WAR DEPARTMENT TECHNICAL MANUAL TM 11-620

RADIO SETS

SCR-608-A AND SCR-628-A

WAR DEPARTMENT • 1 JANUARY 1944

SECTION III. FUNCTIONING OF PARTS

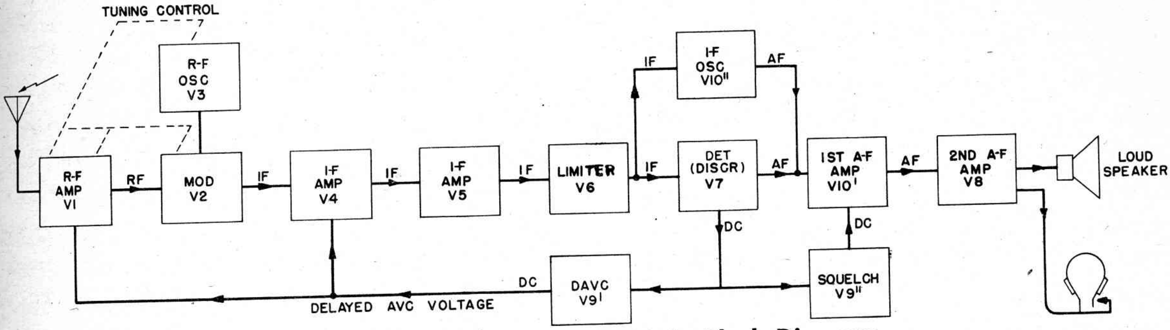


Fig. 24. Radio Receiver BC-683-A: Block Diagram

23. Functioning of Radio Receiver BC-683-A.

a. General Circuits Used. A block diagram of Radio Receiver BC-683-A is shown in Fig. 24.

The receiver employs the superheterodyne principle of operation. The high-frequency circuits include one stage of tuned radio-frequency amplification (V1), a modulator (V2), and a radio-frequency oscillator (V3). The intermediate-frequency amplifier comprises two stages (V4 and V5), the second of which (V5) provides some limiting action on strong signals. The limiter stage (V6) not only functions as a limiter on moderate signals, but it also reduces amplitude modulation. The detector or discriminator (V7) is followed by two stages of audio-frequency amplification (V10′ and V8). An intermediate-frequency oscillator (V10″) permits checking the receiver tuning. A single dual-purpose vacuum tube (V10) functions as the first audio stage (V10′) and the intermediate-frequency oscillator (V10″). A second dual-purpose tube (V9) provides delayed automatic volume control (V9′) and "squelch" (V9″) which suppresses noise by disabling the receiver output when no signal is being received.

b. Schematic, Wiring, and Apparatus Location Diagrams. Complete schematic, wiring, and apparatus location diagrams are shown in Figs. 43, 44, 45, 46, 71, and 72. The system schematic, Fig. 69, shows (with some of the minor details omitted) the general arrangement of the control circuits; this drawing will be useful in studying the basic operation of these circuits.

c. R-f Amplifier, Modulator, and R-f Oscillator. Figure 25 is a functional diagram of the radio-frequency amplifier (V1), modulator (V2), and radio-frequency oscillator (V3) circuits.

The antenna is coupled to the input of the radio-frequency amplifier stage by the antenna tuning unit, LCU1A. Current flowing through the primary winding LCU1A induces a voltage across the tuned secondary winding. The voltage thus developed is impressed between the grid and cathode of V1 through by-pass capacitor C35. Decoupling resistor R37, along with this capacitor, prevents interstage coupling through the automatic-volume-control wiring. These by-pass capacitors are needed because the d-c grid return is made to the automatic-volume-control lead instead of to ground. The amplified radio-frequency voltage from V1 is impressed across the tuned primary winding of the interstage tuning unit, LCU2A, through by-pass capacitor C39. Trimmer capacitor C1.1 is used to compensate for variations in the antenna systems of various installations.

Current flowing through the tuned primary winding, L33, induces a voltage across the tuned secondary winding, L34, that is impressed between the grid and the cathode of the modulator tube V2, through by-pass capacitor C3. Capacitors C36 and C38 provide temperature compensation. The bias potential for V2 is determined by the cathode resistor, R3.

The signal frequency, 27.0 to 38.9 megacycles, is converted to the intermediate fre-

