S	ee SPIEGEL INC.	
	AIR CHIEF	
See FIRES	TONE TIRE AND RUBBER CO.	
AIR	KING PRODUCTS CORP.	
Court Jester	See Model A. 402	
	See model A-405	
Crown Princess	See Model 4704	
Crown Princess A-403 Court Jester,	See Model 4704	
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2 Chassis	See Model 4704 Schematics, changes See Model 4704	16-1
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis	See Model 4704 Schematics, changes See Model 4704 See Model 4704	16-1
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 470-1, 470-2, Chassis 4604D Chassis	See Model 4704 Schematics, changes See Model 4704 See Model 4604D See Model A-403	16-1
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 470-1, 470-2, Chassis 4604D, 4604F, Chassis 458-2	See Model A704 Schematics, changes See Model 4704 See Model 4604D See Model A-403 Schematic, cabinet	16-1 16-2
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 470-1, 470-2, Chassis 4604D, 4604F, Chassis 458-2	See Model A704 Schematics, changes See Model 4704 See Model 4704 See Model 4604D See Model A-403 Schematic, cabinet Clarified schematics	16-1 16-2 16-3
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 470-1, 470-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2	See Model A704 Schematics, changes See Model 4704 See Model 4704 See Model 4604D See Model A-403 Schematic, cabinet Clarified schematics Schematic, cabinet	16-1 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 470-1, 470-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2	See Model A704 Schematics, changes See Model 4704 See Model 4704 See Model 4604D See Model A-403 Schematic, cabinet Clarified schematics Schematic, cabinet	16-1 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se	See Model A704 Schematics, changes See Model 4704 See Model 4704 See Model 4604D See Model 4-403 Schematic, cabinet Clarified schematics Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD	16-1 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se	See Model A-403 See Model 4704 See Model 4704 See Model 4704 See Model 4604D See Model A-403 Schematic, cabinet <i>Clarified schematics</i> Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD	16-1 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALAM</u>	See Model A704 Schematics, changes See Model 4704 See Model 4704 See Model 4604D See Model A-403 Schematic, cabinet Clarified schematics Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O_ELECTRONICS_CORP.</u>	16-1 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALLAM</u> AEC-3RCMB	See Model A704 Schematics, changes See Model 4704 See Model 4704 See Model 4604D See Model A-403 Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O ELECTRONICS CORP</u> . Schematic, alignment Misc	16-1 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALLAM</u> AEC-3RCMB 2RCM	See Model A704 Schematics, changes See Model 4704 See Model 4704 See Model A-403 Schematic, cabinet Clarified schematics Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O ELECTRONICS CORP</u> . Schematic, alignment Misc	16-1 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALLAM</u> AEC-3RCMB 2RCM	See Model A-403 See Model 4704 See Model 4704 See Model 4704 See Model 4-403 Schematic, cabinet Clarified schematics Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O_ELECTRONICS_CORP.</u> Schematic, alignment Misc	16-1 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALAM</u> AEC-3RCMB 2RCM	See Model A704 Schematics, changes See Model 4704 See Model 4704 See Model 4704 See Model A-403 Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O_ELECTRONICS_CORP</u> . Schematic, alignment Misc <u>ALDEN, INC.</u>	16-1 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALLAM</u> AEC-3RCMB 2RCM 40-1500	See Model A704 Schematics, changes See Model 4704 See Model 4704 See Model 4704 See Model A-403 Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O ELECTRONICS CORP.</u> Schematic, alignment Misc <u>ALDEN, INC.</u> Schematic, socket, trimmers,	16-1 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALLAM</u> AEC-3RCMB 2RCM 40-1500	See Model A704 Schematics, changes See Model 4704 See Model 4704 See Model 4704 See Model A-403 Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O ELECTRONICS CORP</u> . Schematic, alignment Misc <u>ALDEN, INC</u> . Schematic, socket, trimmers, alignment, notes Misc	16-1 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALLAM</u> AEC-3RCMB 2RCM	See Model A704 Schematics, changes See Model 4704 See Model 4704 See Model 4704 See Model A-403 Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O ELECTRONICS CORP</u> . Schematic, alignment Misc <u>ALDEN, INC</u> . Schematic, socket, trimmers, alignment, notes Misc KLLIED BADIO CORP.	16-1 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALLAM</u> AEC-3RCMB 2RCM	See Model A704 See Model 4704 See Model 4704 See Model 4704 See Model 4704 See Model A-403 Schematic, cabinet Clarified schematics Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O ELECTRONICS CORP.</u> Schematic, alignment Misc <u>ALDEN, INC.</u> Schematic, socket, trimmers, alignment, notes Misc <u>KLLIED RADIO CORP.</u> (KNIGHT)	16-1 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALLAM</u> AEC-3RCMB 2RCM	See Model 4704 Schematics, changes See Model 4704 See Model 4704 Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O ELECTRONICS CORP</u> . Schematic, alignment Misc <u>ALDEN, INC</u> . Schematic, socket, trimmers, alignment, notes Misc <u>KLLIED RADIO CORP</u> . (KNIGHT)	16-1 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALLAM</u> AEC-3RCMB 2RCM 40-1500	See Model 4704 Schematics, changes See Model 4704 See Model 4704 See Model 4604D See Model A-403 Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O ELECTRONICS CORP</u> . Schematic, alignment Misc <u>ALDEN, INC</u> . Schematic, socket, trimmers, alignment, notes Misc <u>KLLIED RADIO CORP</u> . (KNIGHT) Schematic, socket, trimmers, alignment	16-1 16-2 16-3 16-4 . 16-1 . 16-1 . 16-2 16-1
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALLAM</u> AEC-3RCMB 2RCM 40-1500	See Model 4704 Schematics, changes See Model 4704 See Model 4704 See Model 4604D See Model A-403 Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O ELECTRONICS CORP</u> . Schematic, alignment Misc <u>ALDEN, INC</u> . Schematic, socket, trimmers, alignment, notes Misc <u>(KNIGHT)</u> Schematic, socket, trimmers, alignment Battery Servicing	16-1 16-2 16-3 16-4 . 16-1 . 16-2 . 16-2 . 16-2
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALLAM</u> AEC-3RCMB 2RCM 40-1500 <u>40-1500</u>	See Model 4704 Schematics, changes See Model 4704 See Model 4704 See Model 4604D See Model A-403 Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O ELECTRONICS CORP</u> . Schematic, alignment Misc <u>ALDEN, INC</u> . Schematic, socket, trimmers, alignment, notes Misc <u>(KNIGHT)</u> Schematic, socket, trimmers, alignment Battery Servicing Schematic, socket, trimmers.	16-1 16-2 16-3 16-4 . 16-1 . 16-2 16-1 16-6
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALLAM</u> AEC-3RCMB 2RCM 40-1500 <u>40-1500</u> <u>5B-171</u> 5B-175, 5B-176, Chassis 200 (B 100)	See Model 4704 Schematics, changes See Model 4704 See Model 4704 See Model 4604D See Model A-403 Schematic, cabinet Clarified schematics Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O ELECTRONICS CORP</u> . Schematic, alignment Misc <u>ALDEN, INC</u> . Schematic, socket, trimmers, alignment, notes Misc <u>(KNIGHT)</u> Schematic, socket, trimmers, alignment Battery Servicing Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment	16-1 16-2 16-3 16-4 .16-1 .16-1 .16-2 16-1 16-6 16-2
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALLAM</u> AEC-3RCMB 2RCM 40-1500 <u>40-1500</u> <u>5B-171</u> 5B-175, 5B-176, Chassis 200 6B-122	See Model 4704 Schematics, changes See Model 4704 See Model 4704 See Model 4604D See Model A-403 Schematic, cabinet Clarified schematics Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O ELECTRONICS CORP</u> . Schematic, alignment Misc <u>ALDEN, INC</u> . Schematic, socket, trimmers, alignment, notes Misc <u>(KNIGHT)</u> Schematic, socket, trimmers, alignment Battery Servicing Schematic, socket, trimmers, alignment Schematic, voltage Alignment, socket, trimmers.	16-1 16-2 16-3 16-4 . 16-1 . 16-2 16-2 16-2 16-3
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALAM</u> AEC-3RCMB 2RCM 40-1500 <u>40-1500</u> <u>5B-171</u> SB-175, SB-176, Chassis 200 6B-122	See Model 4704 Schematics, changes See Model 4704 See Model 4704 See Model 4604D See Model 4604D See Model A-403 Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O ELECTRONICS CORP</u> . Schematic, alignment Misc <u>ALDEN, INC</u> . Schematic, socket, trimmers, alignment, notes Misc <u>(LLIED RADIO CORP</u> . (KNIGHT) Schematic, socket, trimmers, alignment Battery Servicing Schematic, socket, trimmers, alignment, socket, trimmers, chassis, dial data	16-1 16-2 16-3 16-4 .16-1 .16-2 16-2 16-2 16-3 16-4
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALAM</u> AEC-3RCMB 2RCM 40-1500 <u>4</u> 5B-171 5B-175, 5B-176, Chassis 200' 6B-155, 6B156	See Model 4704 Schematics, changes See Model 4704 See Model 4704 See Model 4604D See Model A-403 Schematic, cabinet Clarified schematics Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O_ELECTRONICS_CORP</u> . Schematic, alignment Misc <u>ALDEN, INC</u> . Schematic, socket, trimmers, alignment, notes Misc <u>KLLIED RADIO_CORP</u> . (KNIGHT) Schematic, socket, trimmers, alignment Battery Servicing Schematic, voltage Alignment, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, chassis, dial data Parts list, notes	16-1 16-2 16-3 16-4 .16-1 .16-2 16-2 16-3 16-4 16-5
Crown Princess A-403 Court Jester, Chassis 470-1,470-2 451-2, Chassis 458-2, Chassis 470-1, 470-2, Chassis 4604D, 4604F, Chassis 458-2 4704 Crown Princess, Chassis 451-2 Se <u>ALAM</u> AEC-3RCMB 2RCM 40-1500 <u>40-1500</u> <u>5B-171</u> 5B-175, 5B-176, Chassis 200 ' 6B-155, 6B156 	See Model 4704 Schematics, changes See Model 4704 See Model 4704 See Model 4604D See Model 4604D See Model A-403 Schematic, cabinet <u>AIRLINE</u> e MONTGOMERY WARD <u>O ELECTRONICS CORP</u> . Schematic, alignment Misc <u>ALDEN, INC</u> . Schematic, socket, trimmers, alignment, notes Misc <u>KLLIED RADIO CORP</u> . (KNIGHT) Schematic, socket, trimmers, alignment Battery Servicing Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, chassis, dial data Parts list, notes Schematic, trimmers	16-1 16-2 16-3 16-4 .16-1 .16-1 .16-2 16-2 16-3 16-4 16-5 16-6

ANDREA RADIO CORP.

