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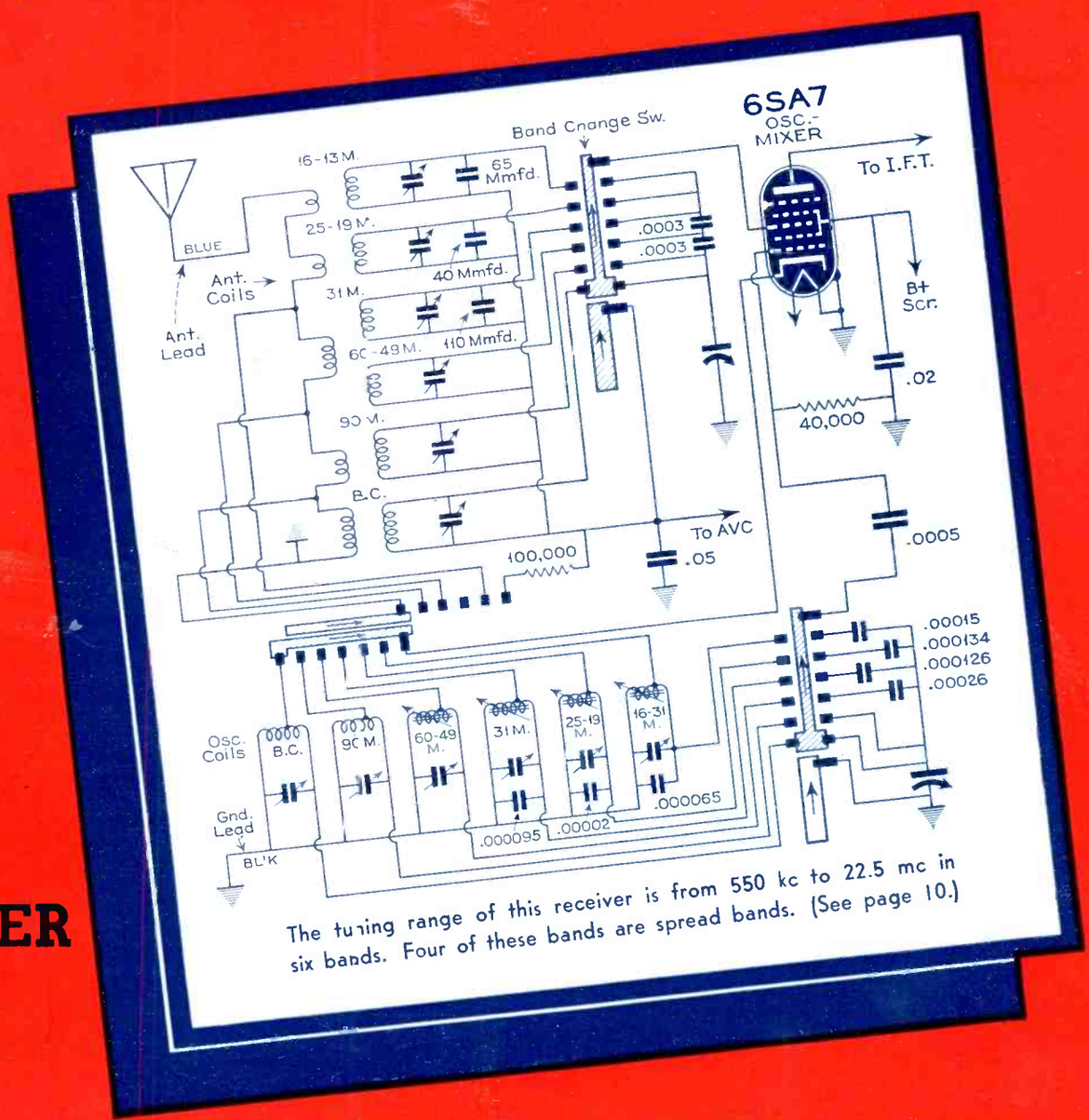

The tuning range of this receiver is from 550 kc to 22.5 mc in six bands. Four of these bands are spread bands. (See page 10.)

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VOL. 9, NO 12 - DECEMBER, 1940

SERVICE

ROBERT G. HERZOG, Editor

A Monthly Digest of Radio and Allied Maintenance

Reg. U. S. Patent Office

MANY large organizations employ two types of salesmen. The first of these is the "canvasser." He digs up live prospects, does the footwork and rarely actually closes a sale. The closing of the sale, on the other hand, is handled by the second type of salesman. He makes the demonstration, discusses price, model, etc.—in short, he does the actual selling.

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FREQUENCY modulation has already reached the stage where we can state that an intimate knowledge of the servicing of f-m receivers is an immediate requirement for every Service Man. With this in mind, we present our feature article "Servicing F-M Receivers," written by no less an authority than Jack Avins, noted engineer, author and lecturer. Beginning on page 5 of this issue, Mr. Avins discusses the problems which the Service Man will encounter in receivers already in the hands of listeners throughout the country. He also gives detailed instruction concerning the alignment of this type of receiver.

His is a first-hand knowledge of the innermost workings of the particular sets about which he writes, for Mr. Avins has worked on them all; run performance tests, corrected faults, and thoroughly analyzed them, all with the purpose of being able to tell you how to fix these receivers more efficiently.

We feel sure that you will find his article both interesting and instructive.

BRYAN S. DAVIS
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JAS. A. WALKER
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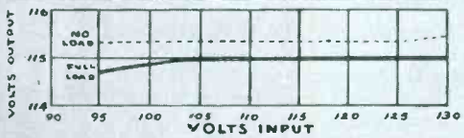

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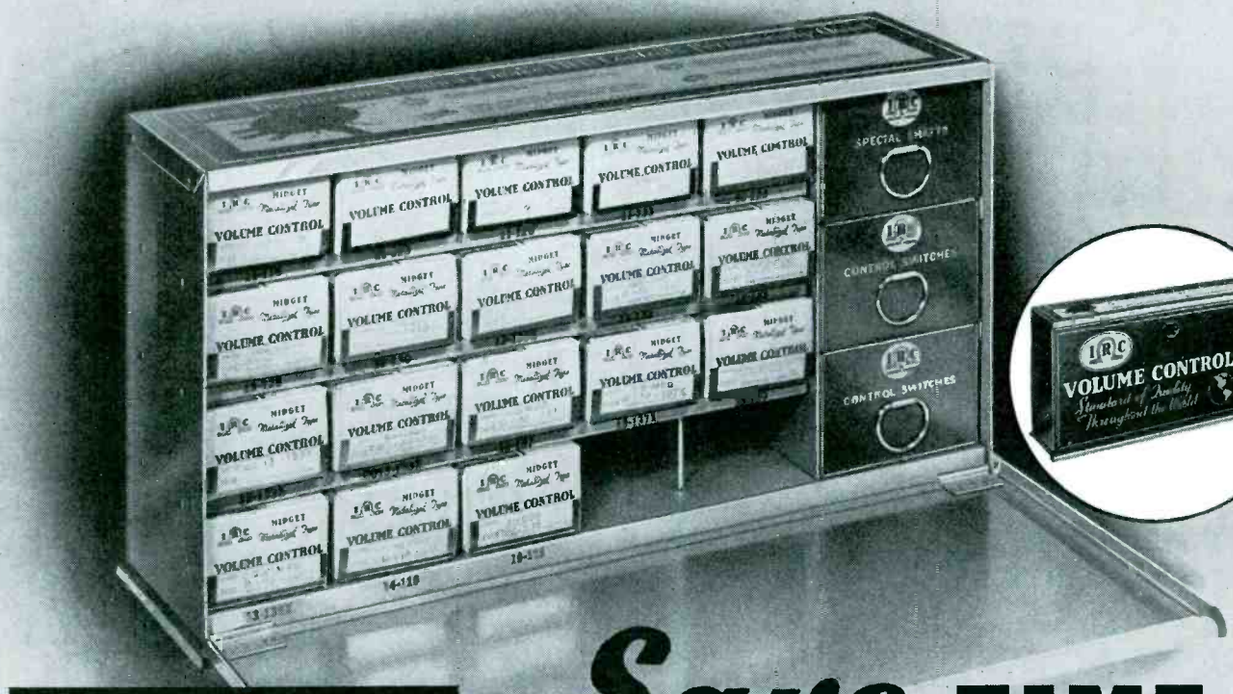
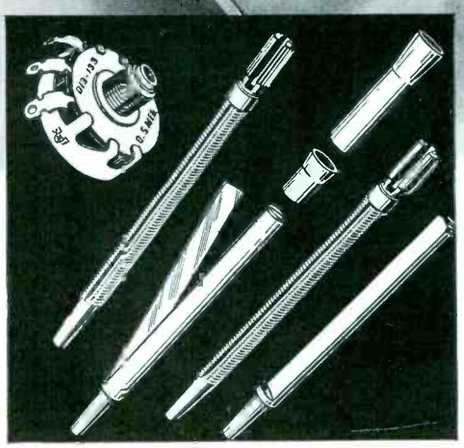


Closed view of cabinet



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SERVICING F-M RECEIVERS

By JACK AVINS

THE general theory of frequency modulation has been covered previously on these pages.[1] It is not necessary, therefore, for us to discuss the improvement which f-m makes possible, in fidelity and signal to noise ratio, over a-m. However, since this article deals with the f-m receiver, it is appropriate to consider what happens to the f-m signal as it passes through the various stages of the receiver.

To take a definite example, let us assume that the receiver is tuned to receive a 45-mc, 400-cycle, 100% modulated signal. Accordingly, the 45-mc f-m signal will vary between 45.075 and 44.025 mc at a rate of 400-cycles-per-second. This signal, with its side bands, which occupy a total band of about 150 kc, is amplified in the r-f stage (if one is used) and fed to the grid of the mixer tube. (See Figs. 1 and 2.) Assuming that the receiver has an i-f of 4 mc, the oscillator would be operating at either 49 or 41 mc to produce a beat frequency of 4 mc in the plate circuit of the mixer tube. Of course, this resulting 4-mc i-f signal has the same characteristics as the original 45-mc signal, in that its frequency varies at the same 400-cycle rate from 3.025 to 4.075 mc. This i-f signal is amplified by the several stages in the i-f amplifier and is then impressed on the grid of the *limiter* tube. The limiter tube has no counterpart in the a-m receiver. It is designed to suppress the very thing which is required in the operation of an a-m receiver—that is, the function of the limiter is to remove all amplitude variations in the signal and to leave only the frequency variations.

The pure frequency-modulated output of the limiter is fed to the *discriminator* or frequency-detector stage of the receiver. This stage corresponds to the second-detector stage in the a-m receiver, but the discriminator is designed to translate the frequency variations into the original audio signal, whereas the a-m detector translates the amplitude variations into the desired audio signal.

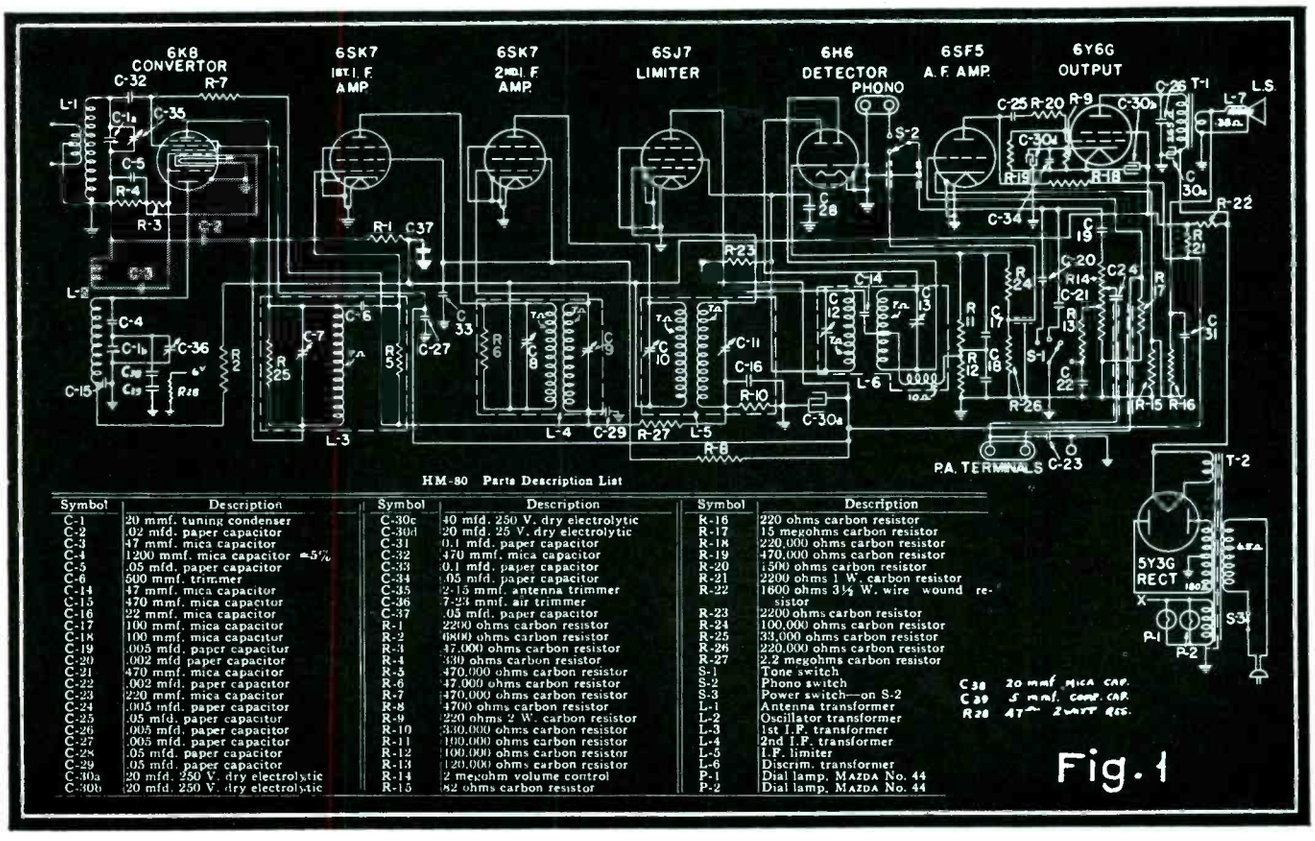
With the recovery of the 400-cycle note in the output of the discriminator, the signal is passed on to a *de-emphasis* circuit, placed in the input circuit of the first audio stage. From this point on, the 400-cycle note passes through the various stages of the audio amplifier and finally reaches the voice coil of the speaker.

The Antenna

Merely because frequency modulation has the inherent property of discriminating against noise and interference, it should not be assumed that no attention need be paid to the antenna. Ac-

[1] "Frequency Modulation," by Jack Avins. SERVICE, Nov. 1940. p. 3.

Fig. 1. G. E. HM80 f-m receiver circuit.