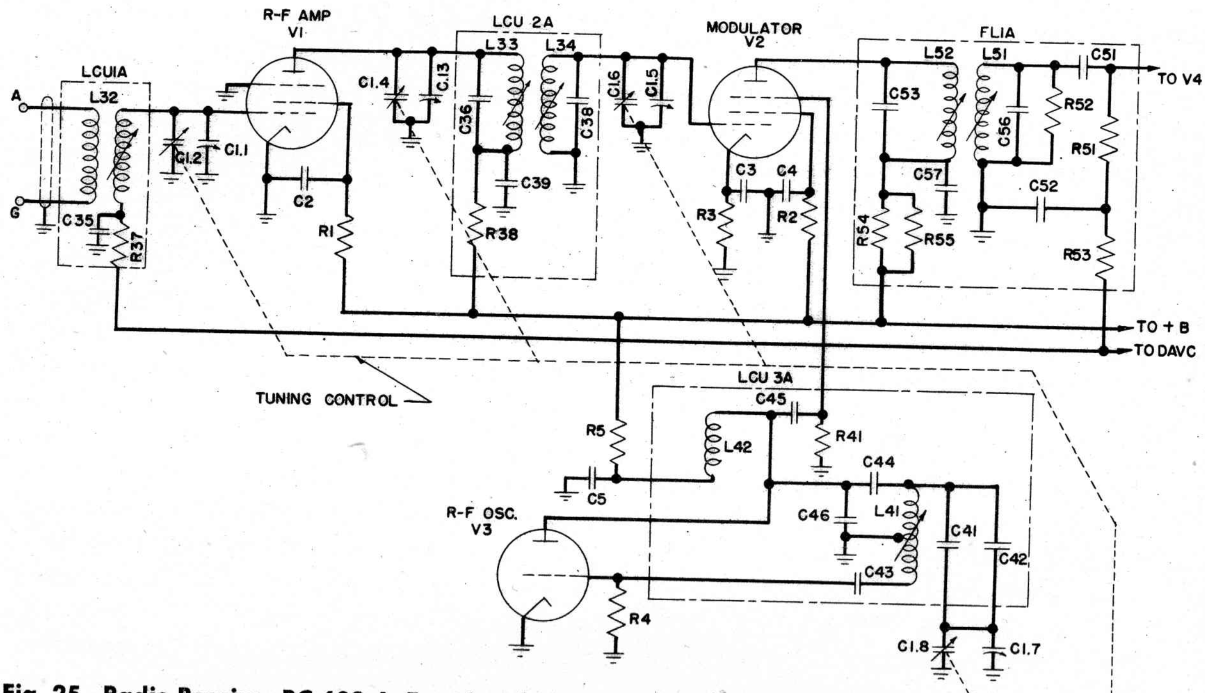


Fig. 25. Radio Receiver BC-683-A: Functional Diagram of R-f Amplifier, Modulator, and R-f Oscillator

quency, 2.65 megacycles, by heterodyning between the signal-frequency voltage and a frequency (2.65 megacycles higher) derived from the radio-frequency oscillator, V3, in the modulator (or mixer) tube, V2. The radio-frequency oscillator voltage is supplied to the suppressor grid of V2. Several modulation frequencies are available in the output of V2; but the first intermediate-frequency filter, FL1A, selects the lower sideband and rejects the undesired frequencies.

The radio-frequency oscillator employs a shunt-fed Hartley circuit. The oscillator embodies three negative coefficient capacitors C42, C44, and C46 in order to compensate for temperature changes and to enable the oscillator to maintain a high degree of frequency stability. Capacitors C41 and C42 are padding capacitors and capacitor C44 is a blocking capacitor. Energy fed back to the grid circuit through coupling capacitor C43 causes the tube to oscillate. Rectified grid current passing through grid leak resistor R4 provides grid bias for V3.

Radio-frequency voltage for the suppressor grid of V2 is derived from the plate circuit of V3 through a coupling capacitor, C45. Resistor R5 and capacitor C5 prevent radio frequency being fed from the plate of V3 to the plus B lead. L42 is the oscillator plate choke inductor.

Capacitors C1.2, C1.4, C1.6, and C1.8 are ganged to permit simultaneous adjustment of all four tuned circuits. Alignment of the circuits is assured by trimmer capacitors C1.1, C1.3, C1.5, and C1.7 and adjustable iron dust slugs in inductors L32, L33, L34, and L41.

d. I-f Amplifier and Limiter. The essential circuits of the intermediate-frequency amplifier and limiter stages are shown in Fig. 26. Band-pass filters FL1A, FL2A, and FL3A suppress undesired frequencies outside an 80-kilocycle transmission band which is centered at 2.65 megacycles, the intermediate frequency. Each filter is aligned by the adjustment of a magnetic core within each coil. Resistors R52, R62, and R72 in the three filters aid in securing the desired band-pass frequency characteristic.

Intermediate-frequency filter units FL1A, FL2A, FL3A, and FL4 are all provided with temperature compensation in the form of ceramic capacitors with negative temperature coefficients. See Paragraph 43*b(10)*.

The arrangement used in later production is shown in Fig. 26. Capacitors C53, C56, C63, C66, C73, C76, and C87 are all negative coefficient ceramic capacitors with a nominal capacitance of 60 micromicrofarads. In each case, the capacitor compensates for the positive temperature coefficient of the coil across which it is connected.

The details of the filters used in earlier production are shown in Fig. 70. In this case, the resonating capacitance for the coils was secured by the use of two parallel capacitors: a 50-micromicrofarad molded mica unit and a 10-micromicrofarad ceramic unit. This latter unit was so constructed that its negative coefficient compensated for the positive coefficients of both its associated coil and the mica capacitor.

The first intermediate-frequency amplifier (V4) is subject to delayed-automatic-volume-control action, its grid bias being supplied through decoupling resistors R51 and R53. The remaining potentials applied to the vacuum tube are such as to allow the tube to operate as a conventional amplifier.

The second intermediate-frequency amplifier (V5) differs from the first in the method of grid bias supply and in the relationships between the screen and plate operating potentials. The signal voltage developed across the secondary (L61) in FL2A is applied to the control grid of V5 through coupling capacitor C61. Grid bias is supplied through the decoupling resistor, R63, and the grid leak resistor, R61, from the negative high-voltage lead. The plate decoupling resistor, R74, is returned to the voltage divider at the common function of R21, R28, and R29; the plate voltage, under no-signal conditions, is approximately 60 volts. As a result of this low plate-supply voltage, the output of this stage is limited to a relatively low amplitude, even with a large input from the first intermediate-frequency stage. (Positive peaks are limited by plate saturation conditions; negative peaks are limited, or "clipped," by plate cutoff.)

The screen of V5 is connected to the plate return of the first intermediate-frequency stage (V4) through dropping resistor R8. Under the no-signal condition, the screen potential is approximately 90 volts. This results in a fairly high-voltage gain on weak signals in spite of the low plate voltage. On strong signals, however, the increased screen current causes a relatively large voltage drop in resistor R8 (70,000 ohms); this reduces the screen potential, thereby reducing the gain. Consequently, the screen circuit serves as a form of automatic gain control.

On strong signals, rectified grid current flowing through R61 and R63 holds a negative charge on capacitor C61. The values of R61, R63, C61, and C63 are such that their time constant is high with respect to the intermediate frequency. As the input signal swings positive in each half cycle, grid current flowing through R61 charges C61. The charge is retained during the negative half cycle because of the high time constant. The negative bias from the rectified grid current flowing through R61 and R63 limits the positive swing on the grid of V5, thus limiting the peak excitation. The negative half-cycle swings are limited by the cutoff of the tube, which has been fixed by the plate voltage selected. The receiver is frequently required to operate with an extremely wide range of signal strengths impressed on the antenna. A peak limiter which is effective on moderate signal strengths tends to overload and fall off in output for very strong signals. To avoid this possibility the peak limiting action mentioned above is provided in the second intermediate-frequency stage to reduce the range over which the limiter stage (V6) is required to function.