MODEL				PAGE
T- 16	Schemat Clarifi	ic, trimmers	, notes	16-1 16-2
T- U16	Alignme Schemat Alignme	nt ic, trimmers nt	, notes	16-3 16-4 16-5
	ANSLEY	RADIO CORP.		
FM-4, FM Tuner	Schemat	ië, trimmers	,	16-2
WOYD	Parts J Soberat	ist		16-3
677, 678	Schemat	ic ic		16-4
5111	Schemat Clarifi	ic, alignmen ed schematic	s t s	16-6 16-5
	ARC RA	DIO CORP.		
601	Schemat	ic, battery (iate	16-1
	volta	ige, notes	a ,	16-2
	A	RVIN		
5	ee NOBLITT S	PARKS INDU	STRIES	
A	UTOMATIC RAD	10 MFG. CO.	, INC.	
А.Т.Т.Р. С-60Х	Schemat Schemat	ic ic, battery	data,	16-1
F-790	socke Schema	et, trimmers tic, socket,	trimmers	16-1 16-3
601, 602, Seri	es B Schemat es C Schemat	tic, socket,	trimmers trimmers	16-2 16-2
620	Schema	tic, socket,	trimmers	16-3
720	Schemat	tic, socket,	trimmers	16-4
	AVIOLA	RADIO CORP	-	
501, 512	Schema	tic, dial dat	a, cabinet,	16-1
	Alignm	ent, socket,	trimmers	16-2
509, 518	Schema trim	tic, alignmen mers, dial da	it, socket, ita	16-2
512	Voltag See Mo	e, cabinet del 501		16-1
518	See Mo	del 509		
	BELMONT	RADIO CORP	2	
Boulevard 5P113, 5P116,	See Mo 5P117.	del 5P113		
Boulevard	Schema	tic, alignmen	nt, battery	16-10
6D111, Series	B Schema	tic, sensitiv	rity,	16+1
	Alignm	ent, socket,	trimmers,	
	butt	on data	çe, pusir-	16-2
60120, Series	A Schema Alignm	tic, voltage ent, socket,	trimmers,	10-3
	dial butt	data, cabino on data	et, push-	16-4
11AF21, Series	A Schema dete	tic, voltage	, switch v. selec-	
	tivi	ty		16-5
	A-M Al	ignment, dia	l data,	16-0
	F-M Al	ignment, soc	ket,	10-7
	trim Parts	mers, notes list		16-8
	BENDIX	RADIO DIV.		
626-A	Scheme	tic, socket,	voltage, neformer data.	
	resi	stance		16-1
	Parts	list, dial d	ata, alignment,	16-3
	RR	UNSWICK		
	See RADIO AN	D TELEVISI	ON INC.	
	CHEVROLET DI	V GENERAL	MOTORS	• • •
986067	Schem Pushb	atic, voltage utton data, p	, antenna notes arts layouts,	16-1
	cab Align	net ment, voltage	avout conter	16-2
	Parts	Trac, harrs 1	ayout, SUCKEL	10*4

CONCORD EMPIRE

	CONCORD RADIO CORP.		ELECT	RONIC CORP. OF AMERICA	
MODEL		PAGE	MODEL		
			201	Schematic, voltage Mis	с.
6C51B, 6C51W	Schematic, voltage, alignment, socket dial data	16-1	ELECTR	ONIC LABORATORIES, INC.	
7G26C	Schematic, voltage, parts	10 1	Orthosonic	See Model 710T	
	layout, dial data, coil data,	16.9	Radio Utiliphone	See Model 76RU	
	Clarified schematics	16-2	76RU, Radio Utiliphor Chassis 2865	Alignment obtage, notes	
	Alignment, trimmers, parts		0123313 2005	Alignment, chassis, notes Alignment, selectivity.	
	list	16-4		sensitivity, dial data	
	CORONADO			Sub-station data, tube data, notes	
	See GAMBLE-SKOGMO INC.		710T, Orthosonic,	Schematic, voltage	
			Chassis 2875	Alignment, tube data, chassis,	
CO	RONET RADIO & TELEVISION CO.			Alignment, selectivity,	
1583	Schematic, sockets	16-1	9011	sensitivity, dial data	
	Clarified schematics	16-2	2011 2865, Chassis	Schematic, socket See Model 76RU	
1701	Schematic Clarified schematics	16-3	2875, Chassis	See Model 710T	
		10 4	EMERSON	RADIO & PHONOGRAPH CORP	
C	ROSLEY DIV AVCO MFG. CORP.		503, 510, 510 A , 520, 53	9 Schematics	
56FC	Schematic, cabinet, socket,		Chassis 120000,12002	9, Alignment, voltage	
	trimmers Clarified acheration	16-1	120030,120032,120035,	Ponto list notes	
	Voltage, parts, alignment	16-3	505, Chassis 120020	Schematic, battery data	
56TD	Schematic, voltage	16-4		Alignment, coil and trimmer data	
	alignment	16-5		Dattery data, parts list Voltage	
	Parts list	16-6	505,523, Chassis		
56TN-L	Schematic, voltage Clarified schematics	16-7	120041	Schematic, notes	
	Cabinets, socket, trimmers,	10 0		battery data, parts list	
	alignment Bonto lint	16-9	507 509 518 599 525	Voltage Schematic notes	
56TX-L	Schematic, voltage	16-12	Chassis 120004,	Schematic, notes	
	Clarified schematics	16-2	120045	Alignment, voltage, parts	
	Socket, trimmers, alignment Parts list	16-13	518	See Model 503 See Model 507	
56TZ, 57TQ 1st	and 2nd Schematics, cabinets, dial	10 0	520	See Model 503	
Production	data Becord Changer, V-M Model	16-10	522	See Model 507 See Model 505, Chasais 120041	
	400 RCD. C	Ж.15-1	524, Chassis 120011,		
	Socket, trimmers, alignment,	16-11	524-2, Chassis 120022	Schematic, notes Clarified schematics	
	Parts list	16-6		Alignment, adjustments, dial dat	
56XTA, 56XTW	Schematic, voltage Clasified schematics	16-14	525.552 Chansia	Parts list, voltage	
	Socket, trimmers, cabinets,	10-8	120037	Schematic	
	alignment Desta list	16-15		Alignment, voltage	
57 TQ	See Model 56TZ	10-19	531, 532, 533,	voltage, parts list, notes	
66CS, 66CSM, 66	CS(s) Schematics	16-16	Chassis 120040	Schematic, notes	
	Model K BCD. C	H. 15-2		voltage, alignment, parts list, dial data	
	Socket, trimmers, alignment	16-17	535	See Model 507	
	Cabinets, voltage Parts list	16-18	543, 544, Chasaia	See Model 503	
66TC-S	Schematic, voltage	16-20	120046	Schematic	
	Clarified schematics Socket trimmana alignment	16-21	543 544 Channin	Alignment, voltage	
	cabinet	16-22	120052	Schematic, notes	
0.000 0.000	Parts list	16-19		Alignment, voltage	
80LN, 80LS	cabinet l	6-23.24	1002, 1003, Chassis	See Model 525	
	Clarified schematics	16-25	129003	Schematic	
	Voltage, socket, trimmers Alignment	16-26		Alignment, voltage, parts list, dial data	
	Alignment, dial data	16-29	120000, Chassis	See Model 503	
	Parta list	16-30	120004, Chassis 190011 Chassis	See Model 507 See Model 524	
	CLARION		120020, Chassis	See Model 524 See Model 505, Chassis 120020	
			120022, Chassis	See Model 524-2	
	See water on MIG. CO.		120035, Chassis	See Model 503	
	CORONADO		120037, Chassia	See Model 525	
	See GAMBLE SKOGMO INC.		120041, Chassis	See Model 505, Chassis 120041	
	DETROLA		120044, Chassis	See Model 503	
	ULINULA INTERNATIONAL DURBOLI COTT		120045, Chassis 120046, Chassis	See Model 507 See Model 543. Chassis 120046	
2	WEE INTERNATIONAL DETROLA CORP.		120052, Chassis	See Model 543, Chassis 120052	
	DEWALD RADIO MFG. CORP.		12/003, 0443513	CCC MOUCA 1002	
A-507	Schematic batter data			EMOR RADIO, LTD.	
	voltage, cabinet	16-1	100	Schematic, miscellaneous data,	
A-509	Schematic, alignment	16-2		Clarified schematics	
	Gravity real schematics	10-3		-	
D. T	EDWARD'S FM RADIO CORP.		E	IPIRE DESIGNING CORP.	
rM luner	Schematic, notes Antenna data, socket, trimmera	16-1 16-2	55 56	Schematic, socket Misc	

PAGE

16-1 16-2 16-3

16-4

16-5 16-6

16-7 16-8

16-1

16-2 16-3 16-4 16-5

16-7 16-6 16-5 16-7 16-8

16-2

16-14

16-2 16-7

16-15 16-16

16-17

16-2

16 - 18

16-2

16-19

16-20

16-1

16-2

Misc.16-4

Misc.16-4

Misc.16-3

Schematic, socket

Schematic, notes16-9Clarified schematics16-10Alignment, adjustments, dial data16-12Parts list, voltage16-13