Symbol	Description	Symbol	Description	Symbol	Description
C-1	20 mmf. tuning condenser	C-30c	40 mfd. 250 V. dry electrolytic	R-16	220 ohms carbon resistor
C-2	.02 mfd. paper capacitor	C-30d	20 mfd. 25 V. dry electrolytic	R-17	15 megohms carbon resistor
C-3	47 mmf. mica capacitor	C-31	.01 mfd. paper capacitor	R-18	220,000 ohms carbon resistor
C-4	1200 mmf. mica capacitor ±5%	C-32	470 mmf. mica capacitor	R-19	470,000 ohms carbon resistor
C-5	.05 mfd. paper capacitor	C-33	.01 mfd. paper capacitor	R-20	1500 ohms carbon resistor
C-6	500 mmf. trimmer	C-34	.05 mfd. paper capacitor	R-21	2200 ohms 1 W. carbon resistor
C-14	47 mmf. mica capacitor	C-35	2-15 mmf. antenna trimmer	R-22	1600 ohms 3½ W. wire wound resistor
C-15	470 mmf. mica capacitor	C-36	7-23 mmf. air trimmer		
C-16	22 mmf. mica capacitor	C-37	.05 mfd. paper capacitor	R-23	2200 ohms carbon resistor
C-17	100 mmf. mica capacitor	R-1	2200 ohms carbon resistor	R-24	100,000 ohms carbon resistor
C-18	100 mmf. mica capacitor	R-2	6800 ohms carbon resistor	R-25	33,000 ohms carbon resistor
C-19	.005 mfd. paper capacitor	R-3	47,000 ohms carbon resistor	R-26	220,000 ohms carbon resistor
C-20	.002 mfd paper capacitor	R-4	330 ohms carbon resistor	R-27	2.2 megohms carbon resistor
C-21	470 mmf. mica capacitor	R-5	470,000 ohms carbon resistor	S-1	Tone switch
C-22	.002 mfd. paper capacitor	R-6	47,000 ohms carbon resistor	S-2	Phono switch
C-23	220 mmf. mica capacitor	R-7	470,000 ohms carbon resistor	S-3	Power switch—on S-2
C-24	.005 mfd. paper capacitor	R-8	4700 ohms carbon resistor	L-1	Antenna transformer
C-25	.05 mfd. paper capacitor	R-9	220 ohms 2 W. carbon resistor	L-2	Oscillator transformer
C-26	.005 mfd. paper capacitor	R-10	330,000 ohms carbon resistor	L-3	1st I.F. transformer
C-27	.005 mfd. paper capacitor	R-11	100,000 ohms carbon resistor	L-4	2nd I.F. transformer
C-28	.05 mfd. paper capacitor	R-12	100,000 ohms carbon resistor	L-5	I.F. limiter
C-29	.05 mfd. paper capacitor	R-13	120,000 ohms carbon resistor	L-6	Discrim. transformer
C-30a	20 mfd. 250 V. dry electrolytic	R-14	2 megohm volume control	P-1	Dial lamp. MAZDA No. 44
C-30b	20 mfd. 250 V. dry electrolytic	R-15	82 ohms carbon resistor	P-2	Dial lamp. MAZDA No. 44

C30 20 mmf. MICA CAP.
C29 .5 mmf. COND. CAP.
R28 47Ω 2 WATT RES.

Fig. 1

tually, wide-band f-m requires that the signal should at all times be at least twice as great as any interference which may be present. Where noise is more than half the strength of the signal, the noise will be amplified at the expense of the signal. In such cases the signal-to-noise ratio will be reduced. In locations where the signal strength is very high, almost any length of wire attached to the antenna post will be satisfactory. However, if the signal strength is low a good dipole antenna must be used. As with all antennas, its location should be as high as possible and as far away from sources of interference as is practicable. It is sometimes advantageous to rotate the antenna until the greatest desired signal is obtained.

Some combination f-m and a-m receivers are designed so that the same dipole antenna can be used for both f-m and a-m reception. In these receivers the band switch takes care of the change required in the input circuit so that the dipole can be used efficiently on the lower frequencies. In other receivers provision is made for separate antennas for the f-m and a-m bands.

The R-F Amplifier

The purpose of r-f amplification in f-m receivers is to provide increased selectivity; this has the advantage of reducing image and other interference. At the same time, the gain provided by using an r-f stage provides a greater signal at the limiter grid, so that more effective limiting action is obtained for weak signals.

The use of f-m as against a-m does not introduce any special problems in the r-f amplifier. In particular the required band width of 150 kc is readily obtained because of the high frequencies used for f-m transmission. Contrary to a popular misconception, there is no sideband cutting in f-m r-f amplifiers, because a bandwith of 150 kc at 45 mc corresponds to a band width of about 3 kc at a carrier frequency of 1000 kc. Thus it is just as easy to amplify a bandwidth of 150 kc at 45,000 kc as it is to amplify a 1000-kc signal which has a total bandwidth of 3 kc.

Incidentally, in the r-f section of combination f-m, a-m receivers, it is general practice to use a special 6-section tuning condenser with the lower capacity sections used for f-m and the higher capacity sections for a-m. The use of such an arrangement enables a higher L/C ratio to be obtained and at the same time provides the smaller tuning capacitance required to cover the comparatively small range from 42 to 50 mc.

In servicing the r-f portion of f-m receivers it is of great importance not to disturb the lead dress. These leads have an appreciable reactance at the high carrier frequencies used in f-m. For the same reason, wherever the replacement of by-pass condensers or other parts are required, exact duplicate parts should be used.

Mixer and Oscillator

The present general practice in f-m receivers is to use a single 6SA7 tube as mixer and oscillator. The tube performs satisfactorily as both an oscillator and mixer at frequencies as high as 50 mc, the upper limit of the f-m band. To increase the selectivity of the input circuit, the cathode resistor of the 6SA7 is sometimes unby-passed; this increases the selectivity by decreasing the loading of the tube across the mixer tuned circuit.

Special attention has been paid to the design of the oscillator circuit in f-m receivers in order to secure stable operation. Because of the high frequency at which the oscillator operates, even a small percentage variation or drift in its frequency will cause a considerable amount of detuning and prevent operation on the central portion of the discriminator characteristic.

It is general practice to provide some form of temperature compensation in the oscillator circuit to achieve the required degree of frequency stability. This may take the form of a condenser which has a temperature coefficient of the right amount and in the right direction to compensate for the frequency drift which would otherwise occur as the receiver gradually comes to its normal oprating temperature. Needless to say, the *exact* replacement condenser is required, should replacement ever be necessary. Using a condenser of the correct capacitance is not enough; it must also have the proper temperature coefficient. To assure proper operation of this form of temperature stabilization, the compensating condenser must be mounted in a definite position which should not be changed in the course of service operations. In some instances, the compensating condenser may be mounted near a resistor which acts as a heater so that the desired variation in capacitance is obtained.

To reduce the effect of variations in operating voltage to a minimum, the VR150 regulator tube has been used to regulate the plate supply to the oscillator. The regulator tube prevents variation in the frequency which might occur as a result of line voltage variation (not heater voltage, though) or as a result of variation in the B-voltage due to the variable drain on the power supply during the audio cycle.

Because of the nature of f-m, the voltage supply to the oscillator and mixer must be carefully filtered so as to prevent any hum modulation of the oscillator frequency, that is, to prevent the frequency of the oscillator from varying at a 60- or 120-cycle rate. The effect of such hum modulation is to frequency modulate the i-f signal and introduce an undesired hum into the audio signal. Even a very small percentage modulation of the oscillator frequency will cause an appreciable amount of hum in the audio output.

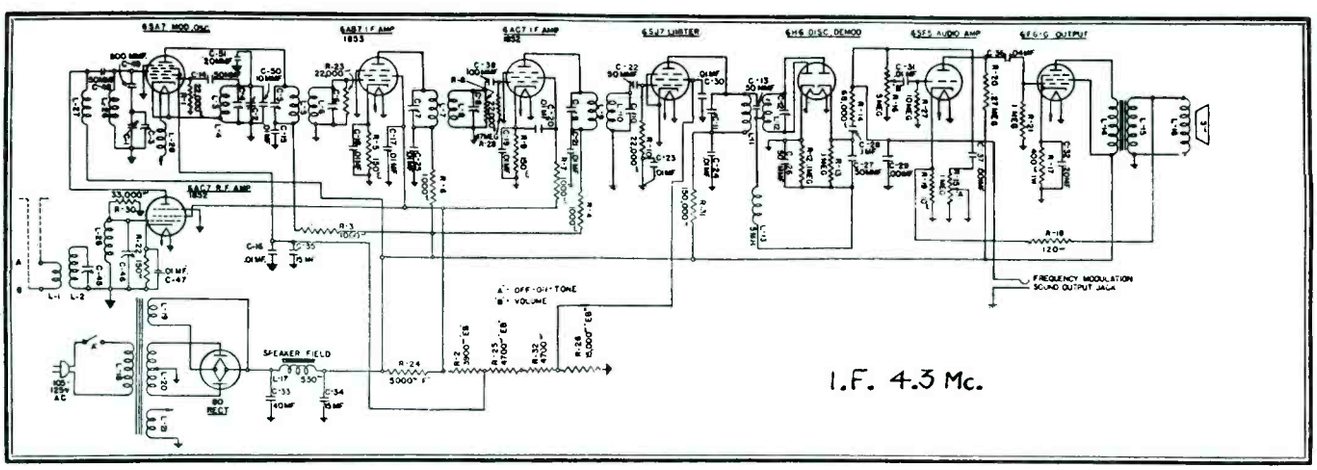


Fig. 2. Stromberg Carlson 505H, 505HB f-m receiver circuit.

Where hum is encountered in f-m receivers, one of the first sources to be suspected (exclusive of the a-f amplifier) is the oscillator tube. This should be replaced, and if there is still no improvement, the filtering of the voltage supply to the oscillator should be checked.

F-m receivers are usually designed so that the oscillator works below the signal frequency. This is, of course, in direct opposition to the conventional practice followed in broadcast and short-wave receivers. Operating the oscillator below the signal frequency has the advantage that somewhat greater stability is secured because of the lower frequency and at the same time greater freedom from image interference is usually obtained because the image response is taken out of the television channels which lie above the f-m band. Although the latitude of the trimmer

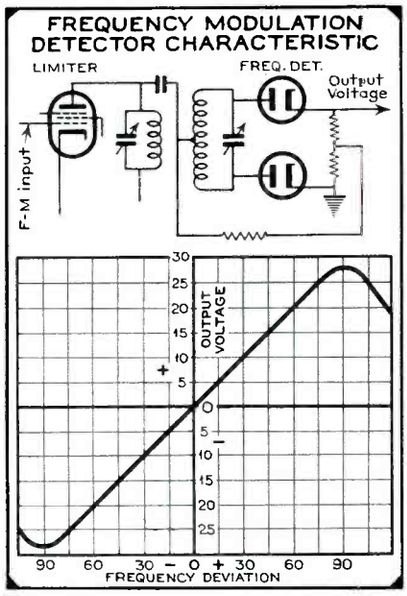


Fig. 3. The output of the discriminator is proportional to the frequency deviation of the signal from the center i-f.

will not always permit the oscillator to be aligned to the wrong frequency (above, rather than below the signal), this difference from conventional a-m practice should be kept in mind.

I-F Amplifier

The i-f amplifier in f-m receivers is more complex than in a-m receivers because of the higher frequency and because of the greater gain which is necessary to secure enough signal for the proper operation of the limiter. Again the higher bandwidth (150 kc) required does not present a difficult problem because the intermediate frequency is considerably higher than the 465 kc customarily used in a-m receivers. To take an average f-m i-f of say 4 mc, it is no more difficult to secure a bandwidth of 150 kc at this frequency than it is to secure a bandwidth of 15 kc at 400 kc; the latter problem corresponds largely to that encountered in the high fidelity a-m receiver. Actually, the requirement for flat response over the i-f band is less severe in f-m receivers, since the limiter removes the effects of any non-uniformity in the amplification over the band. In addition to providing a bandwidth of roughly 150 kc, the f-m i-f amplifier must have sufficient selectivity so that adjacent channel interference is prevented.

In combination receivers designed for both f-m and a-m, it is common practice to use the same i-f tubes for both a-m and f-m amplification. This is usually done by connecting the f-m and a-m transformers in series (See SERVICE, Nov. 1940, p. 7.) or by providing a switching arrangement so that either the f-m or a-m transformers are automatically selected by the band switch. In some instances only one i-f tube is used for a-m, so that only the first tube uses this dual transformer arrangement. The output of the first tube then feeds directly into the a-m second detector, while the f-m output of the first i-f stage feeds into another i-f stage (for f-m only) and from this into the limiter and the discriminator. This arrangement is practical because one i-f stage is usually adequate for a-m reception, while at least two are necessary for satisfactory f-m operation.

In some combination receivers, see page 13 this issue) the f-m i-f amplifier is kept entirely separate from the a-m i-f amplifier. In receivers of this type, the only connection between the r-f and i-f section of the f-m and a-m receivers is the common power supply.

The service problems arising in connection with f-m i-f amplifiers are much the same as with a-m i-f amplifiers. Because of the higher operating frequency, and greater gain, however, it is likely that more trouble will be encountered as a result of regeneration and improper alignment. The precautions concerning the proper lead dress and the use of physically identical components apply with almost equal force to the i-f amplifier as well as to the r-f amplifier.

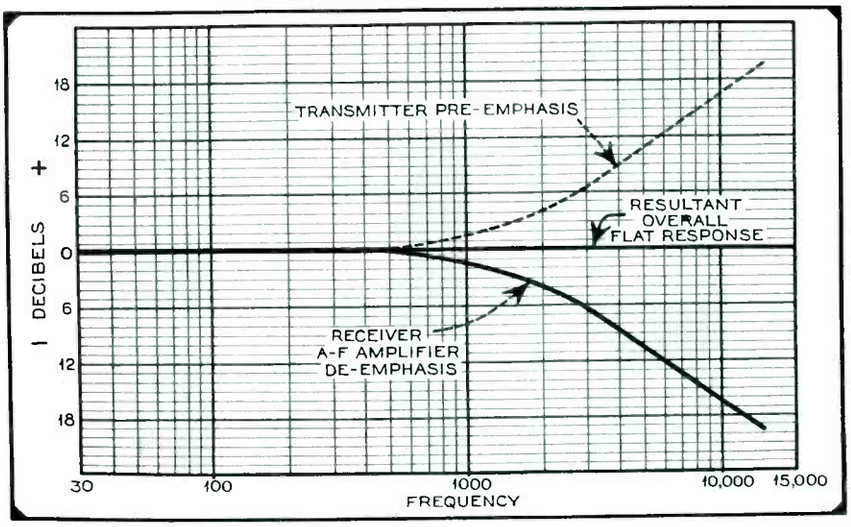


Fig. 4. The gain in the a-f amplifier of an f-m receiver is progressively lower for the higher audio frequencies.

The Limiter

The function of the limiter is to remove any amplitude modulation which may have crept into the f-m signal. This amplitude modulation may be the result of noise or an interfering signal; it may have been present in the transmitted signal and ordinarily would be removed by the limiter; or it may be amplitude modulation hum which is introduced in the r-f, i-f or mixer. If the limiter is not functioning properly, interference or distortion from one or more than one of these possible sources may be present in the output of the f-m receiver. For this reason it is important that proper operation of the limiter be secured.

The limiter is an ordinary amplifier stage, usually a sharp cutoff pentode, which is operated at zero bias and with a low plate and screen voltage (about 90 volts). As a result of these operating conditions, the output of the limiter is limited in one direction by plate current cutoff and in the other direction by the fact that the plate current of the limiter tube can never rise above the value corresponding to the zero bias plate current. Thus, provided the signal at the limiter grid is always in excess of about 7 volts (this corresponds in most receivers to an input signal of about 10 or more microvolts) the output of the limiter will not exceed the value corresponding to a grid swing between cutoff and zero bias. If the signal falls below about 5 volts, however,

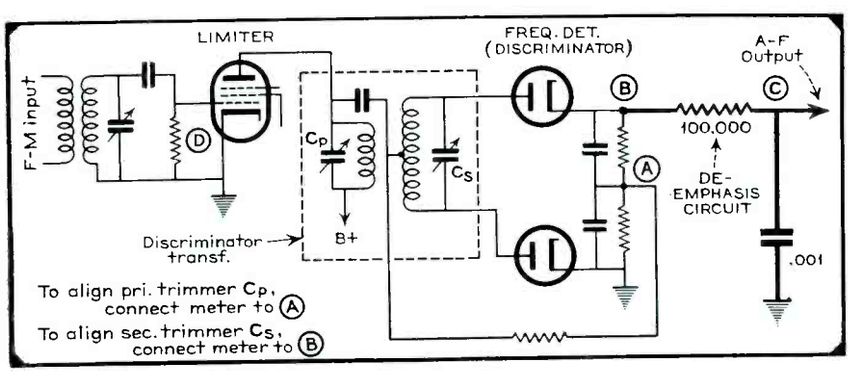
the limiter will not have sufficient signal to function properly and the entire operation of the f-m system will be impaired.

In this connection, it is worth while to point out that the discriminator responds to both amplitude and frequency variations in the signal. It is up to the limiter to remove the amplitude variations so that the discriminator can produce an output which is proportional only to the original frequency variations introduced into the signal at the transmitter. If the amplitude variations are not removed by the limiter, they will appear in the output of the discriminator in the form of noise and undesired signals.