The limiter stage (V6) uses two separate types of limiting action: (1) overload (peak) limiting, as just described, and (2) feedback limiting. The fixed grid bias obtained from the voltage drop across R24 is sufficiently large to give a degree of plate detection prior to overload, which is important in feedback limiting.

The overload method establishes a ceiling which the output cannot exceed. On received voltages big enough to reach this ceiling this method keeps the output uniform and thus cuts off disturbances which would tend to increase the output irregularly. It does not, however, have any limiting effect on signals which do not reach this ceiling.

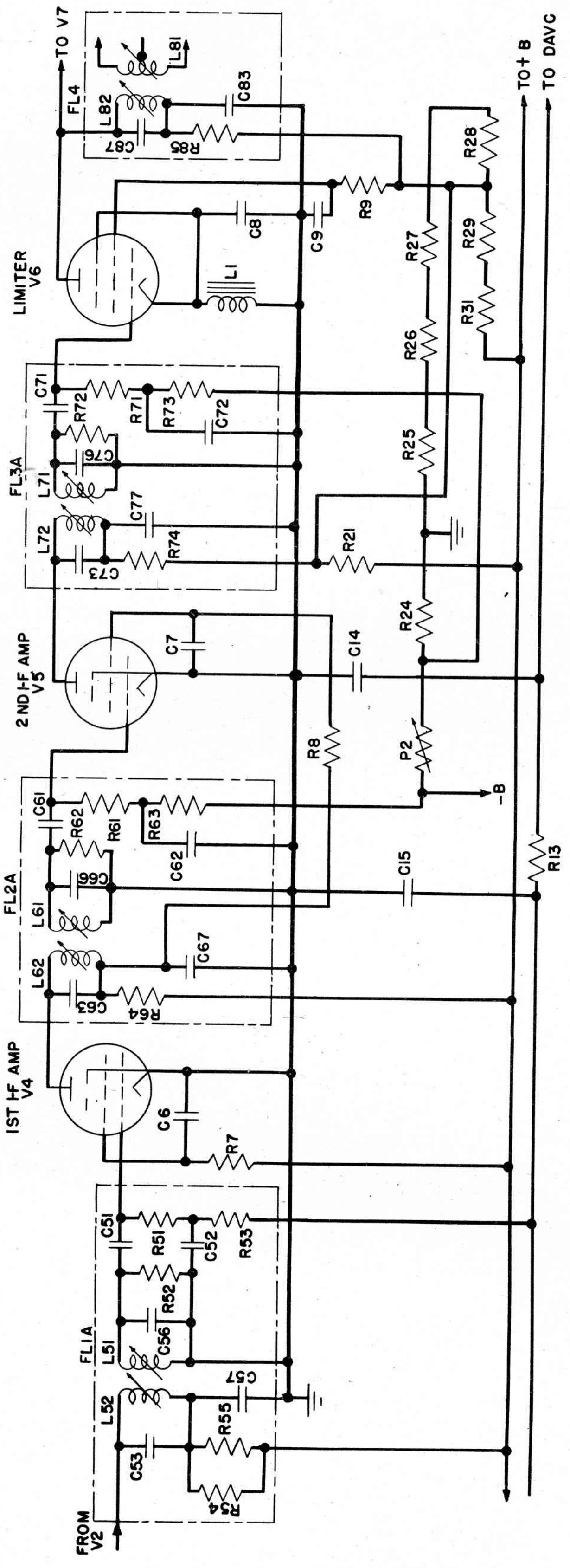


Fig. 26. Radio Receiver BC-683-A: Functional Diagram of I-f Amplifier and Limiter

The feedback method is based on the idea of balancing out a disturbance in the audio-frequency range by means of an equal and opposite impulse. This is very effective on disturbances of an audio-frequency nature which are not large enough to be taken care of by the overload limiter. It is less effective but still helpful in the range between signals strong enough to start partial peak limiting and those of sufficient amplitude to cause complete peak limiting. The negative feedback method operates by means of the coil L1 and the small parallel capacitor C8, presenting a low radio-frequency impedance and a high audio-frequency impedance. Coil L1 is connected in series with the cathode of V6 and low-frequency amplitude variations in the plate circuit flow through this coil. The effect of this current flow is to develop a voltage across the coil between ground and the cathode. This voltage is therefore effectively applied across the grid-cathode circuit of the tube. The voltage developed across the coil and applied to the cathode opposes the effect of the audio-frequency variations in the grid circuit. When the grid voltage increases at an audio-frequency rate due to an increase in the undesired "ripple," the cathode bias will oppose the increase. When it decreases due to a decrease in the ripple, the bias will oppose the decrease. This action tends to smooth out the ripple. Amplitude variations at the carrier frequency will be by-passed by the capacitor C8 and will produce negligible feedback. At frequencies below the audible range the cathode choke L1 represents negligible impedance and does not affect the bias of the tube. For these slower changes the delayed automatic volume control is effective provided the signal is sufficiently large to overcome the delay bias. On the other hand, delayed automatic volume control does not respond to audio-frequency changes in amplitude, due to automatic-volume-control filter circuits.

In this discussion the noise producing disturbance has been considered as a single frequency having a more or less steady value. In practice, however, the disturbance will probably consist of a number of varying frequencies of varying amplitudes. As long as the disturbing frequencies interact with the carrier to produce frequencies which are in the audio range (and the amplitude is not large enough to reach the ceiling of the peak limiting action), feedback caused by the coil will occur and smoothing of the ripple will be produced.

*e. **Discriminator.*** The purpose of the discriminator is to transform the received intermediate-frequency currents (which are frequency-modulated) into amplitude variations at audio frequencies. A functional diagram is shown in Fig. 27a.