ESPEY GEN TEL

ESP	EY MFG. CO., INC.	
MODEL		PAGE
FJ-97A, Chassis	Schematic	16-1
neviseu	Clarified schematics	16-2
5181	Schematic Clarified schematics	16-3
	Voltage, socket, trimmers,	
	alignment	16-6
FADA RADI	IO & ELECTRIC CO., INC.	
172	Schematic Classified asherotics	16-1
	Clarifica schematics	10-2
FARNSWORTH	TELEVISION & RADIO CORP.	
BT-68	Schematic Alignment, voltage and resistance	16-1
EK-081, EK-082, EK-083,	Schematic, voltage and resistance	16-3
EK-681, Chassis C-156, C-157, C-193	Model P-51 RCD.CH.	15-1
	Clarified schematics	16-4
	dial data, parts list, coil	
GK-140 GK-141.GK-142.	data, pushbutton data Schematic, voltage and resistance.	16-5
GK-143,GK-144, Pre-	coil connections 1	6-7,8
liminary	Clarified schematics Alignment, socket, trimmers,	10-9
	dial data, coil data	16-10
	FM alignment, oscillograms	16-6
FEDEB	AT TEL & RADIO CORP.	
E1025TB	Schematic, socket, resistance	
	and voltage	16-1
	Alignment, socket, trimmers	16-2
1030T 1540T	Chassis layout, parts list	16-4
10301, 13401	data, dial data	16-5
	Clarified schematics Voltage and resistance	16-6
	parts list	16-7
	Alignment, socket, trimmers	16-8
FEF	GUSON RADIO CORP.	
5X47	Schematic Misc.	16-5
7X47	Schematic Misc.	16-5
THE FIRE	STONE TIRE & RUBBER CO.	
Brilliantone	See Model 7403-1	
Noamer 4-A-17	See Model (402-6 Schematic	16-1
	Record Changer, Detrola	15-1
	Alignment, voltage, socket,	. 13 - 1
	trimmers, cabinet, notes Stage gain, dial data	16-2 16-9
7379-1,7405-3,7406-1	Schematic, voltage, notes	16-3
	Alignment, socket, trimmers,	10~4
7383-4	parts list Schematic socket	16-5 16-6
1303-4	Alignment, dial data	16-7
7396-1	Voltage, notes Schematic	16-8
	Parts list, alignment	16-10
7402-6, Roamer	Schematic, battery data,	10-11
	cabinet Alignment voltage, notes	16-12
	Parts list, socket, trimmers	16-8
7403-1, Brilliantone	Schematic, socket, trimmers, voltage, notes	16-14
7405 2 7406 3	Alignment, parts list	16-11
(405-3, (406-1	See Model (3/9-1	
G	AMBLE-SKOGMO INC.	
43-7601, 43-7601A, 43-7601B	Schematic, dial data, selectivity. sensitivity	16-1
	Clarified schematics	16-2
	socket, trimmers, alignment, coil data, voltage, changes	16-3
	Parts layout, cabinet	16-4
43-7602	Schematic, dial data,	
	selectivity, sensitivity Clarified schematics	16-1 16-2
	Socket, trimmers, alignment,	16-2
	Parts layout	16-4
	Parts layout Parts layout, cabinet	16-5 16-6
43 01/0	Schematic, voltage, alignment	16-7

GAMBLE-	SKOGMO FNC. (Cont'd.)	
MODEL		PAGE
43-8160 (Cont'd)	Cabinet, coil data, parts layout	16-8
	Parts layout, socket, trimmers, dial data, selectivity,	
43-8437	sensítivity Schematic, alignment, dial	16-9
	data, voltage, trimmers, socket, selectivity, sensi-	
	tivity Parts layout	$16-10 \\ 16-11$
43-8576	Cabinet, notes, parts list Schematic, coil data, voltage,	16-12
	selectivity, sensitivity Clarified schematics	16-13 16-2
	Dial data, alignment, trimmers, notes	16-14
	Cabinet, parts layout Parts layout	16 - 15 16 - 16
GARC	DD ELECTRONICS CORP.	
The Companion	See Model 5AP1-Y	
The Ensign	See Model 5Al Schematic, socket, trimmers,	
JAI, The Dasign	cabinet	16-1
5AP1-Y, The Companion	Alignment Schematic, alignment, socket,	10-2
5D-3, 5D-3A	trimmers, cabinet Schematic, battery data,	16-2
JD-3, JD-3A	cabinet	16-3
	cabinet, battery data	16-4
GEN	ERAL ELECTRIC CO.	
180	Schematic, cabinet Alignment socket, trimmers,	16-1
	voltage, stage gain data,	
254	dial data, notes Schematic, cabinet, voltage	16-2
234	Alignment, socket, trimmers,	16-4
	Parts layout, parts list	16-5
260	Schematic, voltage, dial data, socket, trimmers, cabinet	16-7.8
	Parts list, terminal data,	16.6
	wiring data, notes Clarified schematics	16-9
	Alignment, stage gain and	
	trimmers	16-11
290	Alignment, battery data Schematic, socket, cabinet,	16-12
200	notes	16-13
	Alignment, socket, trimmers,	10-14
	dial data, stage gain and voltage data, switch wiring	
	data	16-15
417	Schematic, notes 10	5-17,18
	Clarified schematics Parts list dial data, notes	16-19
	Voltage, switch wiring data,	16 10
	stage gain and voltage data Alignment	16-21
	Alignment, socket, trimmers,	16-23
	Band switch wiring data	16-24
801	Schematic, cabinet, notes 1 Amplifier, converter and	6-25,26
	oscillator data	16-27
	voltage data	16-28
	Voltage data, alignment Alignment	16-29
	Alignment, dial data, miscel-	16-31
	Miscellaneous adjustment data	16-32
	Changes, operation data, service notes	16-33
	Service notes, voltage Alignment	16-34
	Alignment, waveform measure-	16.94
	ments Chassis layouts, waveform	10-30
	measurements Parts list	16-37 16-38
GENERAL	TELEVISION AND RADIO CORP.	
4B5	Schematic, cabinet, stage	16-1
	Dial data, socket, trimmers,	16-9
5B5	Schematic, stage gain data, cabine	t 16-3
	voltage and resistance, socket, trimmers, parts layout, alignmen	nt 16-4

GEN TEL LEAR

_ _ _ .

GENERAL TELEVI	SION AND RADIO CORP. (Cont'd)
MODEL		PAGE
5B5 (Cont'd) 9A5	Dial data Schematic, stage gain data.	16-2
	voltage and resistance,	16.5
	Dial data	16-5
23A6	Alignment Schematic, stage gain data	16-4
	cabinet, voltage and resistance	·,
	socket, trimmers, parts layout Dial data	16-6 16-2
24B6	Alignment	16-4
2400	cabinet	16-7
	Socket, trimmers, parts layout,	16-9
	Dial data	16-2
25B5	Alignment Schematic, stage gain data,	16-4
	cabinet Socket trimmere perte levent	16-9
	voltage and resistance	16-10
	Dial data Alignment	$16-2 \\ 16-4$
Overland	San Model 66B	
56A, 56B, 56C, 56D, 56E	Schematic, voltage, alignment,	
66AM. 66DM	socket, trimmers,notes Schematic, voltage, alignment,	16-1
(CR Serie 0	socket, trimmers, notes	16-2
Series 3, Overland	ments, sockets, trimmers,	
6.6DM	battery data See Model 66AM	16-3
6 6 PM	Schematic, voltage, alignment,	
	socket, trimmers Record Changer, General In-	16-4
86 Series	strument Model 204 RCD. CH	. 15 - 1
00 Series	socket, trimmers, dial data,	
	notes Record Changer, Webster Model	16-5
	56 RCD. CH	. 15 - 10
_		10 0
B	(MANTOLA)	
8-635	(MANIOLA) Schematic	16-1
	Clarified schematics, push-	1.0-1
	button data Socket, trimmers, alignment.note	16-2 s16-3
	Pushbutton and electric tuner	
R-661	data Schematics, switch data	16-4 16-5
	Socket, trimmers, alignment,	16-6
	voltage, parts list	10-0
	GRANTLINE	
Se	ee W.T.GRANT CO.	
	W.T.GRANT CO.	
	(GRANTLINE)	
500, 501, Series A	Schematic, coil data, dial	
	data, selectivity, sensi- tivity, notes	16-1
	Socket, trimmers, voltage,	
	data	16-2
502, 503, Series A	Parts list Schematic, voltage, push-	16-5
	button data, cabinet,	
	notes	16-3
	Coil data, dial data, socket, trimmers, alignment, notes	16-4
510 Samian A	Parts list	16-5
SIV, Series A	Dial data, socket, trimmers,	10-0
	battery data, cabinet, aliamment, selectivity.	
	sensitivity	16-7
	Parts list, cabinet, miscel- laneous notes	16-8
THE	HALLLOBAFTERS CO	
Skyranger	See Model S-39	
Super Skyrider	See Model SX-28A	
EU-18, Echophone	alignment	16-1