The limiter stage contains relatively few components so that it is a simple matter to check its operation. When the limiter is functioning properly the signal voltage at the input to the limiter can be increased from about 5 volts up to above 50 volts without any appreciable increase in the signal produced in its output. The most convenient point at which to check the ouput of the limiter is at point A in Fig. 7 since the d-c voltage at this point is proportional to the output of the limiter. To obtain the relatively high signal voltage required at the limiter grid for this check, it is most convenient to feed the signal to the grid of the mixer tube. The r-f grid lead may have to be disconnected in order to obtain sufficient output from the signal generator, since the r-f coil has only a few turns and thus acts to short circuit the signal generator output.

The time constant of the resistor and condenser in the limiter grid circuit must be small in comparison with the highest audio frequency and high in comparison with the intermediate frequency. Since the latter is of the order of 3000 kc, whereas the former is about 15 kc, this condition is easy to realize. In practice, a value of about 2 microseconds is widely used. In the event that the improper resistor-condenser combination is used in the limiter grid circuit, the limiter will not function properly. Should it be necessary to replace any of the condensers or resistors in the limiter grid circuit, the specified values should be used to make the replacement.

Fig. 7. The limiter removes any amplitude modulation before the signal is fed to the discriminator.



Discriminator

A typical discriminator characteristic is shown in Fig. 3. As is evident in the figure the output of the discriminator is proportional to the frequency deviation of the signal from the center i-f up to a maximum limit of about 85 kc. The output of this particular discriminator is some 30 volts for a deviation of 75 kc which corresponds to 100% modulation. When the discriminator circuit is in proper adjustment, its characteristic should be linear for at least 75 kc on either side of the center frequency.

It should be understood that the characteristic shown in Fig. 3 assumes a constant input signal is being fed to the discriminator. In practice this will mean that the input signal is strong enough for the limiter to level out amplitude variations in the signal.

AVC in F-M Receivers

In the a-m receiver the purpose of avc is to keep the carrier level at the second detector at a constant value regardless of the strength of the input signal. Naturally the avc action does not remove the amplitude variations in the signal since this would completely remove the intelligence.

In the f-m receiver, the problem of automatic gain control is somewhat different in that the signal which is delivered to the discriminator must have a constant amplitude. As we have already seen, the limiter accomplishes this. For the limiter to be effective, however, the input signal to the limiter must be as large as possible and preferably more than 10 volts. For this reason any avc action which would tend to reduce the signal at the limiter grid to some low common level is undesirable.

For the reasons stated above it is common practice not to use avc in f-m receivers but to depend on the limiter to remove all amplitude variations from the signal which is applied to the discriminator. To prevent overloading with a strong input signal, the use of a small coupling condenser and grid leak in the grid circuit of each of the i-f stages is common. With this arrangement, the bias generated by grid current is sufficient to provide all the necessary control action. Where avc is used in f-m receivers, it is always of the delayed type. This means that no control voltage is applied to the r-f or i-f tubes until the signal at the limiter grid is sufficiently strong so that the limiter will function effectively. This usually calls for at least ten volts to be developed at the limiter grid before the gain of the r-f and i-f amplifier is appreciably reduced.

Audio Amplifier

Because of the wider range covered in f-m, the design of the amplifier and speaker system differs somewhat from those used in a-m receivers. The overall frequency response, unlike that of the a-m amplifier, is not flat but the gain is progressively lower for the higher audio frequencies, as illustrated in Fig. 4. It will be noted that the *de-emphasis*, as this progressive attenuation is called, is the inverse or opposite of the *pre-emphasis* of the higher audio frequencies introduced at the transmitter. As a result, the overall audio response of the f-m system is flat since the de-emphasis in the receiver audio amplifier compensates exactly for the pre-emphasis in the transmitter.

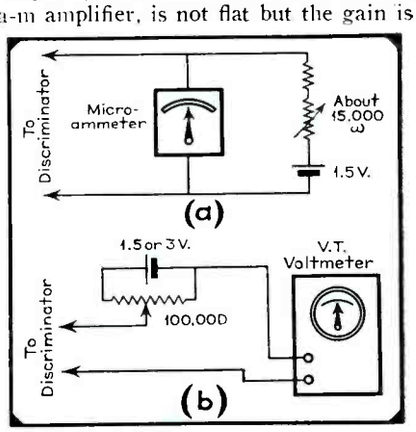


Fig. 5. A simple expedient can be employed to bring the pointer of a meter to the center of a scale for "zero-center" use.

Usually the de-emphasis in f-m receivers is accomplished by a series resistor and shunt condenser in the input circuit of the audio amplifier. When this is done the desired de-emphasis is obtained in the input circuit so that the frequency response of the audio amplifier and speaker can be essentially flat. The advantage of putting the de-

emphasis circuit in the input is that by so doing the response of the remainder of the audio system will be flat for a-m reception and for record reproduction. The usual constants for the de-emphasis circuit are about 100,000 ohms for the resistor and 0.001 mfd for the shunt condenser. This gives a time constant of 100 microseconds which is the same as that used for pre-emphasis at the transmitter. Because the frequency response of the audio system is not entirely flat, it is customary for a somewhat lower value of time constant to be used in de-emphasis circuits. Thus values of R as low as 70,000 ohms in combination with a 0.001 mfd condenser are not uncommon.

Alignment

The alignment of f-m receivers can be carried out with a good signal generator which covers the range through 50 megacycles on fundamentals. Visual alignment equipment is not necessary although it seems probable, when f-m comes into wider use, that special frequency wobblers will be developed for the particular job of speeding up alignment of the i-f amplifier. For the present, provided the manufacturer's instructions are followed, an excellent alignment job can be done using an unmodulated signal generator.

In addition to the signal generator, a special output indicator is required for f-m alignment. The best instrument for this purpose is the electronic or d-c vacuum-tube voltmeter. The high input resistance of this voltmeter makes it possible to measure the rectified output voltage of the discriminator (at points A and B in Fig. 7) as well as the rectified voltage produced in the limiter grid circuit (at point D in Fig. 7). Measurements at each of these points in the discriminator and limiter circuits are required in order to align an f-m receiver.

If the electronic voltmeter is of the center-zero type, then the instrument can be used directly to measure the output of the discriminator at point B in Fig. 7. As the discriminator characteristic is Fig. 3 shows, the voltage at this point varies from a high positive value through zero to a corresponding high negative value, as the frequency of the input signal is varied. For this reason a center-zero type of meter is convenient in making the adjustments required in the discriminator circuit.

If the electronic voltmeter is not of the center-zero type, then a small C-battery can be placed in series with the voltmeter so as to bring the pointer to approximately the middle of the scale (with the leads shorted, of course). It is not necessary that the pointer be brought to the exact center of the scale; any convenient reference indication near the center of the scale is satisfactory. As is illustrated in Fig. 5 (b), the adjustment of the pointer can be readily made by placing a high resistance potentiometer across the battery.

In the event that an electronic voltmeter is not available, it is possible to use a center zero microammeter in adjusting the secondary winding of the discriminator. A meter having a sensitivity of about 200 microamperes is satisfactory. It should be connected to the discriminator through a resistor of about 100,000 ohms to reduce the loading on the discriminator.

Where a microammeter of the conventional left zero type is available, it can be converted into the center zero type by using the circuit shown in Fig. 5 (a). With this arrangement R is adjusted so that a center scale deflection is obtained. The meter can then be used as a center-zero instrument for discriminator alignment.

Either an electronic voltmeter or a milliammeter in the limiter grid circuit can be used to indicate the output voltage during the alignment of the i-f and r-f section of the f-m receiver. Several limiter circuit arrangements in use are shown in Fig. 6. If an electronic voltmeter is available, it is only necessary to connect it directly to the grid of the limiter tube. If a circuit similar to that at (d) is used in the receiver, however, it is preferable to connect the electronic voltmeter probe to the high side of the grid resistor rather than directly to the grid of the limiter. Regardless of the circuit it is possible to connect the electronic voltmeter probe directly to the grid, since the capacitance of the probe is isolated from the grid circuit by the one megohm resistor which is generally incorporated in the signal-circuit probe of the voltmeter.

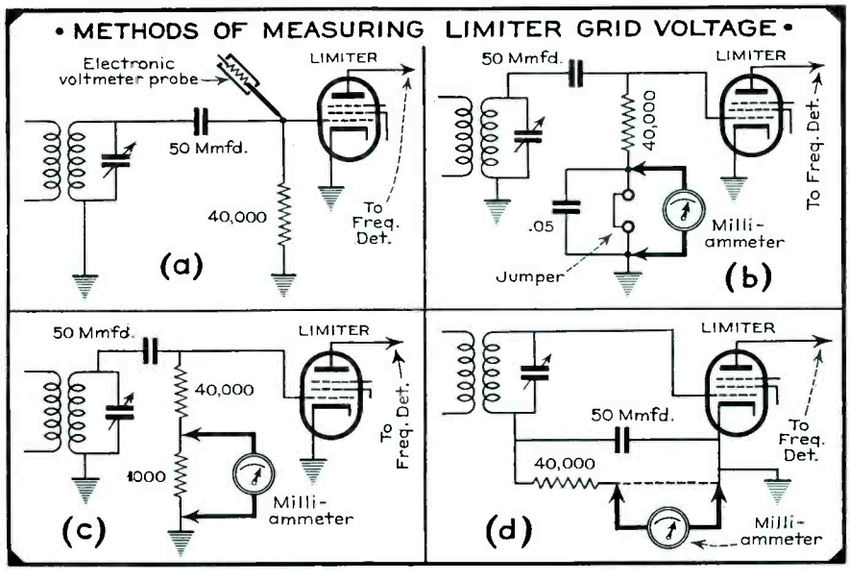


Fig. 6. Many methods can be used to measure the limiter grid current during alignment of the f-m receiver.

Where an electronic voltmeter is not available, the voltage at the limiter grid can be measured by inserting a milliammeter in series with the grid resistor in the limiter grid circuit. In some receivers a jumper is provided in the grid circuit (see Fig. 6 (b)) for this purpose. An 0 to 3 milliampere meter is satisfactory for this measurement. When the alignment is completed the jumper should be replaced, of course, so as to complete the grid circuit.

Where no jumper is provided, the same method can be used but the ungrounded end of the milliammeter should be by-passed to prevent possible feedback. The same principle also applies to the different arrangements shown in the various circuits shown in Fig. 6.

To eliminate the necessity for unsoldering leads where an electronic voltmenter is not available, one manufacturer uses a 1000-ohm resistor in series with the 40,000-ohm grid resistor. (See Fig. 6 (c).) In this circuit, the milliammeter can be connected directly across the 1000 ohms to measure the grid current. Since the meter resistance is small in comparison with the 1000 ohms, the major portion of the grid current will flow through the meter rather than through the resistor.

Discriminator Alignment

To align the discriminator circuit, a signal at the i-f should be fed to the grid of the limiter tube. With the output indicator connected to point A in Fig. 7, the primary trimmer C_p should be adjusted for maximum output. This adjustment will not be critical.

To align the secondary winding of

(*Continued on page 25*)

CIRCUITS

See Front Cover

By HENRY HOWARD

Fig. 5. (Left) Federal has introduced a series of radio-phonograph recorder combinations in console and portable models. Cabinetry ranges from the Old English to semi- and ultra-modern. Several of the console models feature automatic record-changer mechanisms.

Fig. 1. (Below) Wilcox-Gay has announced a small portable radio-recorder which they call the "Recordio, Jr." It weighs less than twenty pounds.

HOME recording is the most advertised feature of the 1941 lines, as was predicted on these pages a year ago[1]. Wilcox Gay have broken the field with a small reasonably priced portable radio - phonograph - recorder combination which they call the "Recordio Junior". (See Fig. 1.) The whole set, housed in an airplane luggage carrying case, weights less than 20 pounds and will play both 10 and 12-inch recordings.

[1] "We Expect," by Robert G. Herzog, SERVICE, Jan. 1940, p. 14.

The outstanding feature of the larger "Recordio" models for 1941 is dual speed (33 1/3 and 78 rpm) which is available in five of the new models. An apartment model (A85) of ultra modern cabinet design is also available, together with several models housed in cabinets styled in the eighteenth century English manner. (See Figs. 2 and 3.) Equalizers are provided in all models featuring 33 1/3 rpm.

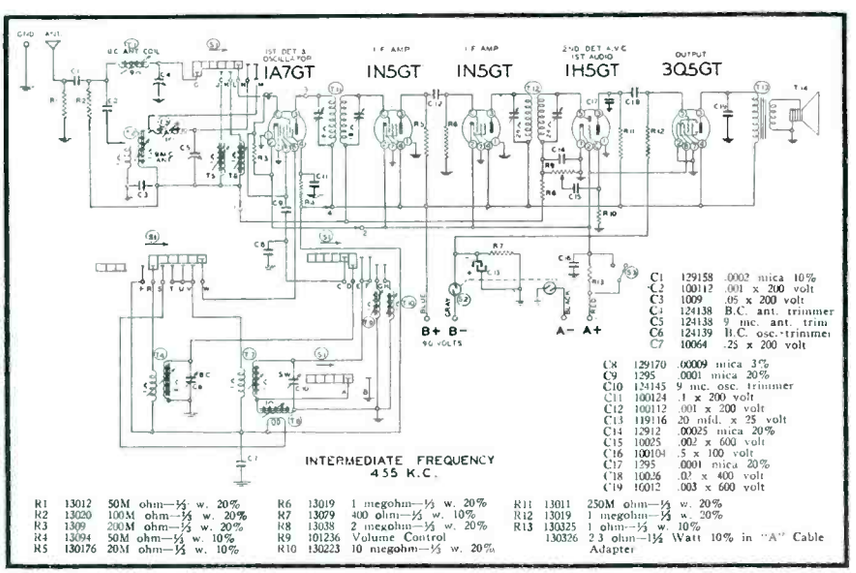
Federal have also added several new models to their line of radio-phonograph-recorder combinations. Both portable and console models are featured. Automatic record changing facilities are available in the large sets. (See Figs. 4 and 5.)

Economizers

Economizers are becoming necessary features of portables. The latest wrinkle is an A battery saver consisting of a small resistor which is connected in series with a battery when new. When the battery is well broken in, the resistor is shorted. This saves tube filaments as well as the filament battery and probably conserves a ma or two from the B battery. Admiral uses a 1-ohm resistor in their Model D4. Belmont does the same in their Model 509. This latter model is a rather elaborate 5-tube, 5-band receiver, has 6 push buttons, and

Fig. 2. (Above) Wilcox-Gay's Model A85 phonograph-radio-recorder features dual-speed (33⅓ and 88 rpm) recording and playback.

Fig. 6. Belmont 509 is a five-band, battery-operated, superheterodyne with push-button tuning. Permeability tuning is used on all bands.



R1	13012	50M ohm—½ w. 20%	R6	13019	1 megohm—½ w. 20%	R11	13011	250M ohm—½ w. 20%	
R2	13020	100M ohm—½ w. 20%	R7	13079	400 ohm—½ w. 10%	R12	13019	1 megohm—½ w. 20%	
R3	1309	200M ohm—½ w. 20%	R8	13038	2 megohm—½ w. 20%	R13	130325	1 ohm—½ w. 10%	
R4	13094	50M ohm—½ w. 10%	R9	101236	Volume Control		130326	2.3 ohm—1½ Watt 10% in "A" Cable Adapter	
R5	130176	20M ohm—½ w. 10%	R10	130223	10 megohm—½ w. 20%				

C1	129158	.0002 mica 10%	C8	129170	.00009 mica 3%
C2	100112	.001 x 200 volt	C9	1295	.0001 mica 20%
C3	1009	.05 x 200 volt	C10	124145	9 mc. osc. trimmer
C4	124138	B.C. ant. trimmer	C11	100124	.1 x 200 volt
C5	124138	9 mc. ant. trim	C12	100112	.001 x 200 volt
C6	124139	H.C. osc.-trimmer	C13	119116	20 mfd. x 25 volt
C7	10064	.25 x 200 volt	C14	12912	.00025 mica 20%
			C15	10025	.002 x 600 volt
			C16	100104	.5 x 100 volt
			C17	1295	.0001 mica 20%
			C18	10026	.07 x 400 volt
			C19	10012	.003 x 600 volt

is provided with an adapter for two-volt storage cell operation. A 2.3-ohm, 1½-watt resistor is self-contained in a special A battery cable. (See Fig. 6.)

While on the subject of battery portables, Zenith has a new job covered with "Tufraw" genuine rawhide. Zenith advertises that this set is "guaranteed to play where other battery portables will fail, or money back". This policy is undoubtedly made possible because of Zenith's removable loop, called the "magic magnet", which may be placed in any position where it will pick up the most signal. (See Fig. 7.)