The discriminator uses the phase shift between the primary and secondary windings of the intermediate-frequency transformer at the input of V7. Look at the diagram, Fig. 27a; the signal voltage across the primary L82 is shown as E_P. The tapped secondary winding L81 is shown as two windings in series. The induced voltage across these two windings is shown as E_S. Voltage E_S is developed across the capacitors C85 and C86 in series. Since C85 and C86 are very closely matched, their junction is at the same voltage as the midpoint of the secondary tuned circuit of FL4. The voltage across C85 is impressed on one diode (terminals 5 and 8 of V7). The return path is through capacitors C20.3 (which is paralleled by C82), ground, C83, C87 (which is paralleled by C88), and back to the junction of C85 and C86. The other half of the secondary voltage (developed across C86) is impressed on the other diode (terminals 3 and 4 of V7). The return is through C81, C20.3, ground, C83, C87, and back to the junction of C85 and C86.

In addition to these secondary voltages, the primary voltage is also impressed on these two diodes. The junction of C85 and C86 also connects directly to the plate of V6 (the limiter). The primary voltage is developed from this point to ground. Thus, E_P is impressed across a circuit consisting of C85, then the diode (terminals 5 and 8 of V7), then C20.3, to ground. The path through the other side of V7 is through C86, through terminals 3 and 4 of V7, through C81

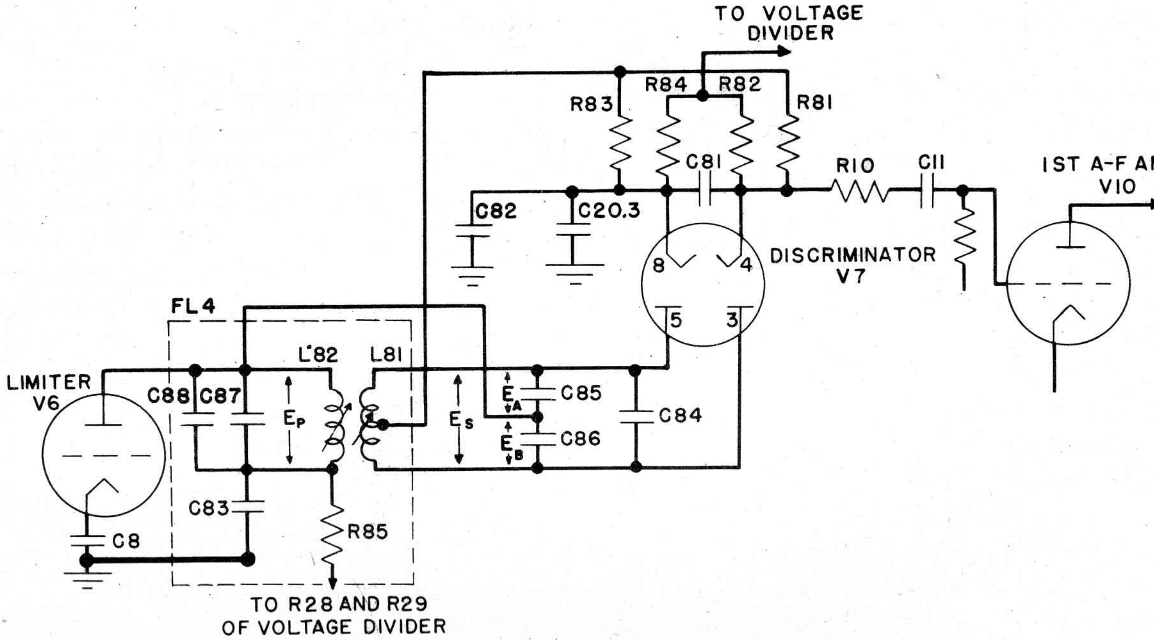


Fig. 27a. Radio Receiver BC-683-A: Functional Diagram of Discriminator

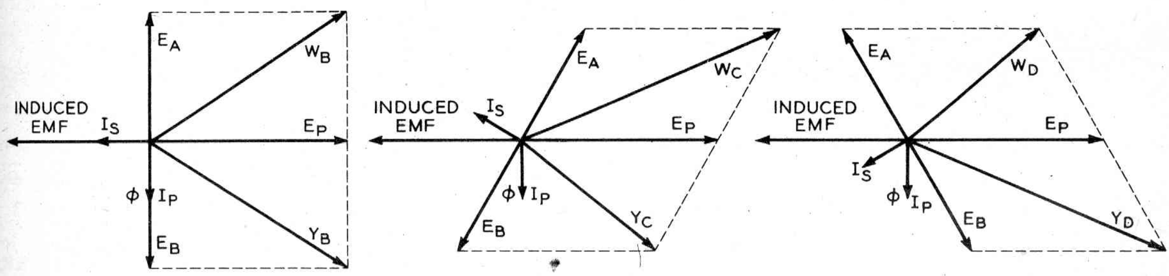
and C20.3, to ground. These are all a-c paths. Since a diode is a tube that is unidirectional, that is, current flows in only one direction, these impressed alternating currents are rectified and this direct current flows through resistors R81 and R83 to the tap at the middle point of L81. This is merely a d-c return.

From this description, it is seen that each diode has impressed on it the primary voltage developed across C87 in series with one half the secondary voltage developed across C85 and C86.

The action of the discriminator depends upon the phase relations between these voltages. At resonant frequency (see Fig. 27b), E_A and E_B are each almost exactly 90 degrees out of phase with the primary voltage E_P. Consequently, W_B, the total voltage across R83, and Y_B, the total voltage across R81, are equal in magnitude; since the rectified voltages appearing across the two resistors are opposite in sign, the resultant d-c voltage is zero. When the impressed signal is either above or below the resonant frequency, however (see Figs. 27c and 27d), the 90-degree phase relationship no longer holds, and the d-c voltages across R83 and R81 no longer balance out. The net result is that the discriminator output voltage follows the variations in frequency of the incoming signal; the original frequency modulation is translated into amplitude modulation of the discriminator output voltage. This voltage is then impressed upon the grid of the first audio-frequency amplifier tube.