THE HALLI	CRAFTERS CO. (Cont'd)	
MODEL		PAGE
EC-1B, Echophone(Cont'd)	Clarified schematics	16-2
EC-403, EC-404,	Saharania wa khusha dasa	
Echophone	notes	16-29 30
	Clarified schematics	16-31
	Parts layouts, trimmers	16-34
	Alignment, socket, trimmers,	16-25
	Parts list, cabinet	16-35
S-39, Skyranger	Schematic, notes	16-20
	Clarified schematics	16-21
	Irimmers Voltage alignment	16-22
	Parts layout, cabinet	16-24
	Parts layout, battery data	16-25
	Parts list Danta list antenna data	16-26
SX-28A. Super Skyrider	Schematic. switch data. notes	16-3.4
	Clarified schematics	16-5
	Parts layouts	16-8
	operation	16-9
	Operation	16-10
	Voltage, audio curves, a.v.c.	
	curve Triana anhian	16-13
	Alignment, miscellaneous	10-14
	service notes	16-15
	Parts list	16-16
4 0	FEMAN BADIO CORP	
4200 4200 Ch i	TIMAN HADIO CONT.	
119 A202, A309, Chassis	Schematic, voltage, chassis,	
	notes	16-1
1700 01	Alignment	16-2
A700, Chassis 1105	trimmers, chassis, voltage	16-4
B400, Chassis 118	Schematic, chassis, voltage,	
	notes	16-3
	Hecord Changer, Aero Model	ጉዞ 16-1
	Alignment	16-2
110S, Chassis	See Model A700	
118, Chassis	See Model B400	
119, Chassis	See Model A202	
н	OWARD RADIO CO.	
M901-A, 901-A	Schematics, sockets, trimmers	16-1
901-AP-A	Schematic, socket, trimmers	16-2
906	Schematic, notes	16-3
	Voltage, parts list, align-	
	antenna notes, cabinet	16-4
906C	Schematic, socket, trimmers,	
	cabinet Voltage alignment reaket	16-5
	trimmers, antenna notes	16-4
	Dial data, notes, parts list	16-6
TNTEDNA	TIONAL DETROLA CODD	
INTERNA	TIONAL DETROLA CORP.	
582	Schematic Clarified schematic	16-1
	Alignment, socket, trimmers,	10 1
	dial data	16-3
	Voltage, parts layout, parts	16-4
7270	Schematic	16-5
	Cabinet, socket, trimmers,	
	alignment, voltage, gain data	166
	Dial data	16-3
		10 0
	KNIGHT	
See A	LLIED RADIO CORP.	
	LAFAYETTE	
See RA	DIO WIRE TELEVISION	
LAURE	HK RADIO MFG. CO.	
L-52	Schematic Mi:	sc.16-6
	IFAR INC	
	LLAN, 130.	
568 565BL, 566, 567,	Schematic	16.1
300	Loop, socket, trimmers,	10-1
	alignment	16-2
662 663 665 6619	Dial data, voltage Schematic	16-3
002, 003, 003, 0018	Voltage, dial data. loop	16-5
	Aliana a saila a saina a	
	Allgament, socket, trimmers	10-0

4

¥.

I FAR MOTOROLA

LEA	R, INC. (Cont'd)	
MODEL		PAGE
6617PC	Schematic, voltage Dial data lasp	16-8
	Alignment, socket, trimmers	16-6
6618 6619	See Model 662 See Model 6614	
	MAGIC TONE	
See RADIO	DEVELOPMENT AND RESEARCH	
Т	HE MAGNAVOX CO.	
CB-197, CR-197A,	S to a la contra de la contra d	
CH-197B	Clarified schematics	16-1,2
	Nocket, trimmers, parts layout, notes	16-4
	Alignment, pushbutton data, gain data	16-5
	Dial data, gang drive ad-	16-6
Ch. 100 - Ch. 1004	Parts list	16-7
CR-198, CR-198A, CR-198B	Schematic, voltage, notes 10	5-9,10
	Clarified schematics Alignment, nushbutton data	16-8
	gain data	16-5
	justments	16-6
	Parts list Socket, trimmers, parts layout,	16-7
CB-199	notes Schematic voltage 16.	16-11
	Parts list	16-12
	laneous service notes	16-15
	Socket, trimmers, parts layout, notes	16-16
MAJESTIC R	ADIO & TELEVISION CORP.	
5A445, 5A445B	Schematic, voltage, socket,	
	trimmers Parts list, alignment	16-1 16-2
7C432, 7C447, Chassis 4706, 4707	Schematic, antenna data,	
,	socket, trimmers	16-3
1204 1202 01	dress, alignment, notes	16-4
4/06, 4/07, Chassis	See Model 7C432	
s	MANTOLA	
NELCONED VEC	EE DIF, GOODAICH	
9+1065	Schematic	16-1
	Record Changer, General Industries Model	
	R-90L A.R.C. &R	• 2 42
	notes	16-2
	Operating notes	16-3
MII	DWEST RADIO CORP.	
S-12, SG-12, SI-12, Chassis SGT-12	See Model 712	
S-16, SG-16, ST-16, Chassis SGT-16	See Models 716, 716A	
712, Series 12, S-12, SG-12, ST-12, Chassis	Schematic notes	16-1
SGT-12	Clarified schematics	16-2
	alignment	16-3
	dial data, notes	16-4
716, Series 16, S-16, SG-16, ST-16, Chassis	Schematic, notes	16-5
SGT-16	Clarified schematics Dial data	16-7,8 16-4
	Alignment, pushbutton data Socket trimmers chassis parts list	16-11
716A, Series 16, S-16, SG-16, ST-16, Chasais	Schematic potes	16-6
SGT-16	Clarified schematics 1	6-9,10
	Socket, trimmers, chassis,	10-11
	parts list Dial data	16-12 16-4
ALT M DI	AVA CORP. OF AMERICA	
Portapal	See Model 729	
729, Portapal	Schematic Voltage, cabinet, socket.	16-1
	trimmers, servicing notes	16-2

www.americanra	idiohistory com	1	

CR6

MODEL PAGE Schematic, coil data, notes Schematic, coil data, notes 16 - 116-2 8S- 1A MONITOR EQUIPMENT CORPORATION M-403 16-3 Schematic, notes Socket, trimmers, alignment, 16-4 notes M-510 Schematic 16-5 Socket, trimmers, dial data, alignment, cabinet, notes 16-6 16-1 TA56M, TC56M, TW56M Schematic Voltage, cabinets, alignment, socket, trimmers 16-2 MONTGOMERY-WARD 54KP-1209B Schematic, selectivity, sensitivity, coil data, notes Battery data, socket, trimmers, 16-1 16-2 alignment 16-3 Sensitivities Parts list 16 - 4Schematic, voltage data, socket data, coil data Sensitivities, alignment, 64WG-1052B, 74WG-1052B 16 - 5Sensitivities, alignment, socket, trimmers Parts list, dial data, notes Schematic, voltage, senstivity, selectivity, notes 16-6 16-7 64WG-1207A; 64WG-1207B, 74WG-1207B 16-8 Sensitivities 16-3 Alignment, socket, trimmers, dial data 16-9 Parts list 16 - 1064WG-1804C Schematic, voltage Alignment, socket, trimmers, dial data, selectivity, sensi-16-11 16-12 tivity Sensitivities 16 - 3Parts list 16-10 64WG-2010A, 64WG-Schematic, voltage, coil data, 2010B, 74WG-2010B tuning panel Record Changer, Seeburg 16-13 RCD. CH. 15-2 Model K Clarified schematics 16-14 Alignment, socket, trimmers, dial data, selectivity, sensitivity 16-15 16-16 Sensitivities Parts list 16-17 74BR-1812A Schematic, dial data, selectivity, sensitivity, switch data Clarified schematics Alignment, socket, trimmers 16-18 16-19 16-20 Alignment 16-21 Parts list 16-17
 Parts
 Ist

 74WG-1052B
 See Model 64WG-1052B

 74WG-1207B
 See Model 64WG-1207A

 74WG-2010B
 See Model 64WG-2010A

 74WG-2505A, 74WG-2705A
 Schematic, switch data, notes,
 tuning panel Clarified schematics 16-22 16-23 Alignment, socket, trimmers, 16-24 voltage Sensitivity data, alignment 16-25 Parts list Dial data, coil data, socket, trimmers, selectivity, sensi-16-26 tivity Record Changer, Seeburg 16-16 74WG-2705A RCD. CH. 15-18 Model L RCD. Schematic, coil data, voltage Record Changer, Webster 74WG-2703A 16-27 Model 50 RCD.CH.15-1 Clarified schematics 16-28 Socket, trimmers, alignment, dial data 16-29 Parts list, sensitivity data, tuning panel, selectivity See Model 74WG-2505A 16-30 74WG-2705A MOTOROLA, INC. Socket, trimmers, alignment 16-1 Voltage, dial data, sensitivity 16-2 Service notes 16-3 Parts layout 16+4 Chassis 16-5 Pushbutton data 16-6 16-7 I-F transformer notes Parts list 16-8 16-7 I-F transformer notes CT6, OE6, PC6 Pushbutton data 16-9

Dial data, notes

Parts layout

16-10

16-11

MOLDED INSULATION CO.

RS-1

MOTOROLA RCA

	MOTO	ROLA, INC. (CONT'D)	
MODEL			PAGE
CT6, OE6, PC6 (C	Cont'd)	Socket, trimmers, voltage,	16.15
		resistance Alignment, sensitivity,	15-15
		notes Parts list	16-16
CT6		Chassis	16-12
0F.6 PC.6		Chassis Chassis	16-13
FD6, NH6		Parts layout	16-18
		Pushbutton data I-F transformer notes	16-6 16-7
		Chassis	16-19
		Socket, trimmers, voltage,	16-20
		notes, resistance	16-21
OE6, PC6		See Model CT6	10-22
PD6		Schematic, notes Rushbutton data	16-23
		I-F transformer notes	16-7
		Alignment, socket, trimmers Parts lavout	16-24
		Chassis	16-26
		Voltage, resistance, dial data Parts list	16-27
405		Chassis	16-29
		1-r transformer notes Alignment, sensitivity, notes	16-7 16-16
		Socket, trimmers, cabinet,	16-22
		Voltage, resistance	16 - 33 16 - 35
505		Parts list Chassis	16-36
		I-F transformer notes	16-7
		Alignment, sensitivity, notes Socket, trimmers, cabinet.	16-16
		sensitivity Voltana	16-33
		Parts list	16-35
605		Chassis I-F transformer potes	16-31
		Alignment, sensitivity, notes	16-16
		Socket, trimmers, cabinet,	16-33
		Pushbutton data	16-34
		Voltage, resistance Parts list	16-35
705		Chassis L.F. transformer pater	16-32
		Alignment, sensitivity, notes	16-16
		Socket, trimmers, cabinet, sensitivity, notes	16-33
		Pushbutton data	16-34
		Parts list	16-35
	NATION	AL ACOUSTIC PRODUCTS	
WRA-1		Schematic, changes, cabinet Misc.	16-7
	NATION	AL CO-OPERATIVES INC	
R-546		Schematic, socket, trimmers,	
		cabinet Misc.	16-8
	NATION	AL UNION RADIO CORP.	
G-613		Schematic, notes	16-1
		Parts list, alignment, dial data, battery data notes	16-2
G-615		Schematic, notes	16-3
		alignment	16-4
	NOBLE	TT SPARKS INDUSTRIES	
552AN, 552N, 555.	555A	Schematic	16-1
		Chassis, socket, trimmers,	
		Cabinets, miscellaneous	16-2
		servicing notes Parts list nusbutton data	16-3
		dial data	16-4
665		Schematic Record Changer, General	16-5
		Instrument Model 205 RCD. CH.	15-5
		Cabinet, miscellaneous servicing notes, dial data	16-6
		Alignment, chassis, socket,	16 7
		Crimmers	10-1
N605-F	NORTH	1EHN RADIO COMPANY	
1100J-E		Schematic, notes, cabinet Clarified schematics	16-1 16-2
		Alignment, socket, trimmers Dial data, voltage consis	16-3
		tivity, selectivity, notes	16-4