In another portable, the Admiral G6 and XG6 Series, the filaments are connected in parallel for battery operation and in series for line operation. Parallel operation of these low current filament type tubes makes for longer life. There is no tendency to overload any particular tube due to slight differences in filament resistance, or because of unequal voltage drop on the end of the series since the plate current must return through this path. This receiver is a 6-tube job with an r-f stage. A 117Z6 rectifier is used during line operation. (See Fig. 8.)

Philco 41-788

Philco's Model 41-788 is an elaborate 11-tube job with a 115 to 230-volt power transformer and eight tuning bands. Five of these bands are bandspread by means of a 3-gang permeability tuner. A continuous tuning range of 540 to 22,000 kc is provided. The audio end is

Fig. 3. It seems that the manufacturers have finally awakened to the fact that the radio cabinet should have some relation to the other furniture in the customers home. The Wilcox-Gay Model A94, shown above, is a good looking example of Old English styling.

also interesting. Two phase inverter tubes are used as well as degeneration from the speaker to the input of the No. 1 phase inverter. (See Fig. 9.)

Emerson Inverters

Emerson has two d-c to a-c inverters for running phonograph motors on d-c sets. Synchronous vibrators having a capacity of 20 watts are used in conjunction with a full complement of filter components to cut hash to a minimum and preserve contacts. A resistor is used in series with the vibrator to prevent fireworks and blown fuses in the event the vibrator should stick. A power

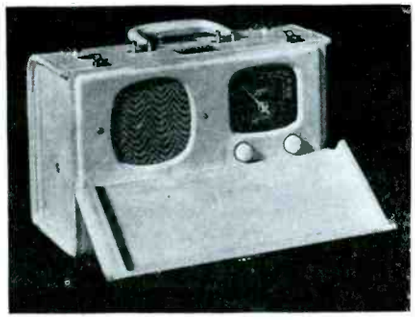


Fig. 7. Zenith claims their portables will work where others fail. A removable loop helps considerably.

factor correcting condenser is provided across the motor terminals. (See Fig. 10.)

Fig. 4. The success of a few manufacturers last year has started an avalanche and at least a score of relatively inexpensive radio - recorder combinations are now available. The Federal portable, shown at the right, features a radio receiver, and separate playback and recording pickups in its portable case. It can be used as a normal receiver, as a record player, as a recorder for direct pick-up, or to record programs received over the radio set. The advent of these machines has increased the profit possibilities for the average Service Man many times over. In addition to providing another instrument in the home that requires periodic servicing, these devices present a sales outlet for discs, stylii and needles.

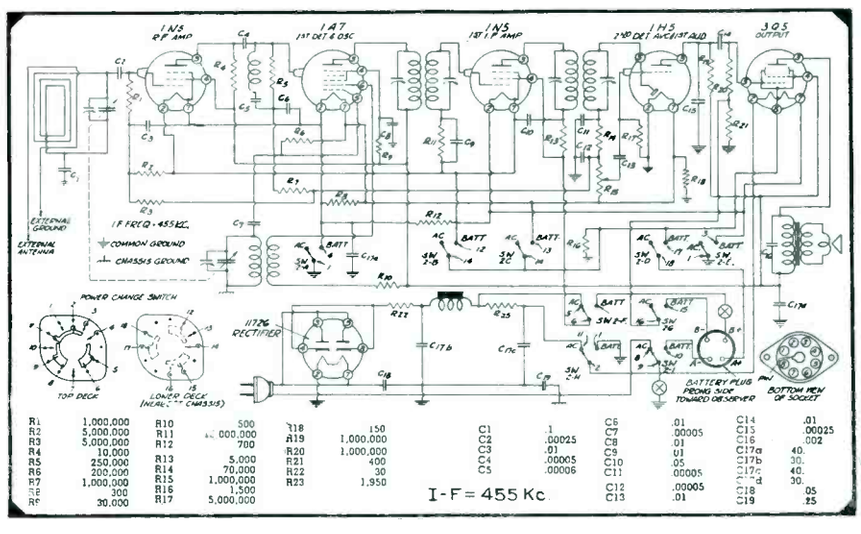
Permeability Tuning

Belmont Model 151 is one of the few midget sets with push buttons this year. Permeability tuning is used with a slide tuner shown in Fig. 11. Ward's Airline Model 04BR515B, a 5-tube, a-c phonograph combination also uses this type of tuning. An antenna plate is used for pickup in installations where indoor antennas of this type will suffice. An interesting point is contained in switching to phonograph operation. The B supply is disconnected from the r-f and i-f stages to silence that portion of the receiver while playing records.

Airline 04BR389T

Ward's Airline model 04BR389T has a power transformer with five voltage taps for operation from 90 to 230 volt a-c lines. The wave-band switching also

Fig. 8. Admiral's G6 and XG6 universal portables switch from parallel filament connection on battery operation to series for line operation.



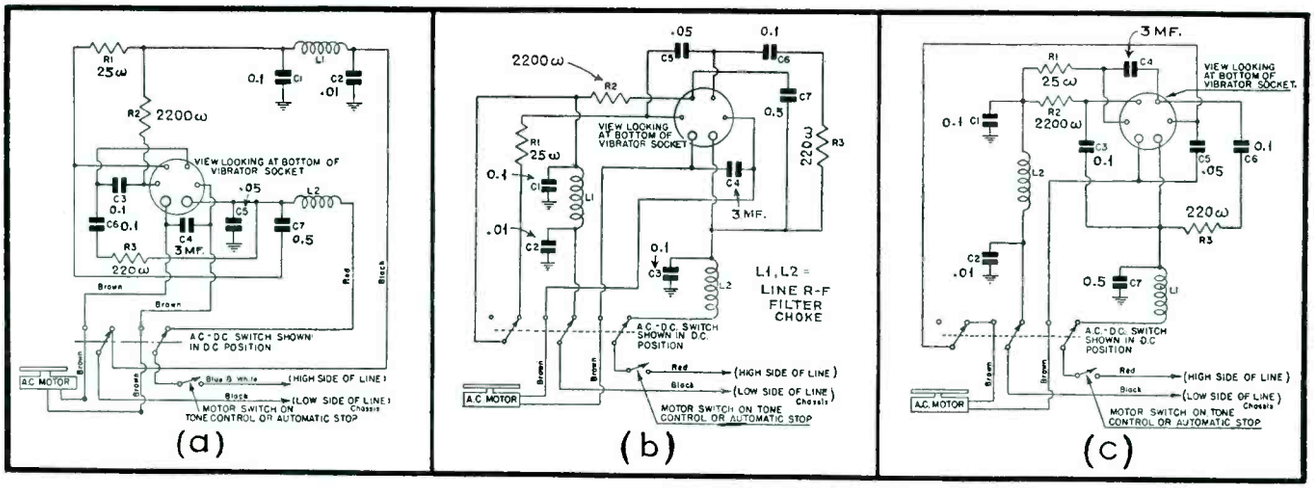


Fig. 10. Emerson has introduced a series of phonograph inverters. At a, left, a separate a-c, d-c toggle switch is used; the switch is mounted on the unit in b and also at c.

deserves attention. The antenna coils are all in series and sections are simply shorted out for the short-wave bands. The antenna coils are connected in parallel on the short wave bands. The oscillator switching looks more conventional. (See Fig. 12.)

Motorola 83F1

Motorola Model 83F1 has a motor operated push-button tuner and an unusual 25-volt, center-tapped filament winding. The winding actually totals 33 volts for the tuning motor but two sets of 12-volt tubes are used on the 25-volt portion. The power tubes are connected in series—in Fig. 13. This model also has automatic record changing facilities.

Crosley 42BR

Crosley Model 42BR is an 8-tube a-c superheterodyne with many advanced features, such as band-spread tuning, flywheel tuning drive, two i-f stages, iron-

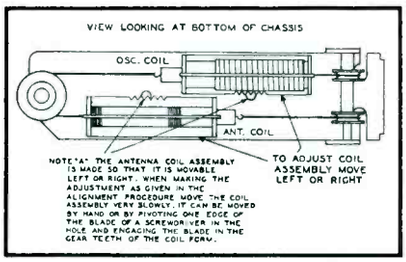


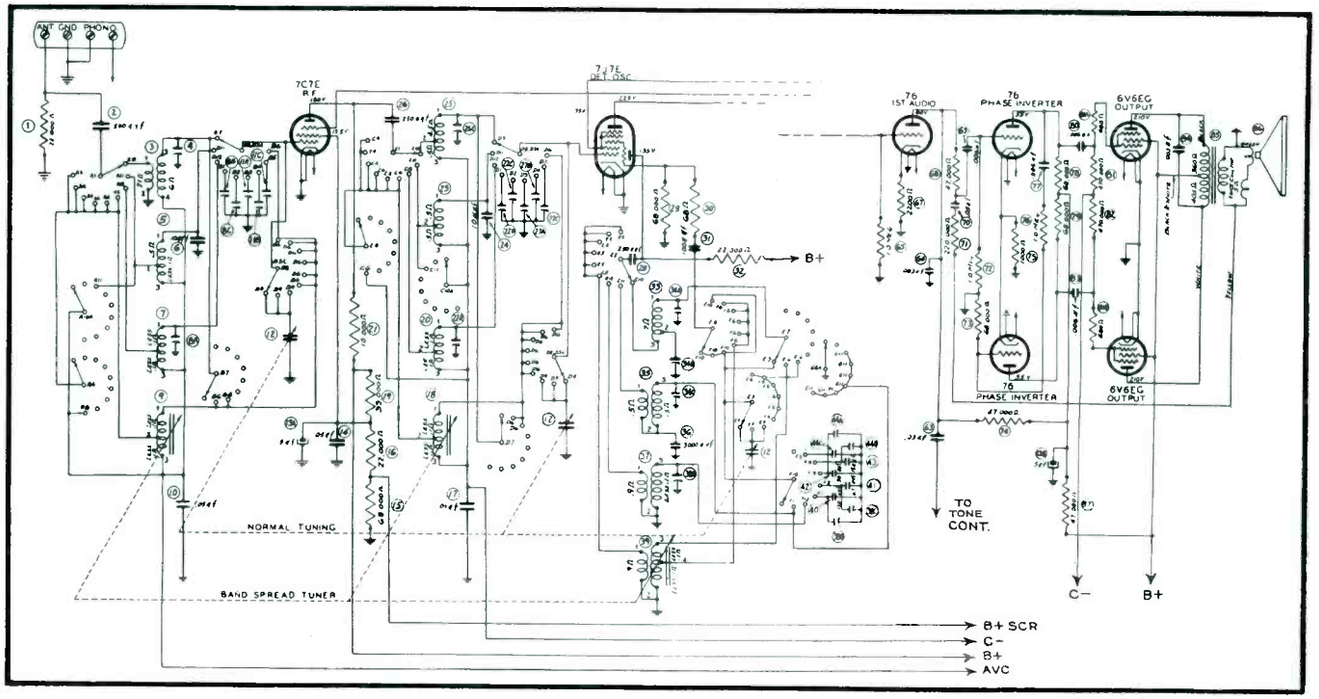
Fig. 11. A number of Belmont and Airline models use the permeability tuning unit shown above.

Fig. 9. Philco's Model 41-788 features band spread tuning with a three gang permeability tuner. The audio end has two phase inverter tubes.

core i-f transformers and oscillator coils for improved tracking on the short-wave bands and push-pull output. The power transformer is built for 50 cycles with four-voltage ranges from 100 to 230 volts. The tuning range covers the spectrum from 550 to 22,500 kc in six bands. The three highest frequency bands are spread by shunting fixed condensers across the gang tuning condenser as shown in the diagram on the cover. Bandspread seems to be featured in many sets this year probably because of the popularity of serious European listening for direct war bulletins.

Stromberg-Carlson 585 F-M Receiver

With f-m rapidly gaining popular approval in many of the larger cities where stations are now operating with regular schedules, we must treat at least one f-m receiver. Probably no one has been pushing f-m more than Stromberg-Carlson. They went to town right from the beginning. Model 585 is an elabor-



STROMBERG-CARLSON No. 585 F.M. & A.M. RECEIVERS

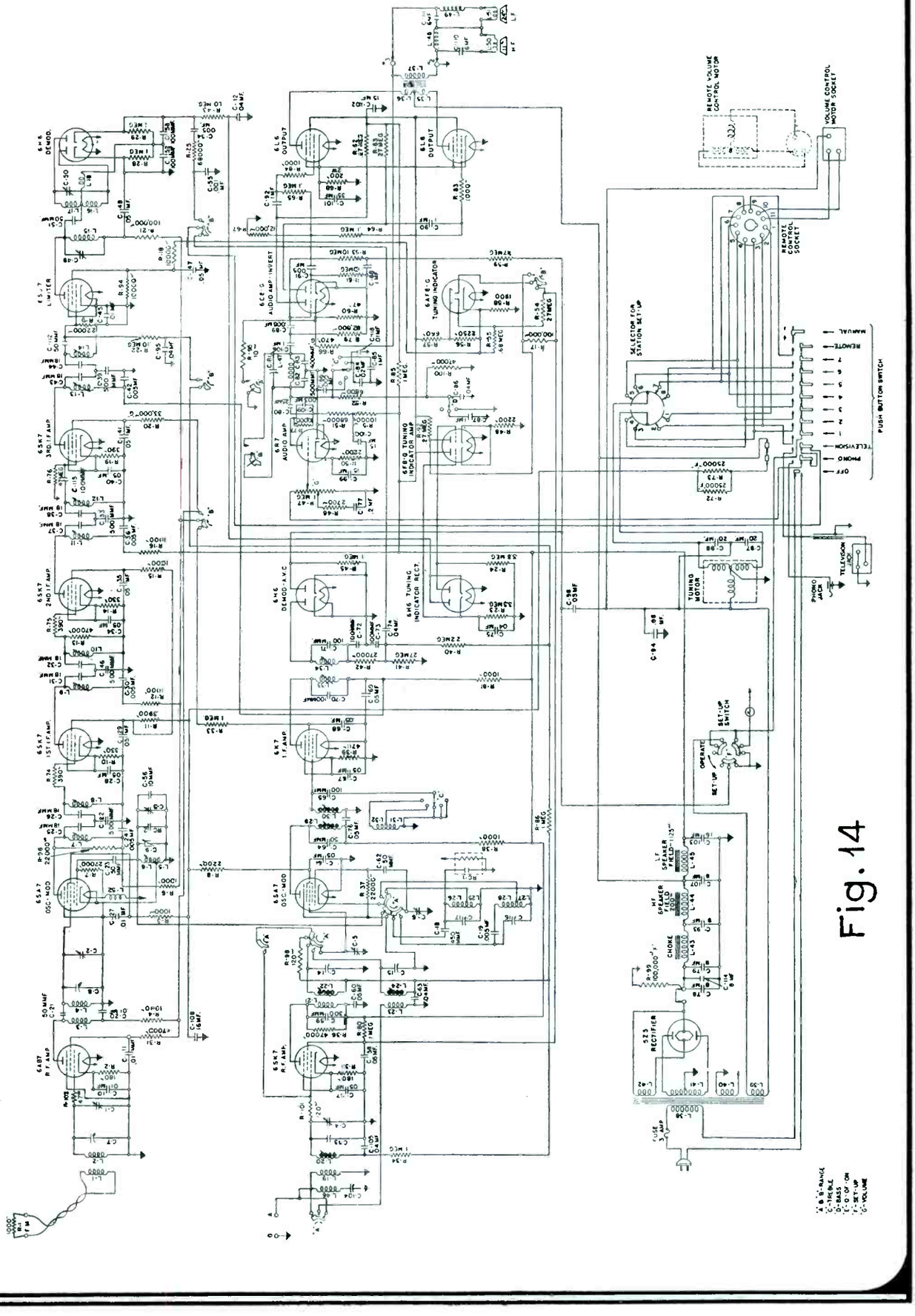


Fig. 14

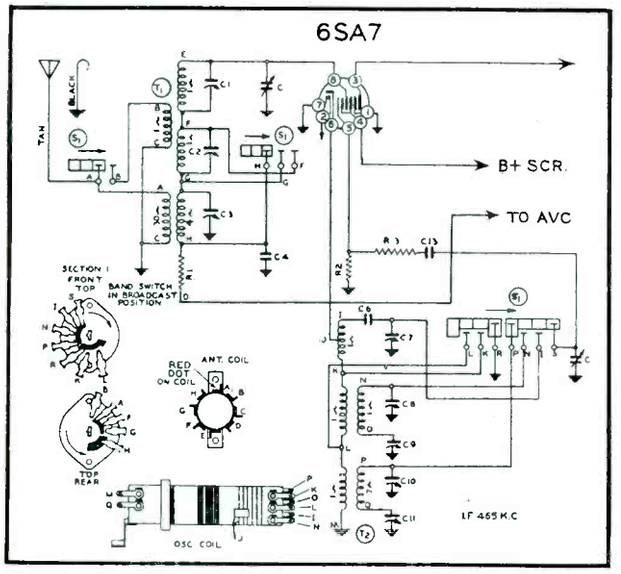


Fig. 12. (Left) Ward's Airline 04BR389T has the antenna coils for the short-wave bands in series. The band switch simply shorts out sections. The oscillator coil is more conventional, however.