A somewhat more detailed explanation of the discriminator phase relations follows: Consider first the conditions when the output of the intermediate-frequency amplifier and limiter is at the resonant frequency to which both the primary and secondary circuits of FL4 are tuned. This is the case when the signal from the distant transmitter is at the mean or resting carrier frequency (i.e., no modulation is taking place). Voltage E_P (see Fig. 27b) exists across primary winding L82; the primary current, I_P, lags E_P by very nearly 90 degrees; the resulting flux, ϕ, which links the secondary winding is exactly in phase with the current, so it also lags 90 degrees behind the voltage, E_P. Now this flux induces, in secondary winding L81, an electromotive force which drives a current, I_S, through the secondary circuit. (Note that this electromotive force or inducing voltage is *not* E_S, the secondary voltage which would be measured by a voltmeter connected across the secondary winding.) The *induced* electromotive force lags the inducing flux by 90 degrees; it therefore lags the primary voltage, E_P, by 180 degrees, as shown in Fig. 27b.

As mentioned before, the secondary circuit is resonated exactly to the frequency of the signal; consequently, the impedance which is presented to the induced electromotive force is a pure resistance and the resulting current, I_S, is in phase with the electromotive force, as indicated in Fig. 26b. Now consider voltages E_S, E_A, and E_B. Since secondary winding L81 is a nearly pure inductance, the voltage, E_S, appearing across its terminals will be almost in quadrature (90-degree phase relation) with the current through it. But the two components of E_S, namely, E_A and E_B, higher than resonance; the essential phase relations within the discriminator circuit are shown in Fig. 27c. The relations of E_P, I_P, ϕ, and the induced electromotive force in the secondary are as they were in the case of resonance. Now, however, the impedance presented to the induced electromotive force is no longer purely resistive; it has an inductive component and consequently the secondary current lags the electromotive force. Consequently, E_A and E_B are related to E_P as indicated in the figure and the voltages across R83 and R81 (W_C and Y_C, respectively) are no longer equal in magnitude; they do not cancel out.



27b. AT RESONANCE 27c. ABOVE RESONANCE 27d. BELOW RESONANCE

Figs. 27b, 27c, 27d. Radio Receiver BC-683-A: Vector Diagrams Showing Phase Relations in the Discriminator for Variations in Received Frequency

are 180 degrees out of phase with each other (remember that each is measured with respect to the mid-point of the two capacitors, or, what is the equivalent, the center tap of the secondary coil). It follows, then, that one of the two voltages must lead I_S by 90 degrees and the other must lag by 90 degrees, as indicated in Fig. 27b.

As explained previously, the total voltage impressed upon the left-hand diode of V7 is made up of E_P (across C87) in series with E_A (across C85); the total voltage impressed upon the right-hand diode is made up of E_P in series with E_B (across C86). These total voltages are shown in Fig. 27b as W_B and Y_B, respectively. It will be noticed that under the condition assumed (namely, the tuned circuits resonant at the frequency of the impressed signal), the absolute magnitudes, or lengths, of W_B and Y_B are the same.

Now assume that the signal frequency is

When the signal frequency is below resonance the phase relations are as shown in Fig. 27d. The series impedance of the secondary circuit is capacitive and accordingly the secondary current, I_S, leads the induced electromotive force with the result shown. Notice that whereas in the preceding case (frequency above resonance) W_C was greater than Y_C, in this case, Y_D is greater than W_D.

The functions of the various units are described as follows: The tuned circuit comprising L82, C87, and C88 tunes the plate circuit of the limiter tube V6 to the intermediate frequency. The capacitors C83 and C8 in series complete the intermediate-frequency circuit between plate and cathode. C88 provides temperature compensation for C87 and L82. The primary winding, L82, is adjusted for exact resonance at the intermediate frequency by means of an iron dust tuning slug. Plate voltage is applied to the limiter tube, V6, through the decoupling resistor R85 from the junction of R28 and R29 on the voltage divider. L81 (the tapped secondary), which is coupled to L82, is resonated with capacitors C85, C86, and C84. (C84 is small and provides temperature compensation for the tuned circuit.) This secondary tuned circuit feeds through the double diode V7 to the load resistors R81 and R83 of the discriminator. Capacitor C81, connected across resistors R81 and R83, serves as an intermediate-frequency by-pass and also contributes somewhat to the shaping of the audio-frequency response characteristic. (R82 and R84 are discussed in connection with the automatic-volume-control and squelch circuits; they play no part in the discriminator action.)

One side of the discriminator load circuit is connected to ground through the radio-frequency by-pass capacitor C82 and the audio-frequency by-pass capacitor C20.3 connected in parallel. The other side of the discriminator load circuit connects to the audio-frequency amplifier through series resistor R10 and coupling capacitor C11.

f. Voltage Divider. The voltage divider which is shown in the lower part of Fig. 29 serves three general functions:

(1) It constitutes a bleeder across the high-voltage direct current from the filter to discharge the capacitors when the power supply is not in use.

(2) It provides the reduced positive voltages required by the second intermediate-frequency amplifier, the limiter, the delayed-automatic-volume-control, and the squelch circuits.

(3) It provides negative grid bias for the radio-frequency and intermediate-frequency amplifiers as well as the limiter.

Current flowing from the positive brush of the dynamotor must pass through audio- and radio-frequency choke coils and through R31, R29, R28, R27, R26, R25, R24, and P2 (provided the SQUELCH switch is in the ON position) to the negative brush of the dynamotor. It will be noted that R29 (13,000 ohms) and R31 (6,800 ohms) in series are shunted by R21 (30,000 ohms); this is, electrically, the equivalent of a single resistor of 12,000 ohms. The combination of three resistors is used, rather than a single 12,000-ohm resistor, because of convenience in mounting and heat dissipation. The junction points between the resistors provide taps giving various voltages which are progressively less positive going from R31 to the junction point of R24 and R25, which point is grounded. (It is useful to bear in mind that neither terminal of the dynamotor is grounded.) The voltage becomes progressively more negative as we go from the ground point through R24 and P2. These two resistors are in the circuit which supplied bias to the grids of the first two amplifier tubes. R24 is fixed but P2 is adjustable. Since an increase in this resistance causes an increase in the voltage developed across it, an adjustment of P2 changes the negative bias applied to the first two amplifying tubes and thus changes the sensitivity of the receiver.

g. A-f Amplifier. A functional diagram of the audio-frequency amplifier is shown in Fig. 28.