	OLYMPIC	RADIO &	TELEVISION	INC.	
MODEL					PAGE
6A-606		Schemat	ic, socket,	trimmers,	
		align	ment, batter	y data, notes	16-1
		Alignme	nt, battery :	notes,	16.0
6B-606		Schemat	ic. socket. :	trimmers.	16-2
		aligna	ment, batter	y data, notes	16-3
		Alignmen	nt, battery i	notes,	
7-596		parts	list	•	16-4
1-320		alien	nent, socket, i	rimmers, Vidata notes	16-5
		Alignmen	nt, battery r	otes,	1.7 5
		parts	list		16-6
		DACEARD	BELL CO		
		FACKARD	DELL CO.		
5DA		Schemat	ic		16-1
		Cabinet,	, voltage, so	ocket,	
		laneou	is servicing	notes	16-2
568		Schemat	ic 🍈		16-3
		Cabinet	voltage, so	ocket,	
			ers, alignmer	nt, miscel-	16 4
		Taneou	is servicing	notes	10-4
		PHILCO	CORF.		
CR-2, Code 1	21	Schemati	c, gain data	L	16-1
		Socket,	trimmers, ch	assis,	
		aligns	ient .	1.	16-2
		and re	sistance	voitage	16-3
CR-4, Code 1	21	Schemati	c, gain data		16-4
		Socket,	trimmers, ch	assis,	
		alignm Dial due	ent 		16-6
		contro	l unit. volt	age and	
		resist	ance		16-7
	0.1	Assembly			16-8
Ch-n, Code I	21	Schemati Sockat	c, gain data		16-5
		alignm	ent	assis,	16-6
		Dial dat	a, permeabil	ity tuner,	
		contro	l unit, volt	age and	
		resist	ance		16-7
46-200, Code	125	Schemati	c. gain data		16-9
		Socket,	trimmers, ch	assis,	
		alignm	ent		16-10
		Dial dat	a, voltage a	nd resis-	14 11
46-1203, Cod	e 125	Schemati	c. gain data		16-12
		Record C	hanger, Phil	co 46-1226	15-45
		Socket,	trimmers, ch	assis,	
		alignm Dial dat	ent a cabinat	voltage	16-13
		and re	sistance	VOICUge	16-14
	PHI	LIPS PET	ROLEUM CO.		
		(WOOLA	ROC)		
3-1AX, 3-2AX		Schemati	c, voltage		16-1
		Alignmen	t, socket, t	rimmers,	14 0
			ata, gain da	ta	16-2
	P P	ILOT RAD	IO CORP.		
T-411-U		Schemati	c. socket. t	rimmers.	
		notes			16-1
		Clarifie	d schematics		16-2
T-521		Schemati	i, socket, t c. voltere	rimmers socket	16-3
		trimme	rs, notes	sockee,	16-4
		Clarifie	d schematics		16-5
		Alignmen	t, antenna n	otes,	
		diai u	ata		10-0
	THE I	URE OIL	CO., U.S.A		
		(PURI	TAN)	-	
5D15WG-\$015.		Schemati	c, coil data	voltage	
5D25WG-5025	1	socket	, trimmers	, vortuge,	16-1
		Alignmen	t, trimmers,	dial	
		data,	parts list		16-2
		PURT	TAN		
	See P	URE OT	CO. II S A		
	1	BCAN	160 CO		
PC 4340 0		11. U.A. 9	<u>1. U.</u>		
nc-4/4D, Chas BC-50711 Chas	515	See Mode	1 X60		
RC-529A, Chas	91S	See Mode	1 0B13		
RC-585, Chass	is	See Mode	1 Q36		
RC-606, Chass	15	See Mode	1 67AV1		
BC-612 Chass	15	See Mode	1 68H1		
RC-1017A. RC-	1017B.	ove mode.	VD13		
Chassis	,	See Mode	62-1		

8

R C A SEARS

R.C.A	. MFG. CO. (Cont'd)	
MODEL		PAGE
RC-1034, Chassis	See Model 61-8	
RC-1044, Chassis	See Model Q103	
RC-1044B, Chassis RC-1047, Chassis	See Model 5485	
Q36, Chassis RC-585	Schematic, voltage, notes	16-1
	Clarified schematics Alignment, wiring data	16-2
	Alignment, socket, trimmers,	10-4
	dial data, notes	16-5
	laneous servicing notes	16-6
0102 0103-2 01024	Parts list	16-7
Q103A-2,	data, notes	16-8
Chassis RC-1044;Q103)	(Socket, trimmers, alignment	16-11
Q103AX-2, Q103AX, Q103AX,	data data	16-12
Chassis BC-1044B	Lead dress notes, cabinets,	16 12
Q103, Q103-2, Q103A,	dial data, parts list	10-13
Q103A-2	Clarified schematics	16-9
Q103A, Q103A-2, Q103AX, Q103AX-2	Clarified schematics	16-10
Q121, Chassis RC-507U	Schematic, voltage, lead	
	dress notes, miscellaneous notes	16-14
	Clarified schematics	16-15
	Alignment, socket, trimmers,	16-16
	Cabinet, control panel, dials,	10 10
	miscellaneous servicing notes Power supply data loudeneoker	16-17
	and cable connections, parts	
OB13 Channin BC-5204	list	16-18
RC-612	Schematic, gain data, notes	16-19
	Clarified schematics	16-20
	dial data, coil and band	
	switch data, lead dress notes	16-23
	miscellaneous servicing data	16-24
X60 Channin HC- 474D	Parts list	16-7
100, Chassis HC-4140	Clarified schematics	16-26
	Cabinet, pushbutton data,	
	dial data	16-27
54B5, Chassis RC-1047	Schematic, gain data, voltage,	
	socket, trimmers, alignment, lead dress notes	16-28
	Miscellaneous servicing notes,	1 (00
	Cabinet, parts list	16-29
61-8, 61-9, Chassis	Seberation and data with an	
NC+ 10 54	socket, trimmers, alignment,	
	dial data	16-31
	parts list	16-32
62-1, Chassis BC-1017A, BC-1017B	Sebenetic soin data voltare	16 22
10-101 (D	Record Changer, R.C.A.	10-22
	Model 960260-2 RCD.CH.	15-17
	alignment, dial data,	
67AVI. 67VI Champin	controls	16-34
RC-606	Schematic, gain data, voltage,	
	coil data Becord Changer B C A	16-35
	Model 960260-1 BCD. CH.	15-17
	Clarified schematics Socket trimmers alignment	16-36
	speaker connections, antenna	
	data, dial data Cabinat land drana notice	16-37
	controls, chassis	16-38
6881 6882 6982	Dials, parts list	16-39
68R4,	Schematic, gain data, voltage	16-40
Chassis RC+608	Clarified schematics Socket, trimmers, alignment	16-41
	Cabinets, dial data, chassis,	10-42
	lead dress notes, miscel-	16-42
	Dials, parts list	16-39
8578	Schematic, coil data Clarified schematics	16-44
	Socket, trimmers, alignment,	10-40
	cabinet, voltage Parta liat, miscellaneous	16-46
	servicing data	16-47
212	Schematic, gain data, voltage, cabinet, notes	16-48

B	CANEG CO (Contid)	
MODEL	C.A. Mrd. CO. (Cont a)	PAGE
515 (Cont'd)	Clarified schematics	16-49
510 (0000 0)	Socket, trimmers, alignment,	10 47
	dial data, parts list, lead dress notes	16-50
D .(1)		
D-6876 SE-6810	DIO AND TELEVISION INC.	
T-4000, T-4000-1/	2 Schematic, resistance, voltage,	
	notes Becord Changer Farmsworth	16-1
	Model P-51 RCD. CH	. 15-1
	Clarified schematics Switch data, coil data, I-F	16-2
	transformer data, socket,	14.2
	Alignment, oscillograms	16-4
	Alignment, parts list	16-5
RA	DIONIC EQUIPMENT CO.	
14B 240T	Schematic, cabinet Schematic, cabinet	16-1
		19-2
80 12	ADIO WIRE TELEVISION	14.1
Dr - 12	Battery data, operating data	16-2
FA-15 +	Schematic Schematic schinet nower	16-3
	supply notes	16-4
MC-11	Schematic, voltage Socket, trimmers, alignment	16-5
ar	CAL ELECTRONICE CORD	-
800. 801	Schewatic	16-1
900	Schematic, voltege	16-2
1049	Clarified schematics Schematic, voltage	16-3 16-2
	Clarified schematics	16-4
	HEMLER CO., LTD.	
5100	Schematic, notes Sisc.	16-9
BF	KEL WERCHANDISE COMPANY	
L-266	Schematic, voltage, socket.	
	trimmers, alignment, notes,	14.1
	Alignment, battery data,	10-1
L-266-A	parts list Schematic, voltage, socket,	16-2
	trimmers, alignment, notes,	16.2
	Alignment, battery data,	10-3
L-266-U	parts list Schematic, voltage, socket	16-4
	trimmers, alignment, notes,	
	Dattery data Alignment, battery data,	16-5
	parts list	16-6
I	RYAN SALES COMPANY	
C5TS3	Schematic, notes	16-1
	Socket, trimmers, alignment, voltage, notes	16-2
00000		
Imperial All Wave	Schematic	16-1
800-B6	Partial schematic, parts list,	10-1
	attenuator, notes	16-2
	SEARS ROEBUCK & CO.	
7020, Ch. 101.807;	Schematic, voltage, dial	
7054, Ch. 101.807	A; data, alignment	10-1
	Chassis, socket, trimmers, notes	16-2
7054	Parts list See Model 7020	16-3
1034	Schematic, voltage, dial data,	
7080, Ch. 101-809;	notes	16-4
7100, Ch. 101.811	Alignment Socket trimmers chassis	16-1
	Parts list	16-8
7100 7165, Ch. 101.823:	See Model 7080	
Ch. 101, 823-1; 71 Ch. 101, 8234, Ch	66,	
101.823-1A	Schematic, voltage	16-6
	Socket, trimmers, chassis	16-7
	Alignment, miscellaneous	10-1