Fig. 16. (Below) Lafayette 1102 features degeneration from the voice coil to the cathode of the 6Q7 first audio amplifier stage. The proper percentage of the output voltage is selected by means of a resistance divider connected across the voice coil winding.

ate f-m, a-m combination receiver having two completely separate r-f portions feeding an excellent audio amplifier and speaker system. Dual speakers are featured with a frequency dividing network. The treble speaker with its back completely enclosed is mounted directly in front of the bass speaker. The labyrinth is used, of course, and the complete system is capable of practically flat response from 65 to over 10,000 cycles. A remote control unit is provided, automatic tuning being obtained by a motor drive. Fig. 14 shows the output circuit as well as one of the three f-m i-f stages with its wide band coupling transformer.

Other Models

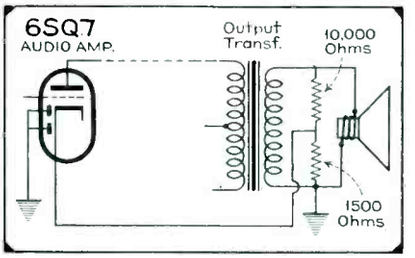
Model 16T4 of RCA Victor is a 6-tube push-button set with an r-f stage operating on 3 bands in conjunction with two loops. Note the link (Fig. 15) which grounds the antenna coupling coil when set for loop operation.

Degeneration over the entire audio amplifier is featured in the Lafayette Model 1102, where voltage is taken from the output transformer and fed back to the cathode of the 6SQ7 first audio stage. (See Fig. 16.)

STROMBERG CARLSON 520PS, 520PN, 520PG

Eliminating some of the high frequencies of the 520 PS, PN and PG when playing records: To eliminate some of the reproduction of high frequencies internally and thus eliminate the necessity for using the tone control to minimize surface noise in the reproduction of phonograph records, a 75-mmfd capacitor has been added to the circuit of these models manufactured after November 12, 1940.

This 75-mmfd capacitor is located across the 1.5-megohm resistor (R6) connected from terminal No. 3 of the 6V6 output



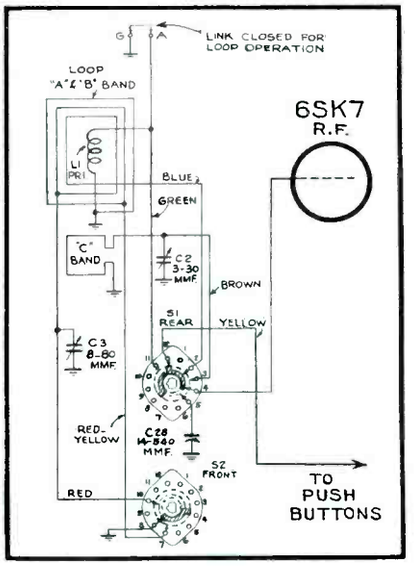


Fig. 15. (Above) Two loops are employed on the RCA 16T4 three band superheterodyne.

socket to the single point terminal block located on the mounting support bracket of the variable capacitor.

If the customer desires greater fidelity of reproduction of phonograph records this capacitor should be removed.

WELLS GARDNER 6C13, 6C14, D1090, D1091

External speaker grounds: The C issue radio is equipped with a speaker that does not have to be insulated from the car ground if mounted externally and in back of the instrument panel. The voice coil and the field coil of this speaker are not connected directly to ground but, instead, are soldered to a lug insulated from ground. A bare wire connects this lug to the speaker frame—See illustration below. When the speaker in the C issue radio is mounted externally, cut off this bare ground wire. This insulates the speaker windings from car ground at the speaker mounting.

The speaker in the A and B issue radios does not have this grounding arrangement and this procedure for insulating the speaker windings from car ground cannot be followed.

The issue letter is the letter at the end of the chassis number on the chassis label. This label is on the round can in the radio.

J. K. Rose, Service Manager
WELLS-GARDNER & COMPANY

WILCOX GAY A89, A91, A92, A93, A94

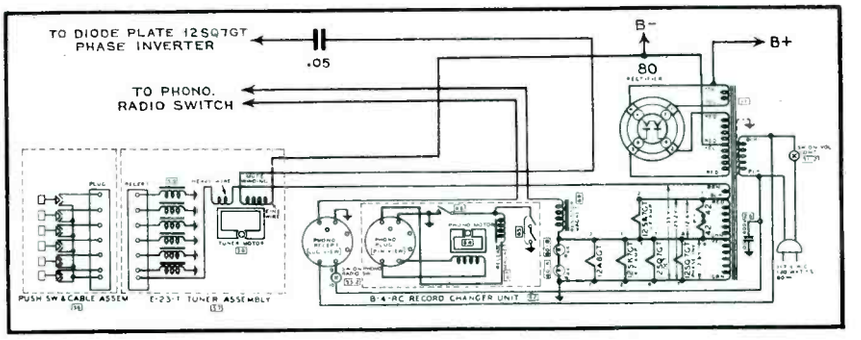
Bass response and microphonism: In dual-speed Recordio models with serial numbers over 621520, the 500,000-ohm resistor (R36), connected in shunt with the phonograph input circuit, has been changed to one of 2.0 meg.

The resistance value of R36 governs the amount of low audio frequency response (bass) that may be obtained in playing phonograph records, without encountering rumble or microphonism due to cabinet resonance. Increasing the resistance value increases the bass response, and vice versa.

By use of the 2.0 megohm resistance value, the degree of low frequency response is adjusted to a safe margin from the borderline of microphonism.

Should it be desired to increase the bass response of phonograph record reproduction in dual-speed Recordio models bearing serial numbers lower than indicated above, the highest resistance value, not to exceed 2.0 megohms, should be used in circuit position R36, that affords record reproduction at full volume entirely free from microphonism.

Fig. 13. (Below) The Motorola 83FI has a motor operated push-button tuning arrangement.



SOUND IDEAS

By JAY ALLEN

With the Emergency Training Program for National Defense in the headlines, greater attention is being given to schools in general Changes and improvements are planned on a large scale throughout the country. The addition of sound equipment is an item marked down as number one by many supervisors.

High School Sound

At the Sunset High School, in Dallas, Texas, an installation was made (see Fig. 1) for sound reinforcement of dramatics or of any assembly that requires pick up of the entire stage. The five Shure Unidyne cardioid microphones are fed to individual inputs of an amplifier located off stage. Several speakers are used to distribute the sound to the audience.

Previously, microphones were used in the footlights but this did not provide proper coverage from all parts of the stage.

The installation was made by Wilkinson Brothers, radio parts distributers in Dallas, Texas. Elliott Wilkinson, one of the brothers, received a letter from Mr. W. T. White, principal of the Sunset High School which stated:

"Regarding the microphones installed in our auditorium, I am now ready after having opportunity to make sufficient tests, to report they are entirely satisfactory.

"The quality of tones reproduced by the microphones is remarkably natural. However, the thing that has been of most interest to me is whether or not group conversations and action on the stage could be amplified by the use of all microphones without distortion of individual voices. During a recent assembly which involved group action, the results were fine."

Towboat Sound

The appearance of the new all-welded steel towboat "Tri-Cities" on its trip to various points on the Mississippi River from Hartford, Ill., has caused much comment. This has been due, not to its modern design, but more directly to the loudspeaker installed atop the pilothouse which permits voices to be heard for more than two hundred yards.

Orders from the pilothouse to engine room, captain's quarters or galley on the new boat are transmitted by a Philco sound system.

A loudspeaker atop the pilothouse makes possible ready communication with deck hands or persons ashore. The system permits transmission of orders more than 600 feet from the pilothouse —a situation frequently occurring since river towing involves the handling of long and bulky tows.

The new installation permits more ready handling of tows passing through locks as well as expediting loading and unloading which heretofore had required relaying of verbal orders.

Recording Studio

As an extra business feature, Allied Engineering Services, a radio service shop located at 410 Marion Avenue, Lima, Ohio, makes recordings for their patrons, at a small fee for each disc.

The equipment used, see Fig. 2 is a special rack and panel job designed by T. P. Hover, of Allied. It was built on the Allied Engineering work bench.

This feature is played up in window displays, throw-aways and other local advertising and provides a definite source for added income. Margret Hover, sales manager of Allied (shown in the photo) reports, in addition, that the recording studio helps to build store traffic and increases prestige with the customer.

With home recording taking the limelight in the set manufacturer's advertising for 1941, business from this source should show a marked increase. Customers considering the purchase of home recording equipment will undoubtedly call upon Allied's before making any decision.

Fig. 1. Five microphones (four in the back drop and one on the speakers stand) are used to pick up sound on the stage in the auditorium of this Texas high school.

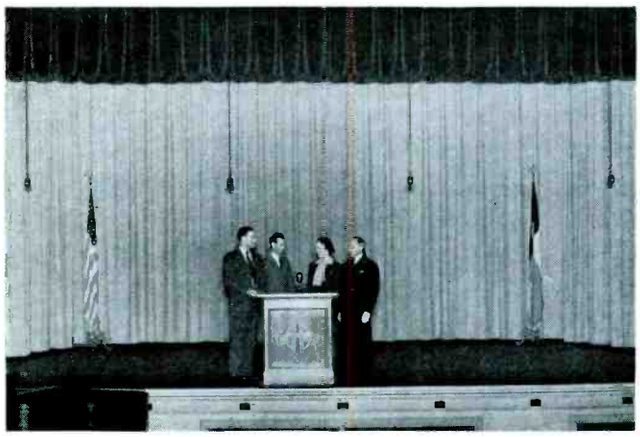
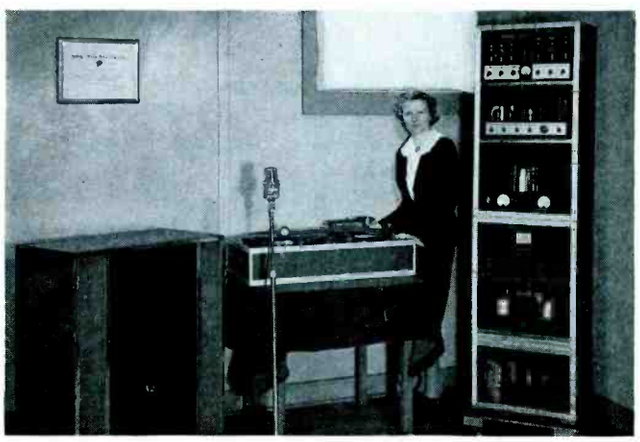


Fig. 2. By making recordings for their customers, Allied Engineering Services, Lima, Ohio, have built up a profitable side line to their already flourishing radio service business.



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ANNUAL SERVICE INDEX

JANUARY, 1940 — DECEMBER, 1940

An asterisk preceding a listing indicates that a partial or complete circuit accompanies the text.

ANNUAL SERVICE INDEX

ANNUAL SERVICE INDEX

PHONOGRAPHS, RECORD PLAYERS

PUBLIC ADDRESS

RECEIVERS

Auto

RECORDING

SOUND

TELEVISION

ANNUAL SERVICE INDEX

TEST EQUIPMENT

TUBES

TUNING MECHANISMS

Book Reviews...

SUPERSONICS: THE SCIENCE OF INAUDIBLE SOUNDS, by R. W. Wood, published by Brown University, Providence, R. I., 1939, 158 *pages, price* $2.00.

Professor Wood's excellent summary of supersonics is divided into two main sections, the first concerning itself with the historical development of supersonics while the latter deals with the physical and biological effects of these waves. The properties of supersonic waves are so unusual that it is greatly to be hoped that this book becomes as widely read as it well deserves.

R. L.

TELEVISION RECEIVING EQUIPMENT, by W. T. Cocking, published by Iliffe & Sons, Ltd., Dorset House, London, England, 298 pages, price 7s. 6d.

This book is intended for the student or engineer who is already familiar with radio receiver design. It deals specifically with the cathode-ray type of receiver rather than projection units, the subject being treated as an extension of radio receiver theory.

The first chapter deals with general television principles and serves to acquaint the reader with the essential differences between the vision and sound receivers. This section, written in elementary terms, may be easily understood by the lay reader.

Next the author deals with the television signal. While this chapter is especially well written, the reviewer feels that it is too short to adequately cover this important subject.

The next sixteen chapters are each devoted to a separate functional portion of the television receiver. The data given on electromagnetic and electrostatic deflection is particularly good.

While the author has assumed that the reader has a knowledge of receiver design, he has studiously avoided a mathematical presentation of any portion of the subject. Simple formulas are resorted to only in those cases where mathematics can hardly be avoided. As a result *Television Receiving Equipment* is recommended to those interested in a complete but elementary treatment of television receivers.

R. D. R.

WE PRESENT TELEVISION, edited by John Porterfield and Kay Reynolds, published by W. W. Norton & Co., 70 Fifth Ave., New York City, 1940, 298 *pages, price* $3.00.

This book presents its subject, so to speak, through the eyes of a number of well known exponents of the varied activities of the art . . . such men as Waldemar Kaempffert, Alfred H. Morton, Donald Fink, O. B. Hanson, Thomas H. Hutchinson, Thomas Lyne Riley, Earle Larimore, Charles E. Butterfield, Harry R. Lubcke, J. R. Poppele, Benn Hall, and Robert E. Jones.

This treatise discusses the technique of television, facsimile and of frequency modulation. It also considers the problems of finances, the part of the actor, programming, the director, as well as other interesting aspects of the television art.

The book is intended for the lay reader and is written by men who know their subject. It is recommended to anyone interested in obtaining a composite view of the art.

R. D. R.

(Continued on page 27)

BUSY SHOP

Time is at a premium in this New England Service Shop, which manages to keep busy throughout the entire year. Successful methods, successfully applied serve to bring in a high class of service jobs that ensure fair profits. Judicious advertising in suitable local mediums also helps create a continuous volume of business.

Successful servicing from the shop owner as well as customer standpoint is exemplified in the solidly established and increasingly prosperous business of Community Radio Laboratory, Norwood, Mass., operated by James F. Waldron.

Expert service, expertly advertised, keeps this shop filled with work the year round, at profitable rates, and this without making any calls whatsoever in homes, either for the purpose of giving estimates or performing service work.

Three dollars is the fee, minimum or per hour. Some estimates are given free and others not, depending on conditions. For example, if upon examination it is found that the trouble will take some time to isolate, and, in some cases, even require repairs before an honest estimate can be given, a charge of $2.50 is made, which is deducted from the service charge if the owner decides to have the work done.

In addition to its principal business of home receiver servicing, Community Radio Laboratory installs and maintains police communication apparatus, builds and sells sound equipment, noise elimination filters, electronic control devices for retail store advertising, and in fact almost anything for which there is a profitable sale.

An increasing phase of the company's activity is work done for auto-radio dealers who do not maintain a radio service department of their own. Work for such dealers requiring less than an hour is performed at a flat rate of $1.50 per unit, while jobs requiring more than an hour are billed at the standard rate of $3.00 an hour, with parts billed at cost plus a handling charge of 10%. A check-up of jobs of this nature over a three months' period showed time per job as averaging about twenty minutes each.