The audio-frequency output of the discriminator is developed across the load (R81 and R83 in series) as described in Paragraph 23*e*. It is connected through the series resistor R10 and series capacitor C11 to the grid of vacuum tube V10′. The other side goes to ground through the radio-frequency by-pass capacitor C82, which has C20.3 shunted across it to reduce the audio-frequency impedance of this part of the ground return. The circuit to the cathode of V10′ is through C20.2. Capacitor C13 is shunted from the grid of V10′ to ground and shapes the audio-frequency response curve. The resistor R10, in conjunction with C13, is a radio-frequency filter which among other things prevents intermediate-frequency currents from appearing on the grid of V10′. C11 is an audio-coupling capacitor. C26 is part of the intermediate-frequency oscillator circuit. Plate current flowing through cathode resistor R12 serves to bias the grid of V10′ when the receiver is operated with the SQUELCH switch at OFF. Since R12 is not by-passed there will be a small amount of negative feedback in the first stage of this audio amplifier which causes some reduction in the gain of V10′. (Negative feedback is incorporated in this circuit not primarily to reduce distortion but rather to reduce the gain of V10′, the full amplification of which is not required for this application.) Grid return is completed through the grid leak R11 and the squelch circuit resistor, R17, to one side of R12.

The function of R17 is described in Paragraph 23*i*. A portion of the SQUELCH switch D4 connects the junction of R12 and R17 to ground when the SQUELCH switch is at OFF (removing any additional bias that might be developed across R17 by the squelch circuit). The plate circuit of V10′ connects through R18 and R19 to the B supply voltage, which is by-passed to ground by C16. The 2-megohm resistor R19 is shunted by the CALL SIGNAL lamp E1, a neon lamp which has an impedance of about 200,000 ohms when normal lighting current is passing through it. When a signal is received the plate current flows and develops a voltage across R19, which increases up to the breakdown potential of the lamp. The lamp then breaks down, greatly reducing the impedance in series with the plate and lighting the lamp. At normal signal levels, the plate current variations of V10′ are not sufficient to extinguish the CALL SIGNAL lamp. At very high signal levels, which normally cause overloading, the lamp may be extinguished over part of the cycle due to that overload. This condition results in some distortion which is not usually objectionable.

The plate of V10′ is connected through the coupling capacitor C21 to one side of the volume control P1, the wiper of this control being connected directly to the control grid of the second audio amplifier (beam power). V8. The grid circuit of V8 is completed from the other side of the volume control P1 to the minus B lead. A high-capacity electrolytic capacitor, C23, prevents audio-frequency feedback across the cathode bias resistor R20, which connects to the minus B lead. Capacitor C19 is connected across P1 to reduce further the higher audio frequencies, and to prevent the possibility of pickup of unwanted intermediate-frequency currents which might otherwise be amplified by V8.

The value of C21 as well as the value of C11 previously referred to were chosen to reduce the gain of the audio amplifier at frequencies below 400 cycles.