SENTINEL TRUETONE

SE	NTINEL RADIO CORP.	
MODEL		PAGE
L-284I, L-284NA,		
L-28NI,	Schematic, voltage	16-8
L-284NR, L-284W	Alignment, socket, trimmers,	16-0
	Parts list. notes	16-10
IU284GA	See Model 284GA	
IU285P	See Model 285P	
10293CT 247	See Model 293CT Schematic voltage cocket	
241	trimmers. chassis	16-1
	Alignment, battery data, notes	16-2
	Parts list	16-10
276P	Schematic, voltage, notes	16-5
	chassis, battery data	16-4
	Battery data, parts list, notes	16-5
284GA, IU284GA	Schematic, cabinet, voltage,	
1	notes	16-6
	chassis	16-7
	Parts list	16-19
285P, IU285P	Schematic, voltage	16-11
	Alignment, socket, trimmers,	14.10
	Chassis Parts list battery data notes	16-12
286P, 286PR	Schematic, voltage	16-14
	Alignment, socket, trimmers,	
	chassis	16-15
	Parts list, cabinet, battery	16-16
293CT. IU293CT	Schematic, voltage	16-17
	Record changer, General	
	Instrument 205 RCD.CH.	15-17
	chassis	16-18
	Parts list, notes	16-19
510	Schematic	16-20
0 F 7	CHELL CARLSON INC	
JOT SEI	CHELL-CARLSON, INC.	
427	Schematic socket trimmere	16-1
4 +1	cabinet. notes	16-2
	,	
SIGN	AL ELECTRONICS, INC.	
341T	AL ELECTRONICS, INC. Schematic, dial data, socket	
341T SIGN	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Misc.	16=10
341T <u>SIGN</u>	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Misc.	16=10
341T <u>SIGN</u>	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Misc. SILVERTONE	16=10
341T Se	<u>AL ELECTRONICS, INC.</u> Schematic, dial data, socket, alignment <u>SILVERTONE</u> e SEARS ROEBUCK CO.	16=10
341T <u>SIGN</u> Se	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment SILVERTONE e SEARS ROEBUCK CO.	16=10
341T Se <u>SONORA</u>	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP.	16=10
341T Se A-11, Chassis A	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic	16=10
341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 BCME 930	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment	16-1 16-2
341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment Schematic, socket, trimmers, alignment, notes	16=10 16-1 16-2 16-3
SIGN 341T Se A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Misc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, notes	16-1 16-2 16-3 16-4
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, notes Alignment	16-1 16-2 16-3 16-4 16-2
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment	16-1 16-2 16-3 16-4 16-2
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Schematic, dial data, socket, disc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, battery notes.	16-1 16-2 16-3 16-4 16-2 16-5
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Schematic, dial data, socket, disc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, battery notes, alignment, socket, trimmers	16-1 16-2 16-3 16-4 16-2 16-5 16-6
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment, socket, trimmers, alignment Schematic, battery notes, alignment, socket, trimmers, schematic, battery notes, alignment, socket, trimmers	16-1 16-2 16-3 16-4 16-5 16-5
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Schematic, dial data, socket, signment SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, battery notes, alignment, socket, trimmers, alignments, socket, trimmers, alignments, socket, trimmers, schematic, socket, trimmers, alignment	16=10 16-1 16-2 16-3 16-4 16-2 16-5 16-6 16-7
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Misc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, battery notes, alignment Schematic, battery notes, alignment Schematic, battery notes, ulignment, socket, trimmers Schematic, battery notes, schematic, socket, trimmers, schematic, socket, trimmers, tuning data Alignment Schematic, socket, trimmers,	16=10 16-1 16-2 16-3 16-4 16-2 16-5 16-5 16-6 16-7 16-4
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Misc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, battery notes, alignment Schematic, battery notes, alignment Schematic, socket, trimmers, schematic, socket, trimmers, alignment, socket, trimmers, tuning data Alignment Schematic, socket, trimmers, alignment	16=10 16-1 16-2 16-3 16-4 16-2 16-5 16-5 16-6 16-7 16-4 16-8
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Misc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, battery notes, alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment, socket, trimmers, tuning data Alignment Schematic, socket, trimmers, alignment	16=10 16-1 16-2 16-3 16-4 16-2 16-5 16-6 16-7 16-4 16-8
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU <u>SP</u>	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Misc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment, socket, trimmers, tuning data Alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, tuning data Alignment Schematic, socket, trimmers, alignment, antenna notes ARKS-WITHINGTON CO.	16=10 16-1 16-2 16-3 16-4 16-2 16-5 16-6 16-7 16-4 16-8
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU S-26, 5-26PS, 5-26X	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Schematic, dial data, socket, signment Misc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment, notes Schematic, socket, trimmers, alignment, notes Schematic, battery notes, alignment Schematic, battery notes, alignment, socket, trimmers, tuning data Alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, schematic, socket, trimmers, tuning data Alignment Schematic, socket, trimmers, alignment, antenna notes ARKS-WITHINGTON CO. Schematic, dial data, voltage	16-1 16-2 16-3 16-4 16-2 16-5 16-6 16-7 16-4 16-8
SIGN 341T Se SONORA A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU 5-26, 5-26PS, 5-26X	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Schematic, dial data, socket, signment Misc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, battery notes, alignment, socket, trimmers, tuning data Alignment Schematic, socket, trimmers, alignment, antenna notes ARKS-WITHINGTON CO. Schematic, dial data, voltage Alignment, socket, trimmers	16=10 16-1 16-2 16-3 16-4 16-2 16-5 16-6 16-7 16-4 16-8 16-1 16-2
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU S-26, 5-26PS, 5-26X 6F1	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Schematic, dial data, socket, disc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment Schematic, socket, trimmers, alignment, notes Alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment, socket, trimmers Schematic, socket, trimmers, alignment, socket, trimmers, alignment, socket, trimmers Schematic, socket, trimmers, alignment, antenna notes ARKS-WITHINGTON CO. Schematic, dial data, voltage Alignment, socket, trimmers Schematic, dial data, notes	16=10 16-1 16-2 16-3 16-4 16-5 16-5 16-6 16-7 16-4 16-8 16-1 16-2 16-3
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU S-26, 5-26PS, 5-26X 6F1	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Schematic, dial data, socket, alignment Misc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment, socket, trimmers, alignment, socket, trimmers, schematic, socket, trimmers, alignment, antenna notes ARKS-WITHINGTON CO. Schematic, dial data, voltage Alignment, socket, trimmers Schematic, dial data, notes	16=10 16-1 16-2 16-3 16-4 16-5 16-5 16-6 16-7 16-4 16-8 16-1 16-2 16-3 16-4
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU 5-26, 5-26PS, 5-26X 6F1	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Misc. <u>SILVERTONE</u> e SEARS ROEBUCK CO. <u>RADIO & TELEVISION CORP.</u> Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, battery notes, alignment Schematic, socket, trimmers, schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment, antenna notes <u>ARKS-WITHINGTON CO.</u> Schematic, dial data, voltage Alignment, socket, trimmers, sensitivity, notes Voltage	16=10 16-1 16-2 16-3 16-4 16-5 16-6 16-7 16-4 16-8 16-1 16-3 16-2 16-3 16-4 16-3 16-4 16-5
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU S-26, 5-26PS, 5-26X 6F1 6F1D	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Misc. <u>SILVERTONE</u> e SEARS ROEBUCK CO. <u>RADIO & TELEVISION CORP.</u> Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, battery notes, alignment Schematic, socket, trimmers, schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, schematic, socket, trimmers, alignment, antenna notes <u>ARKS-WITHINGTON CO.</u> Schematic, dial data, voltage Alignment, socket, trimmers, sensitic, dial data, notes Alignment, socket, trimmers, sensitivity, notes Voltage Schematic, notes	16=10 16-1 16-2 16-3 16-4 16-5 16-6 16-7 16-4 16-8 16-1 16-2 16-3 16-4 16-5 16-5 16-5 16-5
SIGN 341T Se SONORA A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU 5-26, 5-26PS, 5-26X 6F1 6FID	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, battery notes, alignment Schematic, socket, trimmers, schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment, socket, trimmers, tuning data Alignment Schematic, socket, trimmers, alignment, antenna notes Alignment, socket, trimmers, alignment, socket, trimmers, schematic, dial data, voltage Alignment, socket, trimmers, schematic, dial data, notes Alignment, socket, trimmers, sensitivity, notes Voltage Schematic, notes Voltage Alignment, socket, trimmers	16=10 16-1 16-2 16-3 16-4 16-5 16-6 16-7 16-4 16-8 16-1 16-2 16-3 16-4 16-5 16-5 16-6 16-5 16-7 16-5