Advertising of the concern, which is consistently maintained in the local newspaper at an average cost of $25 per month, emphasizes that while no cut or bargain prices are offered, the customer is guaranteed honest treatment and full value for every dollar spent. The following example will illustrate:

OUR PROFESSIONAL SERVICE FEE

We value our time at a much higher rate than any other company we know of—but—for value received we can honestly refer you to our many satisfied customers. Ask any or all of them. Three dollars is our fee, minimum or per hour. We invite you to investigate. Thank you. Community Radio Laboratory.

James F. Waldron employs photographs of his "Community Radio Laboratory" workbench in advertising copy with resulting favorable press comment and increased business. The instruments shown are, from left to right, CRA oscillograph; Model 110 signal generator; Model 111 Unisignal frequency modulator and Model 135 Unichecker on rack with a Model 79C beat frequency oscillator. We can readily see that this is one shop that is amply equipped to do efficient service work.

Photo courtesy Clough-Brengle

Photographs of the shop, which, as the accompanying illustration shows, is made up of latest type of instruments for rapid dynamic testing and visual precision check and alignment, have been extensively employed in advertising, with resulting favorable press comment and increased volume of high-class trade, with midget receivers absent.

Work is performed at the front of the shop, where customers are privileged to look on all they like and satisfy themselves that in work expertly performed with latest precision, time saving instruments, they are actually getting the most for their money.

"There is no better success formula for Service Men," says Waldron, "than to know your business and let the public know you know it. Expert work plus good showmanship pay excellent dividends on time and money invested."

Case Histories

STEWART-WARNER HUDSON DB40, SA40

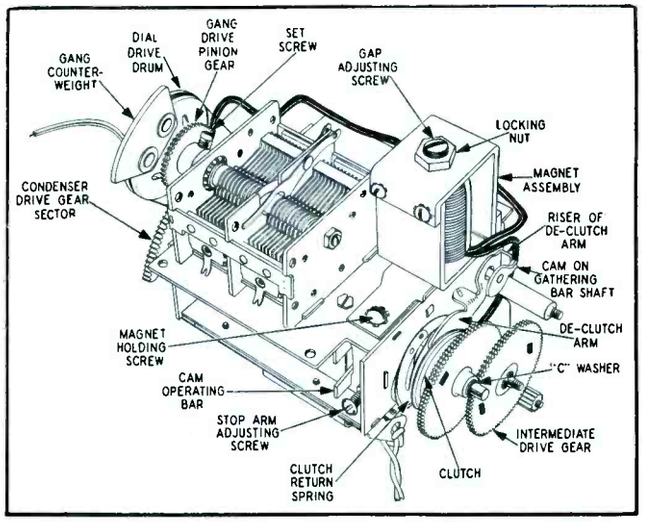


Fig. 3. The Stewart-Warner Hudson Models DB40 and SA40 employ a mechanism called Feathertouch Tuning. The device is shown in the illustrations at the right and at the bottom of the page. Tuning buttons can be set in any order and without the use of tools. One or more can be reset without disturbing the settings of any of the others.

Feathertouch tuner operation: When a push-button is depressed, it makes mechanical contact with the cam operating bar located under it, and depresses the bar so that the gathering bar can make contact with it. At the same time, the key forces the contact plate downward, making electrical contact through the contact screw. When the contact screw makes contact, it energizes the winding of the magnet assembly causing the plunger to be drawn completely into the magnet as shown in Fig. 2. The plunger is mechanically coupled to the gathering bar and gathering bar shaft, so that when the plunger is drawn into the magnet, it causes the gathering bar to be forced ahead. The gathering bar engages the cam operating bar which is depressed by the push button key and drives it forward as shown in Fig. 2. This position of the cam operating bar is indicated by the ends of the cam operating bar extending from the mechanism frame (see Fig. 3). When the cam operating bar moves forward, the cam stops attached to the bar, engage the cam, rotating it until it is in the position indicated in Fig. 2. The rotation of the cam causes the cam shaft and gear segment to rotate likewise, rotating the gang condenser to a position corresponding to the station to which this particular key is set.

Locking mechanism: The cam shaft assembly consists primarily of a shaft on which five cams are alternately spaced between friction collars. On the clutch end of this bar is a short threaded section upon which screws the collar which is part of the clutch and clutch spring assembly. When the cams are locked, this threaded collar is turned upon the threaded section of this cam shaft, exerting pressure upon the cams and friction collars, thus locking them securely in position. When the cams are unlocked, this threaded collar is turned so as to unscrew it and exert a minimum of pressure on the cams and friction collars. The only pressure then exerted upon the cams to hold them in position is that exerted by a spring washer near the threaded end of the shaft. Thus the cams are held so they cannot move of their own accord, but are still loose enough to permit them to be set to correspond to the desired station.

The threaded collar is connected through the clutch to the manual tuning control, permitting adjustment of the cams from outside the tuning unit.

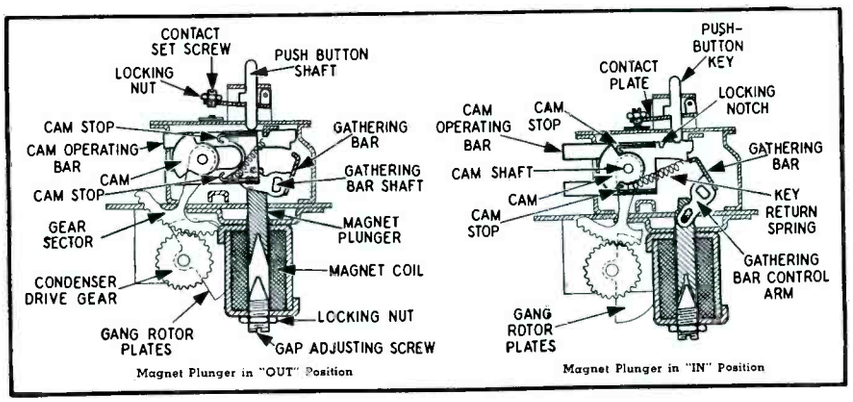
Clutch and de-clutch arm: The clutch mechanism of this tuner (see Fig. 3) functions every time a push button is depressed. Its purpose is to decouple the manual-tuning control and its associated gears from the automatic portion of the tuner when tuning electrically. The clutch is a dual unit, providing positive mechanical coupling between the manual tuning gears and the cam shaft, and it also has a leather friction disc which operates in conjunction with the positive coupling element to remove excessive backlash when tuning mechanically.

When the plunger is drawn into the magnet, turning the gathering bar shaft the came attached to the shaft (Fig. 3) moves downward on the riser of the declutch arm, releasing the pressure on the declutch arm, which bears against the inside section of the clutch. When this pressure is released, the clutch return spring contracts, separating the two halves of the clutch, thus disengaging the manual tuning gears.

When the push button is again released, allowing the plunger to be withdrawn from the magnet, the cam on the gathering bar shaft moves upward on the declutch arm riser, again exerting pressure on the declutch arm, and in turn on the clutch, thus engaging the two clutch sections, and making manual tuning possible.

Tuner troubles. Set tunes improperly: If the set fails to tune in stations properly, first check the set-up of the various buttons. If the set-up is incorrect, the set will tune consistently to the same point, and this condition can be remedied by resetting the buttons.

Figs. 1 and 2. Push-buttons operate a solenoid which in turn drives the condenser proper.



If the set will not tune in stations, although the plunger tends to move, make sure the bristol headed set screws in the retaining collar are tight. This is the collar which is almost touched by the condenser drive gear sector when the condenser plates are unmeshed. A loose set screw may strike the unit frame, causing the plunger to stick in either the in or out position.

If the set fails to tune properly, and the dial stops at different points when approaching the station from opposite ends of the dial the mechanism may not be properly locked up. The next step is to check for binding of the mechanism. This trouble also may occur if the pulling force of the magnet is not great enough. This may occur when the battery voltage is low (below 5 volts). It may also be due to too large a gap between the plunger and the pole piece of the magnet assembly. On later sets the gap can be adjusted. The adjustable magnet assemblies are identified by the gap adjusting screw and locking nut shown in Fig. 3.

In the early type of magnet assemblies, the gap is not adjustable. If one of these magnets is found to have insufficient pull, the remedy is installation of the new type magnet assembly. However, before replacing a magnet assembly, make sure that improper tuning is not due to low battery voltage or the other causes mentioned above.

Ends of drum rubbing brackets: The dial drum should have a slight amount of end play. If it doesn't, it may be binding. This may be due to improper placement of the volume control mounting bracket. To correct this difficulty loosen the two screws holding this bracket and move this bracket slightly farther away from the drum.

Similar binding may also be due to a loose end cap on the dial drum. In this case, force the cap back on the drum and punch-mark the cap to hold it in place on the dial drum.

In a few cases it may be found that dial end bearing is out of line or slightly off center. The bearing can generally be bent slightly to restore it to its proper position. If this cannot be done, replace the dial scale assembly.

Binding of the drum on the mounting brackets may be due to the fact that the control units fitted too tightly in early cars. This causes the escutcheon to be forced sideways, thus pressing on the tuning controls, which may move the dial drum brackets. This binding can generally be eliminated by bending the brackets slightly

outward.

Similar difficulties will be encountered if the control head is not properly installed. When mounting the head, tighten the wing nuts evenly, so the control head will not have a tendency to bind against the dash opening, which would push the escutcheon against the controls.

Drive pulley striking antenna coil shield: Check to see that the dial-drive pulley is properly located on condenser shaft. Its bushing should touch the condenser pinion gear.

Also, the antenna-coil shield can may be moved slightly away from the drum by loosening the two nuts holding down the can.

It may also be possible to move the entire tuning unit slightly away from the shield can. Loosen the four screws holding down the unit and shift it.

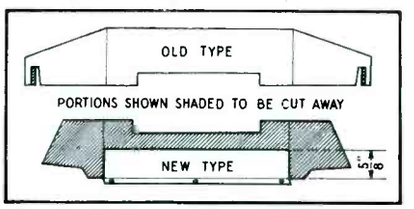


Fig. 4. Binding caused by the light diffusion plate can be corrected by cutting away a portion of the plate.

Tuning control fails to reach stop during unlocking: This is probably due to the shearing off of the "C" washer on the clutch end of the cam shaft (see Fig. 3). On the earlier mechanisms, this "C" washer holding the clutch and gear assembly to the shaft was made of a fairly soft steel. Occasionally these washers may shear off if the customer continues turning the tuning wheel after the mechanism has become completely unlocked. This continued turning forces the gear and clutch assembly against the "C" washer, shearing it off completely. You can replace this washer with a new hardened washer. This can be done without removing the tuning unit from the case. First lock the mechanism, then remove the nuts holding the triangular plate on the clutch end of the tuner. Unhook the plunger return spring so that no pressure will be exerted by the clutch. The washer can now be removed and a new washer installed.

On all early sets, replace this "C" washer even if the old one is still all right.

Shearing or partial shearing of this washer may cause slipping of the clutch or sticking of the plunger in the out position.

If a bronze washer is present between the "C" washer and the gear, remove it and discard it. If a steel washer is present, it must be left in place. On early mechanisms, a 1/32 in a steel washer was used in this position and it must be left in place.

Light diffusion plate rubs: Two types of light diffusion plates were used; the newer type is riveted to the cover, while the older type is mounted on the unit itself. (See Fig. 4.) If the newer type of plate rubs against the dial scale due to warping of the celluloid cut this plate as shown by the shading in Fig. 4. This can be done without removing the shield from the cover. In some early units, this diffusion plate was mounted on the unit itself. In this case, enlarge the notching fitting over the dial lamp wire as shown in Fig. 4. Exercise care when enlarging the notch, as the celluloid is quite brittle and may break. Then cement the diffusion plate to the front of the contact plate assembly so that the shield rests flat against this metal plate.

(*Continued from page 9*)

the discriminator transformer, the output indicator should be shifted to point B. For this operation a center-zero instrument is desirable, as was previously explained. With the generator still at exactly the i-f, the secondary trimmer C_s should be adjusted for zero output. If an artificial zero is used, then the correct adjustment of C_s will be easily detected by the fact that there will be no change in reading as the signal input to the limiter is varied from zero to maximum. If the frequency of the generator is varied slightly in either direction, the reading of the indicator will vary on both sides of the zero deflection.

I-F Alignment

To align the i-f amplifier it is preferable to start at the stage preceding the limiter and to align one transformer at a time. The design of practically all i-f amplifiers is such that they can be aligned at the center i-f and the response will then be satisfactory for 75 kc either side of the center frequency. The limiter will take care of any non-uniformity due to the selectivity of the i-f transformers. A factor tending to simplify i-f alignment is the heavy loading of the i-f transformers; this is used to help in obtaining the required 150-kc bandwidth.

To adjust the last i-f transformer, the signal generator should be connected to the last i-f tube and the trimmers adjusted for maximum output at the center frequency. The output indication is the voltage developed at the grid of the limiter tube. As previously explained, this may be an electronic voltmeter or a milliammeter connected in the limiter grid circuit.

When the alignment of the last stage is completed, the signal generator connection should be shifted to the preceding stage and this stage aligned in the same way. To align the first i-f transformer the signal generator should be connected to the grid of the mixer tube. Here some difficulty may be experienced in obtaining sufficient output because of the virtual short circut across the signal generator output in the form of the few turns constituting the r-f coil. If it is not possible to obtain enough output, then the r-f grid lead should be disconnected. Usually, since single-ended tubes are used, this will mean that the lead will have to be unsoldered. A resistor, about 10,000 ohms in value, should be shunted from grid to ground to complete the grid circuit. This resistor is not required if there is a d-c path through the signal generator output. When the lead is replaced, the same lead dress should be observed to avoid changing the r-f alignment.

The overall i-f and discriminator alignment can be readily checked with the signal generator connected to the mixer grid. At the center frequency to which the i-f transformers are peaked, the output of the discriminator at B in Fig. 7 should be equal to zero; at this same frequency maximum output should be indicated at the limiter grid. If the output at A is not zero, a slight adjustment of C_s will bring it to zero. To check the symmetry of the alignment, detune the signal generator about 75 or 100 kc on either side of the center frequency, and note the output at point A in Fig. 7. If the output is not the same on either side (of course it will be opposite in polarity as Fig. 3 shows), then a readjustment of the primary trimmer C_p can be made until the two values are equal.

In working on combination a-m and f-m receivers which use the same tubes for both the a-m and f-m alignment, particularly those which use the i-f

transformers in series, there may be some interaction between the a-m and f-m alignment. This will be very slight and unless the f-m alignment is carried out while the a-m alignment is very far off, there will be no necessity for realignment of the a-m circuits. This is also true of the a-m alignment.

Oscillator Alignment

The alignment of the oscillator circuit is similar to the alignment of any superhetrodyne high-frequency oscillator. A convenient procedure is to feed a signal into the antenna posts at a frequency near the upper end of the f-m band at about 48 mc. Follow the manufacturer's recommendation for this frequency. Using the output indicator in the limiter grid circuit, the oscillator trimmer should be adjusted so that the dial calibration is correct. Usually no adjustment is provided at the low-frequency end of the band because of the limited tuning range. If the dial calibration is appreciably in error at the low-frequency end of the range, it can be corrected by moving the end turn of the oscillator coil slightly.

It is advisable to check the image response of the receiver to prevent misalignment of the oscillator. Unless otherwise stated by the manufacturer, the oscillator should be adjusted *below* the signal frequency. This means that the image signal will be *below* the receiver dial frequency by an amount equal to twice the i-f. For example, if the dial frequency is 48 mc, and the i-f is 4 mc, then an image response should be obtained when the *signal generator* is shifted to 40 mc.

R-F Alignment

The alignment of the r-f circuits in an f-m receiver is conventional. To obtain the best alignment of the antenna transformers, a dummy antenna consisting of a 75-ohm carbon resistor should be used. This should be connected in series with the high side of the signal generator cable at the antenna posts of the receiver. Usually the r-f circuits are trimmed near the high frequency end of the band at about 48 mc, using the output indicator in the limiter grid circuit. The antenna and r-f trimmers should be adjusted for maximum output; to compensate for interaction between the oscillator and r-f circuits, it is best to rock the tuning condenser while the r-f adjustments are being made. Unless the wiring has been disturbed, the sensitivity of the receiver will be uniform over the band. If the sensitivity drops toward the low-frequency end of the band, then it will be necessary to adjust the inductance of the antenna and mixer grid coils so as to improve the tracking.

Book Reviews ...