The screen grid supply for V8 is obtained

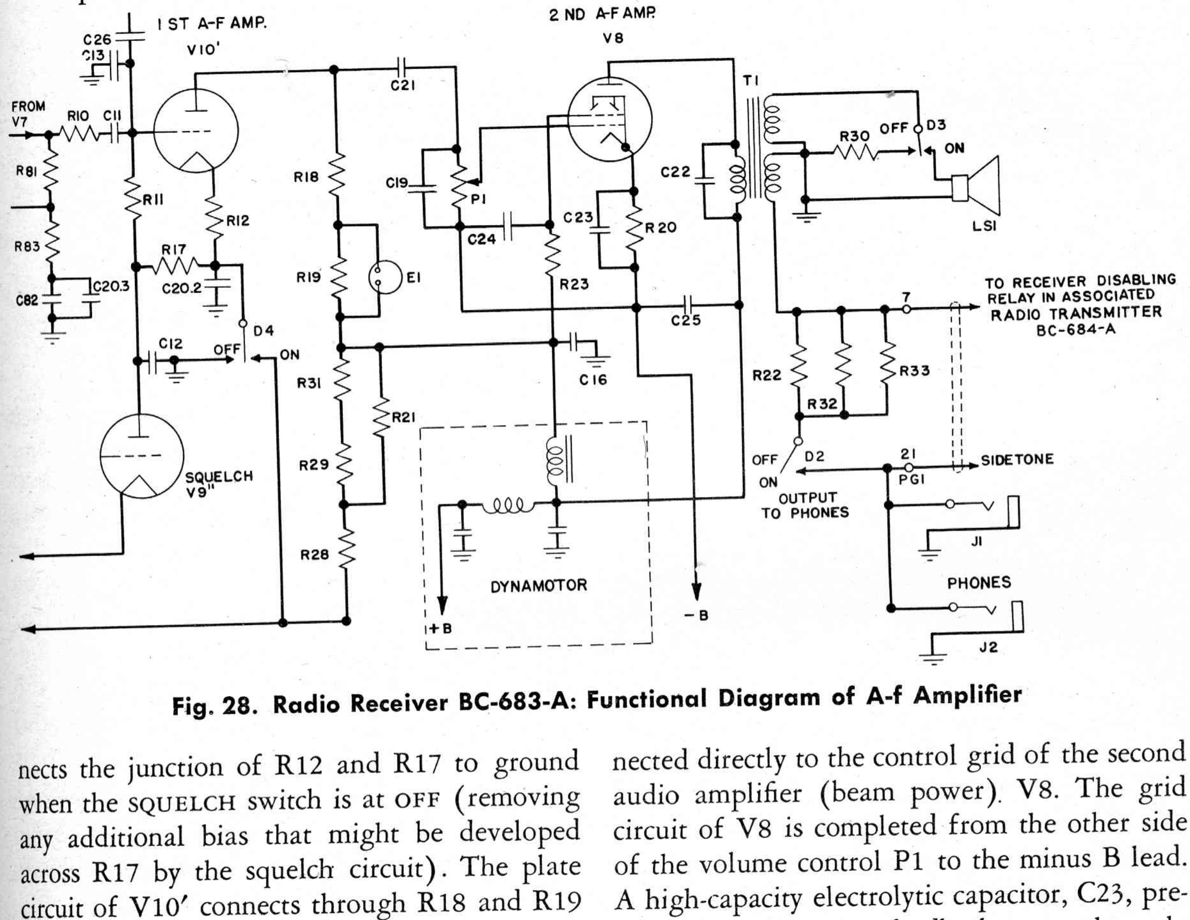


Fig. 28. Radio Receiver BC-683-A: Functional Diagram of A-f Amplifier

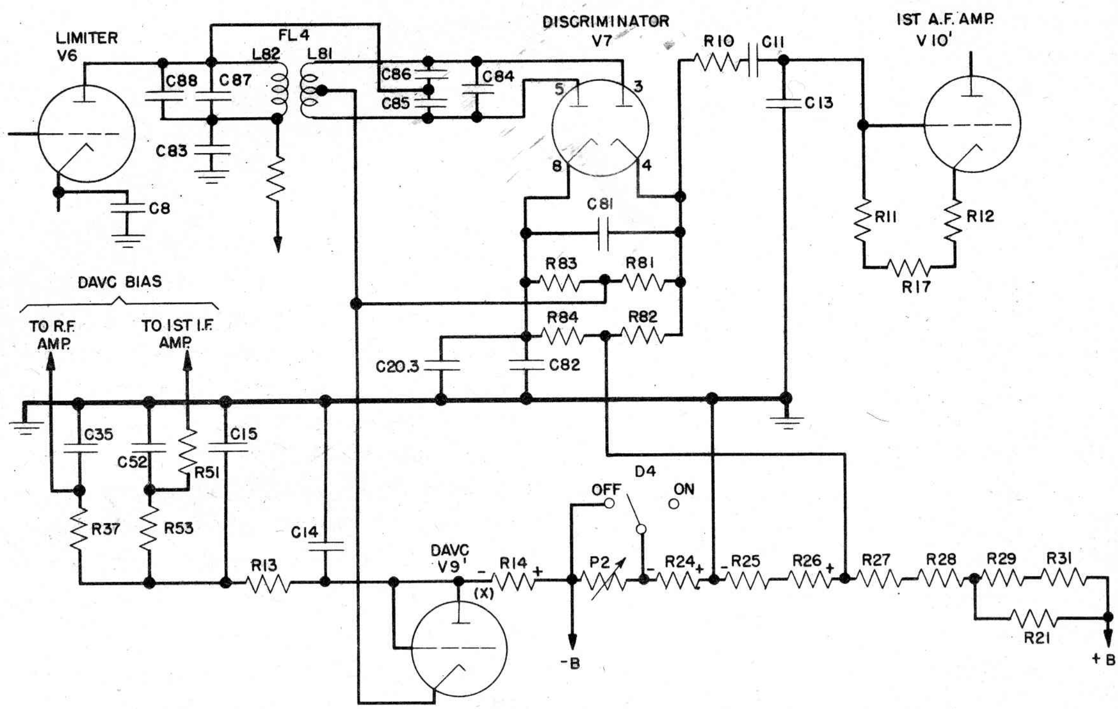


Fig. 29. Radio Receiver BC-683-A: Functional Diagram of Delayed-automatic-volume-control Circuit

through the series resistor R23 from the plate power-supply circuit. Capacitor C24 is the screen by-pass capacitor. The plate circuit of V8 is connected through the primary winding of the output transformer T1 to the power supply which is by-passed at this point by capacitor C25 to complete the return circuit to the minus B lead.

Capacitor C22, connected across the primary winding of the output transformer T1, serves to reduce the higher audio frequencies. It also serves to reduce transient voltages that may be developed in the plate circuit of V8 under overload conditions, which would tend to drive the grid voltage beyond cutoff. The bias for V8 is developed by plate current flowing through the cathode resistor R20. One of the secondary windings of the output transformer T1 may be connected through the speaker switch D3 to the loudspeaker. With switch D3 at OFF, resistor R30 is connected across this winding to prevent changes in headset level taking place when the loudspeaker is turned on and off. Resistor R30 also provides a constant load on the output of V8, further reducing effects of transient voltage.

The remaining winding of the output transformer T1 connects through the parallel resistors R22, R32, and R33 to the OUTPUT TO PHONES switch D2. This switch connects in turn to the PHONES jacks J1 and J2. (A parallel connection is provided from these jacks to terminal 21 of the plug PG1.) The return circuit to this winding is completed through ground from J1 and J2. The series resistors R22, R32, and R33 in this circuit prevent the sidetone circuit (which is also connected to the PHONES jacks J1 and J2 through terminal 21 of PG1) from being short-circuited by the disabling relay in the transmitter. The disabling relay in the associated transmitter functions during periods of transmission to short-circuit this latter winding of T1.

When background noise is high, particularly at the point of transmission, the operator should make sure to talk directly into his microphone in a loud tone of voice in order to override local noise. This will increase the volume of the receiver output considerably. Under actual service conditions the overloading due to loud talking does not reduce the degree of intelligibility very much, but the decreased volume caused by failure to talk loudly and directly into the microphone will often result in poor reception of your signals.

b. Delayed-automatic-volume-control Circuit. A functional diagram of the delayed-automatic-volume-control circuit is shown in Fig. 29.

As already mentioned it is very important that the signals reaching the discriminator be of uniform amplitude. In order to accomplish this, peak limiting is provided in the second intermediate-frequency amplifier (V5) and both peak limiting and feedback limiting are provided in the limiter stage (V6). In addition, the automatic volume control is used to take care of the variations below the audio-frequency range which are too slow to be handled by the feedback limiter and too small for the overload limiter. The detailed circuit arrangements will be described following a discussion of the general method by which the delayed-automatic-volume-control arrangement functions.