SIGN 341T Se SONORA A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU 5-26, 5-26PS, 5-26X 6F1 6F1D	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic Schematic, alignment Schematic, socket, trimmers, alignment, notes Alignment Schematic, battery notes, alignment, socket, trimmers, tuning data Alignment Schematic, socket, trimmers, alignment, antenna notes ARKS-WITHINGTON CO. Schematic, dial data, voltage Alignment, socket, trimmers, schematic, dial data, notes Alignment, socket, trimmers, schematic, dial data, notes Alignment, socket, trimmers, schematic, dial data, notes Alignment, socket, trimmers, sensitivity, notes Voltage Alignment, socket, trimmers, schematic, notes Voltage Alignment, socket, trimmers Roto-selector notes, dial data,	16=10 16-1 16-2 16-3 16-4 16-2 16-5 16-6 16-7 16-4 16-8 16-1 16-2 16-3 16-4 16-5 16-5 16-5 16-5
SIGN 341T Se SONORA A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU 5-26, 5-26PS, 5-26X 6F1 6F1D	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Schematic, dial data, socket, alignment Misc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment, socket, trimmers, alignment, socket, trimmers, schematic, battery notes, alignment, socket, trimmers, alignment, socket, trimmers, schematic, dial data, voltage ARKS-WITHINGTON CO. Schematic, dial data, notes Alignment, socket, trimmers, sensitivity, notes Voltage Schematic, notes Voltage Alignment, socket, trimmers Roto-selector notes, dial data, miscellaneous servicing notes	16=10 16-1 16-2 16-3 16-4 16-5 16-6 16-7 16-8 16-1 16-2 16-3 16-4 16-5 16-5 16-5 16-7 16-8
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU S-26, S-26PS, S-26X 6F1 6F1D 6F2D	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Nisc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment, socket, trimmers, alignment, socket, trimmers, schematic, socket, trimmers, schematic, socket, trimmers, alignment, antenna notes ARKS-WITHINGTON CO. Schematic, dial data, voltage Alignment, socket, trimmers, sensitivity, notes Voltage Schematic, notes Voltage Alignment, socket, trimmers Roto-selector notes, dial data, miscellaneous servicing notes Schematic Alignment, socket, trimmers	16=10 16-1 16-2 16-3 16-4 16-5 16-6 16-7 16-4 16-8 16-1 16-2 16-3 16-4 16-5 16-5 16-7 16-3 16-7 16-8 16-9 16-9
SIGN 341T Se SONORA A-11, Chassis A BBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU 5-266, 5-26PS, 5-26X 6F1 6F1D 6F2D	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Sisc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, battery notes, alignment Schematic, battery notes, alignment Schematic, battery notes, alignment Schematic, socket, trimmers, tuning data Alignment Schematic, dial data, voltage Alignment, socket, trimmers, alignment, socket, trimmers, alignment, socket, trimmers, schematic, dial data, notes ARKS-WITHINGTON CO. Schematic, dial data, notes Alignment, socket, trimmers, sensitivity, notes Voltage Schematic, notes Voltage Alignment, socket, trimmers Roto-selector notes, dial data, miscellaneous servicing notes Schematic Alignment, socket, trimmers, dial data, notes	16=10 16-1 16-2 16-3 16-4 16-2 16-5 16-5 16-7 16-4 16-2 16-3 16-4 16-5 16-5 16-5 16-5 16-5 16-5 16-5 16-5 16-5 16-2 16-2 16-2 16-5 16-6 16-7 16-2 16-7 16-8 16-9 16-1 16-9 16-1 16-5 16-5 16-5 16-5 16-5 16-5 16-5 16-6 16-2 16-5 16-6 16-2 16-5 16-6 16-2 16-7 16-8 16-5 16-5 16-5 16-5 16-5 16-7 16-5 16-7 16-2 16-5 16-7 16-7 16-7 16-7 16-7 16-8 16-5 16-5 16-5 16-5 16-5 16-5 16-5 16-5 16-5 16-5 16-7 16-7 16-7 16-7 16-7 16-7 16-7 16-8 16-5
SIGN 341T Se <u>SONORA</u> A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU S-26, 5-26PS, 5-26X 6F1 6F1D 6F2D	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Misc. <u>SILVERTONE</u> e SEARS ROEBUCK CO. <u>RADIO & TELEVISION CORP.</u> Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment, socket, trimmers, schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment, antenna notes <u>ARKS-WITHINGTON CO.</u> Schematic, dial data, voltage Alignment, socket, trimmers, sensitivity, notes Voltage Schematic, notes Voltage Alignment, socket, trimmers Roto-selector notes, dial data, miscellaneous servicing notes Schematic Alignment, socket, trimmers, miscellaneous servicing notes Schematic Alignment, socket, trimmers, dial data, notes Tuner notes, tuning panel,	16=10 16-1 16-2 16-3 16-4 16-5 16-6 16-7 16-4 16-8 16-1 16-5 16-6 16-5 16-6 16-5 16-7 16-8 16-7 16-8 16-7 16-8 16-9 16-10 16-
SIGN 341T Se SONORA A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, #GFU 5-26, 5-26PS, 5-26X 6F1 6F1D 6F2D	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, notes Alignment Schematic, battery notes, alignment, socket, trimmers, tuning data Alignment Schematic, socket, trimmers, tuning data Alignment Schematic, socket, trimmers, alignment, antenna notes ARKS-WITHINGTON CO. Schematic, dial data, voltage Alignment, socket, trimmers, schematic, notes ARKS-WITHINGTON CO. Schematic, dial data, notes Alignment, socket, trimmers, sensitivity, notes Voltage Schematic, notes Voltage Alignment, socket, trimmers Roto-selector notes, dial data, miscellaneous servicing notes Schematic Alignment, socket, trimmers, dial data, notes Tuner notes, tuning panel, voltage, chassis, notes	16=10 16-1 16-2 16-3 16-4 16-2 16-5 16-6 16-7 16-4 16-8 16-1 16-5 16-6 16-5 16-6 16-5 16-7 16-8 16-7 16-8 16-7 16-8 16-7 16-10 16-11 16-10
SIGN 341T Se SONORA A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU 5-26, 5-26PS, 5-26X 6F1 6F1D 6F2D 6-26, 6-26PA	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic Schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, battery notes, alignment, socket, trimmers, tuning data Alignment Schematic, socket, trimmers, alignment, antenna notes ARKS-WITHINGTON CO. Schematic, dial data, voltage Alignment, socket, trimmers, sensitivity, notes Voltage Schematic, notes Alignment, socket, trimmers, sensitivity, notes Voltage Alignment, socket, trimmers, sensitivity, notes Voltage Alignment, socket, trimmers, dial data, notes Tuner notes, tuning panel, voltage, chassis, notes Schematic, dumy antenna Clarified schematica	16=10 16-1 16-2 16-3 16-4 16-2 16-5 16-6 16-7 16-4 16-8 16-1 16-5 16-6 16-5 16-6 16-5 16-6 16-5 16-6 16-5 16-6 16-5 16-6 16-7 16-8 16-9 16-10 16-10 16-10 16-10 16-11 16-12 16-10
SIGN 341T Se SONORA A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU 5-26, 5-26PS, 5-26X 6F1 6F1D 6F2D 6-26, 6-26PA	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment Schematic, dial data, socket, alignment Misc. SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, schematic, alignment Schematic, socket, trimmers, alignment, notes Schematic, socket, trimmers, alignment Schematic, socket, trimmers, alignment, socket, trimmers, alignment, socket, trimmers, tuning data Alignment, socket, trimmers, alignment, antenna notes AKKS-WITHINGTON CO. Schematic, dial data, voltage Alignment, socket, trimmers, sensitivity, notes Voltage Alignment, socket, trimmers, dial data, notes Voltage Alignment, socket, trimmers, miscellaneous servicing notes Schematic, notes, dial data, miscellaneous servicing notes Schematic, dumg panel, voltage, chassis, notes Tuner notes, tuning panel, voltage, chassis, notes Schematic, dummy antenna Clarified schematics Alignment, socket, trimmers, dial data, notes Schematic Alignment, socket, trimmers, dial data, notes Schematic Russelineous servicing notes Schematic Schematic <td>16=10 16=1 16=2 16=3 16=4 16=5 16=6 16=7 16=4 16=8 16=1 16=2 16=3 16=4 16=5 16=10 16=11 16=12 16=13 3=5</td>	16=10 16=1 16=2 16=3 16=4 16=5 16=6 16=7 16=4 16=8 16=1 16=2 16=3 16=4 16=5 16=10 16=11 16=12 16=13 3=5
SIGN 341T Se SONORA A-11, Chassis A RBMU-176 RGMF-212, RGMF-230 RK-215, RKRU-215 RQ-222, RQU-222 RYMU-224 WA, WAU WGF, WGFU 5-266, 5-26PS, 5-26X 6F1 6F1D 6F2D 6-26, 6-26PA	AL ELECTRONICS, INC. Schematic, dial data, socket, alignment SILVERTONE e SEARS ROEBUCK CO. RADIO & TELEVISION CORP. Schematic, alignment Schematic, alignment Schematic, socket, trimmers, alignment, notes Alignment Schematic, battery notes, alignment Schematic, socket, trimmers, alignment, socket, trimmers, schematic, socket, trimmers, alignment, socket, trimmers, alignment, socket, trimmers, schematic, socket, trimmers, alignment, antenna notes Alignment, socket, trimmers, alignment, socket, trimmers, schematic, dial data, voltage Alignment, socket, trimmers, sensitivity, notes Voltage Alignment, socket, trimmers, dial data, notes Tuner notes, tuning panel, voltage, chassis, notes Schematic, dummy antenna Clarified schematics Alignment, socket, trimmers, dial data, notes Tuner notes, tuning panel, voltage	16=10 16-1 16-2 16-3 16-4 16-5 16-6 16-7 16-4 16-8 16-1 16-5 16-5 16-7 16-4 16-5 16-7 16-8 16-10 16-12 16-13 16-14 16-16 16-16 16-16 16-16 16-16 16-14 16-16 16-14 16-16 16-16 16-16 16-14 16-16 16-16 16-16 16-16 16-16 16-14 16-16

SPARTON See SPARKS-WITHINGTON CO.