AIRCRAFT RADIO AND ELECTRICAL EQUIPMENT, by Howard K. Morgan, published by Pitman Publishing Corporation, 2 W. 45th Street, New York City, 1939, 374 *pages, price* $4.50.

This is a timely book on a subject about which little information has been available. It presents in detail data regarding aircraft transmitters, receivers and accessories together with the inspection and maintenance methods used by the TWA. Complete schematics of representative transmitters and receivers are included with the text and each is completely discussed.

An effort has been made to get away from a cut-and-dried engineering presentation, thus widening the usefulness of the book to those who are not technically trained in the subject. The first three chapters are devoted to elementary electrical and radio theory, which are simply and clearly explained. J. H. P.

ALTERNATING CURRENT BRIDGE METHODS (4th Edition), by B. Hague, published by Pitman Publishing Co., 2 West 45th St., New York City, 1938, 587 *pages, price* $8.50.

First introduced in 1923, Hague's book on bridges has long been accepted as the most complete and authoritative on this subject. In its fourth edition, the fundamental material has been supplemented to include modern developments in the field so that it is thoroughly up to date in every respect. In this latest edition, 150 pages of new matter have been added, largely devoted to modern practice in bridge measurements, new bridges and the applications of vacuum-tube amplifiers, oscillators and detectors in bridge measurements. Some consideration is given to radio-frequency bridges though, as stated in the first chapter, the book is primarily devoted to measurements which are to be made at audio frequencies. J. H. P.

THE AMPLIFICATION AND DISTRIBUTION OF SOUND, by A. E. Greenlees, published by Chapman & Hall, Ltd., 11 Henrietta St., Covent Garden, London, W. C. 2., England, 1938, 254 *pages, price* 10*s.* 6*d.*

Intended primarily for the engineer who is interested in the design, application or operation of public address or sound systems generally, this book is written in an elementary and easily understandable style. The use of mathematics, except for occasional reference to elementary laws of electricity is avoided throughout the text. It is copiously illustrated with charts, curves, and diagrams.

The opening chapters are devoted to a review of the fundamentals of electricity. Later such items as chokes, transformers, microphones, loudspeakers, radio receivers, record reproducing equipment and amplifiers are covered in some detail. Performance data are also covered in excellent style. In addition, such items as installation planning, operation and maintenance of equipment, preparation of specifications and general system aspects of sound systems are dealt with fully.

This book is well written and adequately illustrated. It is recommended to Service Men interested in the subject of sound distribution. R. D. R.

FUNDAMENTALS OF ELECTRICITY AND ELECTROMAGNETISM, by Vernon A. Suydam, published by D. Van Nostrand Co., 250 Fourth Ave., New York City, 1940, 690 *pages, price* $4.75.

This book is intended as a text for the advanced student of electricity and magnetism, much of the material coming from the author's lecture notes on the subject. Written from the viewpoint of the physicist, this excellent treatise should be equally useful as a text and as a reference book for the industrial physicist or engineer. While there are a number of excellent texts available on the subject, this book appears to have more useful fundamentals for the communications engineer than any which has come to the attention of the reviewer. It gives a clear, logical and systematic treatment of the fundamentals which are basic to the communications field.

The chapters on magnetostatics and terrestial magnetism are especially well written and understandable, while the data on "The Magnetic Circuit" should be quite interesting to engineers dealing with electromagnetic devices. Two lengthy chapters are devoted to complex quantities and their application to alternating-current theory. In addition, considerable data is given on a-c bridges, as well as on vacuum tubes, tube rectifiers, mercury-arc rectifiers, r-f amplification and detection, radio transmitters, piezo-electric frequency control and many other allied subjects.

This book is highly recommended.

R. D. R.

(*Continued on page* 31)

PRECISION 854 MULTITESTER

THE Series 854 high-sensitivity multitester is a general service instrument featuring some thirty odd ranges for seven functions. Provision is made for d-c voltage readings at 20,000-ohms-per-volt and a-c voltage readings at 1,000-ohms-per-volt. Voltage ranges are provided up to 6,000 volts and direct current ranges from 60 microamperes (full scale) to 12 amperes. Resistance measurements can be made from a fraction of an ohm to over 40 megohms.

The commonly used voltage, current and decibel ranges are available at a single pair of polarized tip jacks through the use of a master multirange selector. This selector thus permits range change without the necessity of removing and reinserting test leads as would be required if numerous terminals were employed for the various functions.

The higher voltage ranges, namely the 1,200 and 6,000-volt ranges; the high-sensitivity, 60 and 300 microampere ranges; the output, and the 12-ampere ranges are terminated at distinctly marked, individual tip jacks. These ranges are also used in conjunction with the range selector.

The Circuit

The ring type ohmmeter circuit used in the Series 854 is practically unaffected by battery voltage (over the useful range of battery life) or by the setting of the zero adjusting control. The circuit constants are so arranged, and the tolerances so chosen that only slight readjustment of latter control is necessary when changing from one range to another, it is said.

A dry-disc type of instrument rectifier is used to provide for a-c voltage measurements on the d-c instrument. Separate 1,000-ohm-per-volt multipliers are used for these measurements. 20,000-ohm-per-volt multipliers are used for the d-c voltage measurements. To assure higher accuracy for the a-c measurements, individual a-c voltage calibrating controls are provided.

Two separate ring type shunt networks minimize the effects of switch contact resistance during current measurements. These shunts are wire wound to an accuracy of 1 percent.

Paper Condenser Tests

The insulation resistance or permissible leakages of paper and mica condensers is expressed in megohm microfarads. A good 1-mfd condenser will have an insulation resistance of approximately 450 megohms. Furthermore, insulation resistance of paper and mica condensers of similar voltage ratings is inversely proportional to its capacity, so that a 0.1-mfd condenser will have ten times the insulation resistance of a 1-mfd condenser or 4500 megohms. It therefore can be readily seen that it is not practical to use the ohmmeter method for measuring leakages in paper or mica condensers.

In the following method, a high d-c potential is applied to the condenser in series with the proper d-c volts range to determine whether or not it has low insulation resistance or abnormal leakage.

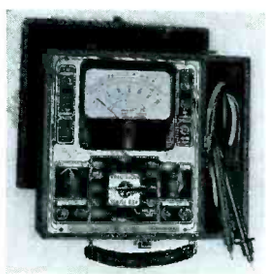
The necessary d-c potential can be obtained from an external high voltage d-c power supply or from the power output tube socket of a receiver. In the latter instance, the plate prong position of that socket will be the positive high voltage lead and the negative return or ground will be the negative lead. Voltage to be applied to the condenser should be slightly higher than its rated voltage.

1) Measure the d-c voltage obtainable from the power supply to be used. Then select the proper voltmeter range that would indicate the greatest deflection for the voltage there available.

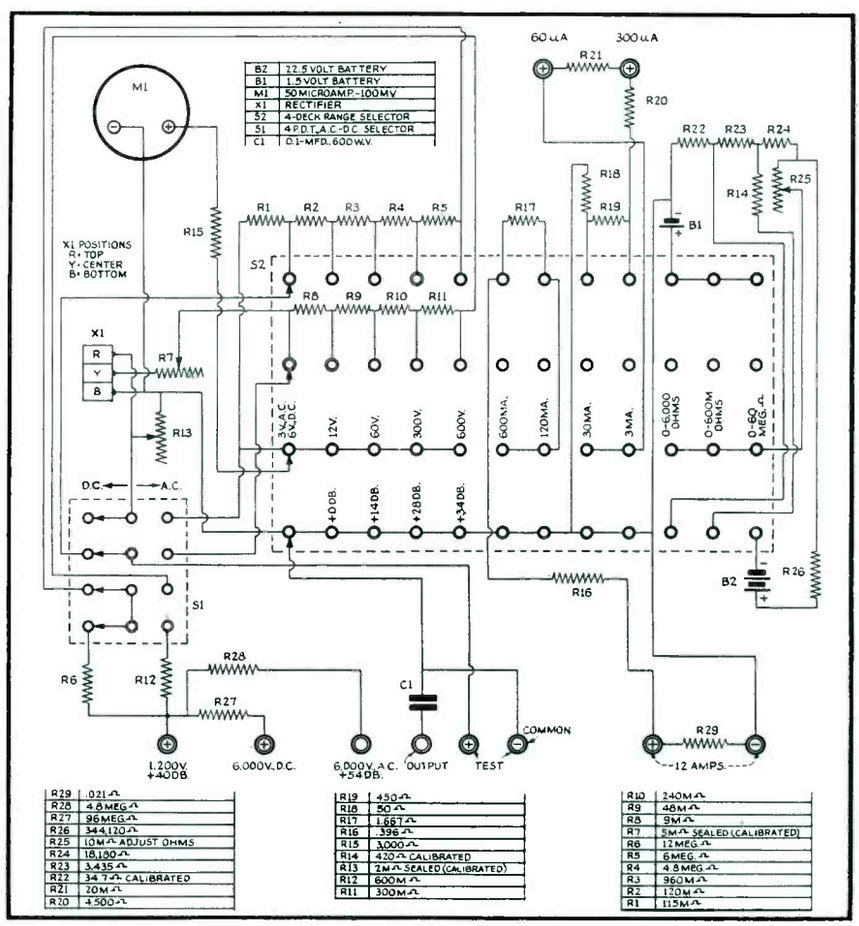
2) With the power supply off, insert the high voltage leads into the instrument tip jacks, observing correct polarities, and insert the condenser to be tested in series with one of these leads.

3) Turn on the power supply. An instantaneous deflection due to the

(*Continued on page* 30)



The Series 854 is a 20,000-ohm-per-volt multitester designed for complete receiver testing. Some thirty odd ranges are offered in both a-c and d-c functions.



ASSOCIATIONS

Trade Show for 1941

At the annual meeting of the Board of Directors of Radio Parts Manufacturers National Trade Show, Inc., held at the Stevens Hotel, in Chicago, Nov. 18, 1940, Messrs. A. A. Berard, H. E. Osmun, and J. J. Kahn, were reelected as president, vice president, and secretary-treasurer, respectively. Herbert W. Clough was elected to the Board of Directors to represent the Western Division of the Sales Managers Club. Mr. Clough began his term of office at this meeting.

The 1941 Radio Parts National Trade Show will be held at the Stevens Hotel, in Chicago, June 10 to 13, inclusive. The first three days will be devoted to the jobbing trade, and on the last day the Exhibition will be open to the radio trade in general.

Dallas, Texas

The Dallas Radio Service Association was host to a representative group of Service Men in the Dallas trade territory at their regular monthly meeting held Dec. 6. Walter Jones, Sylvania engineer, presented a very excellent lecture on "Tube Applications." This makes the sixth in the series of 1940-41 lectures by nationally famous engineers who have been brought to Dallas by the local association as part of its educational program. The program has produced a 50 percent increase in attendance during 1940 and has resulted in very close cooperation between factory representatives, jobbers and Service Men.

Porter T. Bennett, Secy.

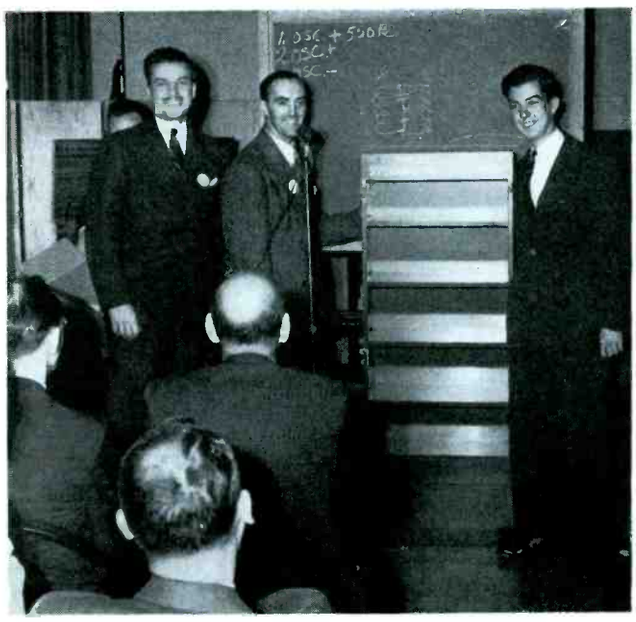
Danville, Ill., RSA

The Danville Chapter of the Radio Servicemen of America have changed their meeting nights from the second and fourth Friday nights of each month to the second and fourth Wednesday nights of each month.

The Chapter now has club rooms at 113½ N. Vermilion St., Danville, Ill., which not only has helped increase attendance at the regular meeting but has made it possible to promote more social activities.

At the present time the entire Chapter is busily engaged in a Christmas program that is proving very satisfactory. Through the cooperation of the local radio station, WDAN, and newspaper, the Commercial News, we appealed to the public for discarded radios to be donated to charity. These radios are to be repaired by the Service Men in our Chapter and then distributed to the worthy needy families in this community at Christmas time. The public is responding to our plan and the radio sets are pouring in as fast as we can repair them. A few nights each week, several of the members meet at our club rooms and repair radios and discuss service problems.

Evard C. Welch, Secy.



George C. Connor, Hygrade Sylvania commercial engineer, is shown (at the left) pulling the winning number at a recent Service Men's gathering held in the Architect's Building, Philadelphia. The meeting was sponsored by Norman M. Sewell of Century Radio (at the mike), Sylvania distributors. W. F. Wolff, 537 W. Cambria St., Philadelphia, won the prize, a floor model stock-boy cabinet. Mr. Connor is a member of the Advisory Board on Industrial Education for the New York Board.

Long Island, RSA

George C. Connor, Hygrade Sylvania commercial engineer, enumerated and clarified the "Changes in Radio and Their Ramifications to the Service Man" at the December meeting of the Long Island Chapter of the Radio Servicemen of America, at Hempstead, L. I. The meeting was sponsored by the Dale Radio Corp., New York distributors for Sylvania, and was presided over by Otto Furman, past president of the group and instructor of radio communications at the Brooklyn Technical High School.

Mr. Connor gave a report on and explanation of technical subjects which were studied and discussed at the IRE fall meeting held at Rochester, N. Y., recently. Speaking on frequency modulation, Mr. Connor declared that it is the hope of the protagonists of this new form of broadcasting and receiving to place in the homes of the American Public, sets that reproduce the full range of musical notes with a complete absence of noise, a feat not possible with amplitude modulation.

At the moment there is a conflict of f-m broadcasting standards, one being based on a horizontally polarized transmission, the other on vertical polarization. This diversity will probably be standardized by the RMA shortly.

The most annoying problem with f-m

(Continued on page 31)

With the arrival of Herb Clough, the Board of Directors of Radio Parts Manufacturers National Trade Show, Inc., is ready to begin preparation of plans for the 1941 Show to be held at the Stevens Hotel, in Chicago, June 10 to 13, inclusive. Left to right are H. E. Osmun (Centralab), vice-president; Herbert W. Clough (Belden Manufacturing Company), new director; Ken Hathaway, managing director; K. C. Prince, legal counsel; Arthur A. Berard (Ward Leonard Electric Company), president; and Jerome J. Kahn (Standard Transformer Corporation), secretary-treasurer, seated.

PRECISION 854 MULTIMETER

(*Continued from page 28*)

charge of the condenser will be indicated on the d-c meter.

a) In the case of a good condenser, the needle pointer will recede to the zero voltage mark.

b) If the meter pointer remains above the zero mark, then this indicates that the condenser has abnormal leakage.

c) If the meter pointer remains at the indicated value of the voltage measurement obtained initially, then the condenser is shorted.

d) If no meter deflection is obtained, then this indicates that the condenser is open or that the capacity is too low in value to indicate an instaneously noticeable meter deflection when charged.

Caution:—After this test is completed, always *first* disconnect the negative test lead from circuit *before* turning off power supply to prevent slamming of needle pointer due to discharge of condenser under test.

Displays . . .

Emerson Radio & Phonograph Corp., 111 Eighth Ave., New York City, has released a full color display card on Emerson Radio tubes. Illustrates glass, bantam and metal types.

Something dramatic has been provided by RCA for the display of the Jr. VoltOhmyst. The display enables the prospective customer to sell himself by providing a demonstration of the instrument's principal features. It consists of a VoltOhmyst, a rectifier tube and transformer, and simple circuits for providing tests of both a-c and d-c voltages, and low and high value resistances. With three leads from the VoltOhmyst the customer can perform many tests normally required in radio servicing. Printed in yellow, red, blue and black. **RCA Mfg. Co., Inc., Camden, N. J.**

Personnel . . .