	1150
MSTS4	<u>TELECOIN CORP</u> . Schematic, socket, trimmers, voltage Cabinet, alignment, notes
Dynamite	TELETONE RADIO CORP. See Model 135. Series H
135, Dynamite, Series H 138, Series N	Schematic M Schematic M
7 Inch Kit	TRANSVISION INC. Schematic Cabinet, circuit functions Circuit functions
	TRAVLER RADIO, CORP.
5003, 5004, 5005, 50	006 Schematic, socket, trimmers,
5019	Schematic, socket, trimmers,
5030, 5031	Schematic, socket, trimmers, alignment
See	<u>TRUETONE</u> WESTERN AUTO SUPPLY CO.

16-1

16-2 16-3

	SPIEGEL, INC.	
MODEL		PA
T-2625	Schematic	16
	Clarified schematics Alignment pocket trimmers	16.
	miscellaneous servicing note	s 16.
831	Schematic, voltage	16
	Clarified schematics Changing schematics	16
	alignment, pushbutton data	16-
5020	Schematic, socket, trimmers,	••
	alignment, notes	16
	Battery data	10
	STEWART WARNER CORP.	
9010A	Schematic, audio oscillation	
	notes, voltage, diai data, gain data	16-
	Clarified schematics	16-
	Clarified schematics	16
	Clarified schematics Alignment	16
	Alignment, socket, trimmers.	10.
	coil data, switch data	16-
	Parts list	16
9013-A	Schematic, switch data, coil	17
	data Clarified schematics	16
	Parts list, gain data. dial da	ta 16
	Alignment, socket, trimmers	16-
	Voltage	16
	STROMBERG CARLSON CO.	
1105	Schematic, socket, trimmers,	
	voltage, gain	16
	Wiring diagram, changes, notes	16
1110	Schematic, voltage, gain	16
	Clarified schematics	16
	Wiring disgram, notes	16
	Alignment, socket, trimmers, dial data parts data PF	
	adjustments	16
1135	Schematic, notes, gain data	16-9
	Wiring diagram	16
	Voltage, socket, trimmers Alignment BF adjustment	16
	RF adjustment, socket, trimmers	10.
	parts list, dial data	16
11254	Dial data, purts list	16
11334	Schematic Clarified schematics	15-11. 14
	Clarified schematics	16
	Clarified schematics	16
	TELECHBON, INC.	
Musalarm	See Model 8H59	
8H59	Schematic, voltage, sockets,	
	notes	16
	Cabinet, alignment, dial data,	
	trimmers, miscellaneous servicing notes	16
	Parts list, clock servicing da	ta 16
	Clock movement assembly, parts	
	list	16
	TELECOIN CORP.	
M5TS4	Schematic, socket, trimmers,	
	voltage	16
	Cabinet, alignment, notes	16
	TELETONE RADIO CORP.	
Dynamite	See Model 135 Series H	
135, Dynamite,	oce model 135, Series n	
Series H	Schematic Mi	sc.16
130, Series N	Schematic Mi.	sc.16-
	TRANSVISION INC	
7 Inch Kit	Schematic	16-1
. inch hat	Cabinet, circuit functions	16-
	Circuit functions	16-
	TRAVLER RADIO, CORP.	
5003, 5004, 5005	, 5006 Schematic, socket, trimmers,	
	. ,	

ą 104

UN MOTORS AERO

UNI	TED MOTORS SERVICE	
MODEL		PAGE
R-1227, R-1228, R-1229	Schematic, voltage, socket,	
	Parts list, dial data, coil	16-1
R-1408, K-1409	data, alignment, cabinets Schematic, voltage, socket.	16-2
	trimmers, chassis, dial	16.0
••••••••	Alignment, parts list, cabimet	16-3 16-4
980690 Revised, 980733, Buick	Schematic, cabinets	16-5
	Voltage, socket, trimmers,	1.2
	Pushbutton data, parts list,	10-0
980733	tuner, alignment See Model 980690 Revised	16-7
982399, Oldsmobile	Schematic, voltage, tuner	16-8
	parts list	16-9
984170, Pontiac	Voltage, socket, trimmers, alignmen Schematic, voltage nushbutton dat	t16-10
	Voltage, dial data, power pack	410-11
	alignment	16-12
U.S. '	TELEVISION MEG. CO.	
5-16M	Schematic	16-1
	Voltage, alignment, socket, trimmers	16-2
5-36MPA	Schematic	16-1
	trimmers	16-2
VIEWTONE '	FIEVISION & BADIO COPP.	
VP100, VP100A, VP101A	Schematic, socket, trimmers	16-1,2
	Miscellaneous servicing note, operation data	16-3
	Antenna notes, alignment	16-4
w.	ARWICK MFG. CO.	
C110	Schematic, socket, trimmers,	
	Becord Changer, Milwaukee	16-1
11305	10700 RCD. CH Schematic, socket, trimmers	.15-1
	alignment	16-2
WATTER	ISON RADIO MFG. CO.	
4782	Schematic, battery data,	
4790	alignment Schematic, antenna data,	16-1
	alignment	16-2
WESTE	RN AUTO SUPPLY CO.	
D2616	Schematic, voltage, selectivity, sensitivity	16-1
	Alignment, socket, trimmers, dia	
	Parts list	16-2 16-3
D2619	Schematic, voltage, socket, notes	16-4
	Parts list, dial data	16-3
D2624 Family D2620	selectivity	16-5
02624 Larly, 02630	Schematic, coil data, selec- tivity, sensitivity	16-6
12624 Late	Schematic, coil data, selec- tivity, sensitivity	16-7
D2624 Early, Late, D2630	Clarified schematics	16-8
	voltage, dial data, notes	16-9
02630	Parts list See Models D2624 Early	16-10
D2644	Schematic, notes Alignment, socket trimmers	16-11
D2645	Schematic, voltage, socket,	10-10
	Clarified schematics	16-12 16-13
	Alignment, trimmers, dial data, parts list. selectivity	
	sensitivity	16-14
WESTING	HOUSE ELECTRIC CORP.	
H-113, H-114,	Service Court	
H-116, H-117, H-119	Schematic, notes 1 Clarified schematice	6-1,2
	Parts layout	16-5
	alignment, socket, trimmers, dial data, notes	16-6
	Parts list, pushbutton data, cabinets	16-7
H-133	Schematic, voltage, dial data,	16.0
	SUCACU, ULIMMERS.CADINEL.NOLES	10-8

ņ,

WESTINGHOUS	E ELECTRIC CORP. (Cont'd)	
MODEL		PAGE
H-133 (Cont'd)	Alignment, parts list, chassis	16-10
n-148	Schematic, voltage, chassis,	
	cabinet	16-9
	Alignment, parts list	16-10
	WOOLAROC	
See	PHILLIPS PETROLEUM	
ZE	NITH RADIO CORP.	
4C54, Chassis	See Model 4K040	
Chassis 4C54	Schematic, voltage, gain, coil	
	data	16-1
	Clarified schematics	16-2
	Alignment, socket, trimmers,	16-2
5C40, 5C40Z, Chassis	See Model 5G003	10-3
5C40ZZ, Chassis	See Model 5G003ZZ	
5C80, Chassis	See Model 5MX080	
5G003, Chassis 5C40; 5G003Z, Chassis		
5C40Z	Schematic, voltage, gain,	
	coil data	16-4
	Alignment, socket, trimmers,	16.6
5G003ZZ, Chassis	ulai uata, parte list	10-0
5C40ZZ	Schematic, voltage, gain, coil data	16-5
	Alignment, socket, trimmers,	14.4
5MX080, Chassis 5C80.	dial data, parts list	10-0
Crosley	Schematic, voltage, gain, notes	16-7
	Alignment, socket, trimmers,	
	ment notes	16-8
	Installation notes, parts list	16-9
6C41, Chassis	See Model 6G004Y	
6C83. Chassis	See Model 66038 See Model 6400083	
6G004Y, Chassis 6C41	Schematic, voltage, gain, coil data	16-10
	Clarified schematics	16-11
	Alignment, socket, trimmers,	16.19
6G038, Chassis 6C50	Schematic, voltage, gain, coil data	16-12
	Clarified schematics	16-14
	Alignment, socket, trimmers,	16 16
6MW083, Chassis 6C83.	Schematic, voltage, gain, notes	16-15
Willy's	Installation, pushbutton data	16-17
	Alignment, socket, trimmers,	
	chassis, core and coll replace-	16-18
	Parts list	16-19
8B03, Chassis	See Model 8ML692	
UML092, Chassis 8803, Lincoln-Zenhyr	Schemetic notes	16-20
Stacora Separa	Installation data. muting cir-	10-20
	cuit note	16-21
	Interference notes, alignment,	16-99
	Alignment part 2, trimmers.	10-22
	voltage	16-23
	Parts list	16-24

INDEX TO RECORD CHANGERS

	ADMIRAL CORP.	
PC170, HC170A	Operation, change cycle	RCD.CH.16-1
	Differences	RCD.CH.16-2
	Adjustments	RCD. CH. 16-3
	Pickup schematic, bottom	
	view	RCD.CH.16-4
	Exploded view of top	RCD.CH.16-5
	Parts list	RCD.CH.16-6
	Service and repair	RCD.CH.16-7
	AERO METAL PRODUCTS	
46-A	Top view, operating	
	instructions	BCD, CH, 16-1
	Bottom and top view.	
	change cycle	BCD, CH, 16-2
	Exploded views of pickup	
	and clutch	BCD. CH. 16-3