Vic Mucher, in charge of sales for **Clarostat Mfg. Co., Inc.,** Brooklyn, N. Y., became the proud daddy of a daughter (Diana Marie) December 1. Mrs. Mucher and daughter doing well, thank you!

Alfred A. Ghirardi, author, took a quick trip to visit service shops and radio manufacturers in Buffalo, Detroit and Chicago to get last minute data for a new book, about to be published.

Claude E. Murray, veteran of 30 years' service with the **Willard Storage Battery Co.,** Cleveland, Ohio, has been appointed vice president and general manager of that company. Mr. Murray had been vice president and general manager of the company's Canadian affiliate.

BOOK REVIEWS

(*Continued from page 27*)

MATHEMATICS APPLIED TO ELECTRICAL ENGINEERING, by A. G. Warren, published by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York City, 1940, 384 *pages, price* $4.50.

This book is written particularly for the technician who is well grounded in calculus and differential equations. It is intended to present labor saving solutions to analytical problems involving a mathematical approach.

The author begins his subject from the engineer's viewpoint rather than from that of the mathematician. Solutions by a combination of graphical and numerical computations are indicated in numerous instances. While not ignoring the beauty of many classical mathematical methods, he centers his effort on the solution of the practical problems involved.

The first few chapters in the book are devoted to such items as real and complex numbers, differentiation and integration as well as to methods and results of differentiation and integration. The body of the text is given over to the solution of representative electrical problems. R. D. R.

PRINCIPLES AND PRACTICE OF RADIO SERVICING, by H. J. Hicks, published by McGraw-Hill Book Co., 330 W. 42nd St., New York City, 1939, 305 *pages, price* $3.00.

This book has been written especially as a text for the radio service man. Fundamental principles are explained in an elementary style so that the reader will understand the why as well as the how of servicing and operation.

The type of material and the method of its presentation would make this book an excellent text for a course in radio servicing, if the author had taken more pains to be accurate in every case. As it stands, however, because technical errors do exist the student could not always rely upon the material.

The first two chapters are devoted to the fundamentals of electricity and magnetism as well as to the principles of radio. Such items as the electromagnetic wave, the Kennelly-Heaviside layer, fading, etc., are treated in some detail. The chapter on antennas and static reduction is well written. In addition to a discussion and explanation of the functional portions of radio receivers, some 40 pages are devoted to servicing. T. H.

ASSOCIATIONS

(*Continued from page 29*)

sets, Mr. Connor stated, is oscillator drift. To counteract that difficulty, it is necessary to be vigilant of three things: 1) stable oscillator design; 2) a wide i-f band pass; 3) linear frequency detector. To date not enough gain nor sufficient oscillator stability has been achieved resulting in inadequate reception. Designing the oscillator circuit to work on a lower frequency automatically provides an improvement in frequency stability. This has been accomplished with the double superheterodyne circuit which has been used only on commercial equipment up to the present, but is now being made available for household sets.

Another circuit suggestion to overcome oscillator difficulty, Mr. Connor stated, is one suggested by James Day, assistant to Major Edwin Armstrong. It comprises a double oscillator one of which is a crystal oscillator. This set has lower drift and more gain.

Other subjects covered were; tuning systems that avoid microphonism and reduce frequency drift; double limiters for f-m receivers and audio feedback circuits.

Representatives attending the meeting from the Dale Radio Co. were sales manager Rene Jacobs and Charles Stern, Arthur Smalkin, Dean Ellner, Robert Tremaine, Norman Leeb, of the sales and service department. *Henry C. L. Johnson*

Rochester, N. Y., RTG

The RTG of Rochester held their second Annual Info.-Meet on Nov. 10, in conjunction with the Fall Meeting of the IRE and RMA engineers. In spite of poor mailing of notices, for which we extend our sincere apologies, the meeting was a success in every way.

Mr. Dorman D. Israel of the Emerson Co., Mr. Walter Jones of Sylvania, and Mr. A. C. W. Saunders of the New England RTG gave interesting, educational and worth while talks. The attendance was very good, many came from distant points.

We want to thank all who attended and promise a bigger and better meet next year.

A. H. Marsh, Secy.-Treas.

New Bedford, Mass., RTG

The Whaling City Chapter of the RTG held their regular meeting, Nov. 20, in Labor Temple.

After the regular business was completed, the secretary told of the Rochester Info-Meet and gave a review of the technical program for the meeting.

James L. Shepley, Secy.

Bulletins and Catalogs...

You cannot keep up to date in a rapidly advancing industry without reading the latest catalogs and bulletins published by the manufacturers who make up that industry. Radio is no exception. Sit down now and write for the literature listed below. It is up to the very minute and may be obtained without cost directly from the respective manufacturers.

• • • • A brief folder entitled "Pick-up Facts" contains 28 interesting statements concerning phonograph pickups, as gathered from the various radio publications. Available from Audak Co., 500 Fifth Ave., New York City.

• • • • The Cornell-Dubilier 1941 Radio Capacitor Bulletin No. 185A lists mica, paper, wet and dry electrolytics, Dykanol and other types of condensers for use in radio receivers. Ratings, sizes, dimensional drawings and prices are included for each type. Copies from Cornell-Dubilier Electric Corp., South Plainfield, N. J.

• • • • Everyone interested in the purchase of a slide rule should obtain a copy of "How to Choose a Slide Rule," by Don Herold. This 24-page booklet is a humorous publication describing the various Keuffel & Esser rules and the advantages of each. Copies directly from Keuffel & Esser Co., Hoboken, N. J.

• • • • Complete information on phototubes and their applications can be found in a 16-page booklet from RCA Manufacturing Co., Inc., Camden, N. J. The phototube's usefulness in various types of instruments is discussed. Circuits, characteristic curves, phototube theory and descriptive material is also contained in the publication.

• • • • Entitled "Radio's Moving Day," a booklet from RCA Manufacturing Co., Inc., Camden, N. J., offers suggestions to Service Men to take full advantage of the opportunity to get into 10 million homes to reset automatic push-button receiver controls—and to sell such other things as complete check-up, alignment, new tubes, antennae, portables and other accessories.

• • • • A 200-page general catalog has been issued by the Radio Service Laboratory of New Hampshire, 1191 Elm St., Manchester, N. H. The book contains listings on radio parts, sound equipment, test apparatus, etc.

• • • • An 8-page bulletin on "Radio Interference Elimination for Public Utilities is available to readers of SERVICE from Sprague Products Co., North Adams, Mass. Includes description of causes and cures of radio interference on power transmission and distribution lines as developed by Sprague engineers.

• • • • The 1941 edition of the Sprague Manual of Radio Interference Elimination has been issued by Sprague Products Co., North Adams, Mass. It is available directly from Sprague for 25c. Covers interference elimination for modern requirements, including data covering flourescent lighting interference.

• • • • The Fifth Edition of the Stancor Hamanual has been announced by the Standard Transformer Corp., 1500 N. Halsted St., Chicago, Ill. The 48-page, 2-color book describes 12 transmitters and 6 amplifiers in complete detail. Circuits and layouts are given in each case. In addition a line of power supply kits is also offered. Copies from Standard for 15c.

• • • • Ward Products Corp., Cleveland, Ohio, will supply upon request an antenna guide (Form No. WA107) for installations of 1941 auto antennae and complete information on the Ward Flex-Angle antenna Model E3-68 which is said to fit all 1941 cars.

WHEN YOU CHANGE YOUR ADDRESS

Be sure to notify the Subscription Department of SERVICE at 19 E. Forty-seventh St., New York City, giving the old as well as the new address, and do this at least four weeks in advance. The Post Office Department does not forward magazines unless you pay additional postage, and we cannot duplicate copies mailed to the old address. We ask your cooperation.

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Sound News...

Additional information on the products described below may be obtained, without obligation, directly from the respective manufacturers.

Astatic's Model UT48 crystal microphone, shown at right, is a high impedance type with an output of —48 db below 1 volt/bar. The frequency response is rising above 500 to a maximum at 3,500 cps. A tilting head is provided.

Astatic's Model FP18 and FP38 crystal pickups are of the low pressure type with rounded jewel point. Astatic Microphone Laboratory, Inc., Youngstown, Ohio.

ROSTRUM SOUND SYSTEM

The Erwood Rostrum portable p-a system has amplifier, speaker and microphone contained in a single case. Removal of the case cover gives access to a reading platform which is illuminated by a miniature lamp. Additional details may be obtained directly from Erwood Sound Equipment Co., 223 W. Erie St., Chicago.

RCA RECORDER

The RCA Type 73A recorder will cut at 33⅓ or 78 rpm from either the outside-in, or the inside-out, without changing lead screws or gears, at 96, 112, 120, 136 or 154 grooves per inch.

The recording head has a frequency response of from 30 to 10,000 cycles. The turntable is rim-driven by two motors operating simultaneously. A microscope is providing for observing the grooves as they are cut. A small shielded lamp is mounted on the adjustable microscope supporting arm to provide illumination directly under the microscope's lens. General illumination for the unit is provided by a lamp supported on a long flexible goose neck.

The 73A also incorporates an adjustable suction nozzle to draw away shavings from the cutting head. A suction pump and coupling hose are available on separate order.

SHURE MICROPHONE

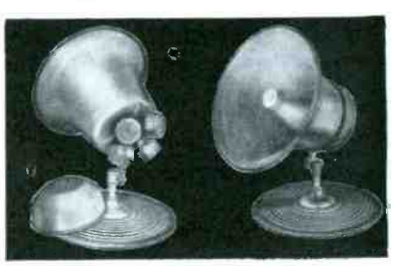
Another Stratoliner, the Model 708SH has been announced by Shure Brothers, 225 W. Huron St., Chicago. This model is designed for phone and speech applications. Output level, minus 29.7 db below 1-volt-per-bar; built in r-f filter; genuine Bimorph crystal; die cast case.

TURNER ELECTRONIC PICKUP

The Turner Co., Cedar Rapids, Iowa, is marketing a magnetic unit for electronic pickup from stringed instruments. The unit may be clamped to violins, banjos, guitars, etc.

UNIVERSITY BULL SPEAKER

University's Model 4XR reflexed exponential horn type speaker is designed for 100-watts of continuous audio power. The reflex projector is acoustically equivalent to a 6-foot straight exponential horn and is made non-resonant by the use of a rubber tired rim on the edges of both the large and small bells. The driver units for this speaker consist of four University standard 25-watt units. These units are connected through a balanced multiple acoustic drive line to the horn itself. The speaker is waterproofed for outdoor use and is supplied with a universal mounting



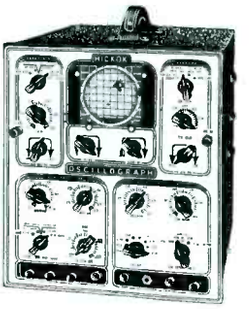
bracket and driver unit cover. Additional information from University Laboratories, 195 Chrystie St., New York City.

New Test Equipment

Additional information and prices of the equipment described below may be obtained, without obligation, from the respective manufacturers.

HICKOK OSCILLOGRAPH

Hickok Model RF05 is designed for visual analysis for frequency modulated, amplitude modulated and television service work. Has self contained wide-band f-m oscillator for f-m and television servicing and a narrow band f-m oscillator for a-m receivers. Also demodulator, video amplifiers, signal tracer and visual a-c vtvm from 0.2 to 1,000 volts, it is said. Hickok Electrical Instrument Co., 10308 DuPont Ave., Cleveland, Ohio.



Sprague's Model IL2 interference locator is a sensitive device for the location and isolation of radio interference. It operates either from self-contained batteries or from a-c or d-c power lines. It is equipped with a directional loop which is mounted on the cabinet top when in use, or carried within a cover recess when transported. Sprague Products Co., North Adams, Mass.

GENERAL PEN-OSCIL-LITE

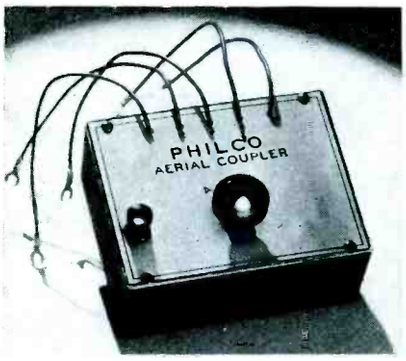
General Test Equipment Co., 213 Crosby Ave., Kenmore, N. Y., have introduced their Pen-Oscil-Lite, a multivibrator type of oscillator self-contained and fully powered in a small pen-lite type case. The unit consists of a high frequency buzzer and battery supply and will generate useable oscillations of the impact excitation type down to the very short waves. Additional information may be obtained directly from General.

New Products . .

TURNER TO MAKE VIBRATORS

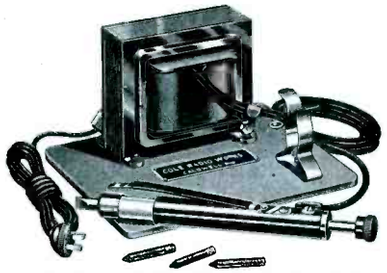
The Turner Co. announces that it is now licensed to manufacture vibrators for car and other portable radios under James Patents No. 1,940,496 and No. 2,113,726 and other patents pending.

Turner will be in production and ready to make delivery Jan. 1, 1941.



Coupling a signal generator to a loop operated receiver for alignment purposes is usually a complicated and often a makeshift arrangement. In an effort to simplify this requirement, Philco has introduced a special aerial coupler shown above. Alignment will be more accurate through the use of this device, it is said. Philco Corp., Allegheny and A Streets, Philadelphia, Pa.

Electro Products Labs., 549 W. Randolph Street, Chicago, are marketing a line of power supplies for the operation of 1.4- and 2-volt receivers from the power lines. Several types (see illustration above and below) are available to meet practically every current drain, it is said. The output voltages are connected to numerous socket arrangements to accommodate the many plugs used on battery receivers in the past few years.



A. B. Cole, Caldwell, N. J., has introduced a quick soldering device for use on the service bench. It employs a special transformer and is said to concentrate the heat at the point of soldering. Several types of tips are supplied.

SPRAGUE PLUG-IN FILTER

Sprague Products Co., North Adams, Mass., have designed the LF2 plug-in radio interference filter, a multiple section inductance and capacity filter for use at the power outlet to which an interfering electrical device is connected. The LF2 can

be employed with electric shavers, hair dryers, erasing machines and similar electrical equipment drawing up to ½ ampere.

Index to Advertisers

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That's why the country's top servicemen—the men who know servicing best—will tell you: "Once you've tried signal tracing with the Chanalyst, you'll never go back to slow, old methods of set-fixing! It's easier. Faster. It gives you more free time to build business because it takes *less* time to fix sets!"

Greatest advance in servicing since servicing began, the RCA Rider Chanalyst is the original signal-tracing instrument—still far and away the best! Learn the facts for yourself—ask your RCA Distributor for on-the-circuit *proof* of the Chanalyst's superiority . . . see it in action on the RCA Dynamic Demonstrator.

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RCA JUNIOR VOLTOHMYST

Electronic Volt-Ohmmeter $34.95

SERVICING radios at best takes brains . . . and aptitude . . . and hard work! But why make the job *harder* by working with inadequate equipment? This great new d-c *Electronic* push-pull volt-ohmmeter costs only $34.95 complete —and look how much you get:

11,000,000 ohms constant input resistance on d-c volts—you can check oscillator-voltages at the grid of the tube with the circuit functioning, the signal present! And even on extreme d-c voltage overloads, the Junior VoltOhmyst has maximum meter protection! Sensitivity is as high as 3,666,666 ohms per volt—6 d-c ranges to 1,000 volts—you can read AVC, AFC, and FM Discriminator voltages accurately—measure bias-cell voltages without harmful drain.

As an ohmmeter, the Junior VoltOhmyst reads from 0.1 ohm to 1,000 megohms . . . without leads to short or zero-point resettings. You can check insulation or condenser leakages accurately, easily, quickly! For extra convenience, there's an a-c Voltmeter too—rectifier-type 1,000 ohms-per-volt, that reads to 1,000 volts a-c. See it at your RCA Distributor's TODAY!

RCA

Test Equipment

RCA MANUFACTURING COMPANY, INC., CAMDEN, N. J.
A SERVICE OF THE RADIO CORPORATION OF AMERICA