Since this is *delayed* automatic volume control, there must be a delay bias. This is provided by connecting the plate of the delayed-automatic-volume-control tube V9′ to a point which is negative with respect to the cathode connection. This fixed bias prevents plate current from flowing in V9′ when there is no output from the limiter V6. This fixed bias is the sum of the voltages across P2, R24, R25, and R26.

When there is output from the limiter, the intermediate-frequency voltage developed across FL4 is impressed across the plate and cathode of V9′ (as described in more detail later). When this is sufficient in magnitude to overcome the fixed bias on V9′, plate current will flow in that tube during part of each half cycle. This plate current flows through a high resistor (R14) which is in the common grid return of the radio-frequency and first intermediate-frequency amplifier tubes (V1 and V4). This causes a voltage to be developed in that resistance, thus increasing the negative bias applied to the grids of those amplifier tubes.

It will be noted that the cathode circuit of V9′ includes R81 and R83 which form the discriminator load resistor. Direct current flowing through these resistors due to discriminator action makes their junction negative with respect to the outer ends of the combination. Since the negative end of this developed voltage is toward the cathode of V9′, this effect tends to reduce the delay bias materially as the signal strength increases.

In addition, intermediate-frequency current flowing through resistors R81 and R83 (from the plate of V6 through C85, C86, and tuned circuit of L81, returning to the cathode of V6 through C81, C82, and C8) causes an intermediate-frequency voltage to be applied directly to the cathode of V9′. This intermediate-frequency voltage is rectified when the peaks exceed the reduced delay bias. It will be noted that since this rectified current divides equally through the discriminator load resistors, it does not affect the audio-frequency discriminator output.

The net result of these factors is that the automatic-volume-control tube, V9′, is biased so that no plate current flows in it until the output of the limiter V6 exceeds a certain amplitude. When that occurs, this intermediate-frequency voltage (which is applied to both the discriminator and the automatic-volume-control tube) undergoes half-wave rectification in V9′ and causes pulsating plate current in that tube. This plate current develops a d-c voltage in R14 which is effectively in series with the fixed bias applied to the radio-frequency and first intermediate-frequency amplifiers (V1 and V4). This rectified d-c voltage component progressively increases the negative bias applied to V1 and V4, decreasing the amplification of these tubes, thus tending to maintain a constant output from the limiter.

The circuit arrangements for providing the automatic-volume-control actions are described in more detail as follows (referring again to Fig. 29): The cathode of the automatic-volume-control diode V9′ is connected through R81 and R82 in parallel with R83 and R84 to the junction of R26 and R27 on the voltage divider, then through resistors R25 and R26, to ground. The plate and grid are both connected through R14 to the negative end of the dynamotor; thus they are negative with respect to the cathode when

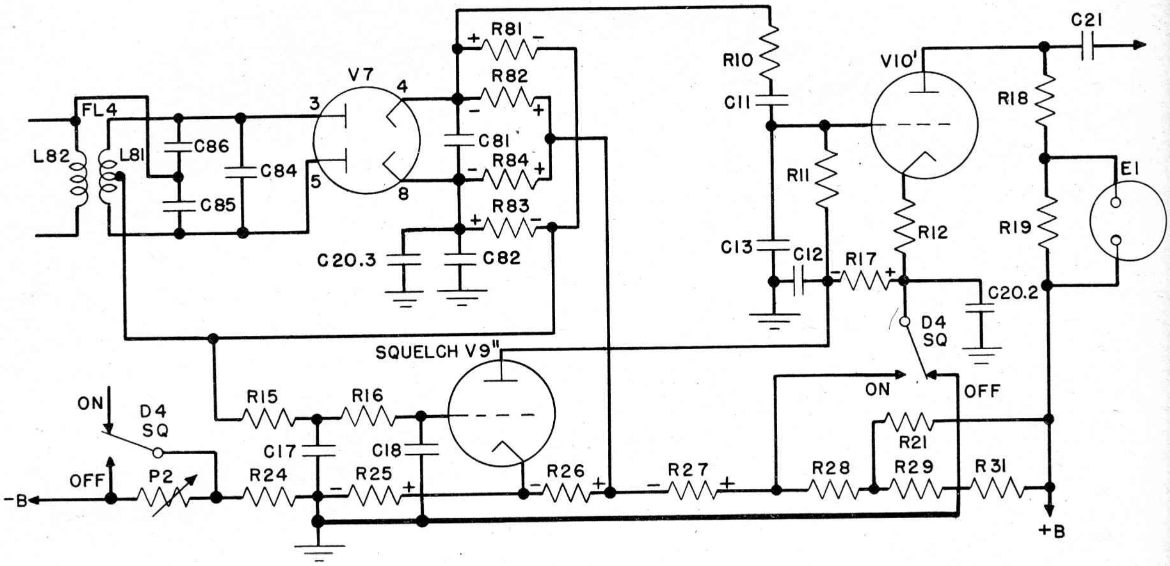


Fig. 30. Radio Receiver BC-683-A: Functional Diagram of Squelch Circuit

no signal is being received. This rectifier circuit is completed to ground through R14 (P2 when the SQUELCH switch is at ON), and R24. These resistors are also in the circuit which provides bias to the first radio-frequency and first intermediate-frequency amplifying tubes, V1 and V4.

The intermediate-frequency voltage developed across FL4 appears between the plate of V6 and ground. The plate of V6 is connected directly to the junction of C85 and C86. As far as relation to ground potential is concerned, this junction is equivalent to the midpoint of L81 which is connected directly to the cathode of V9′. Thus the cathode of V9′ is connected effectively to the plate of V6. The return circuit from the plate of V9 is through C14. The intermediate-frequency voltage is thus impressed across the rectifier V9′. When the amplitude is sufficient, half-wave rectification occurs, which causes plate current to flow through R14. This causes the point (x) to become increasingly negative as the output of V6 increases. Since the potential of point (x) determines the bias applied to V1 and V4 (radio-frequency and first intermediate-frequency amplifiers), it is apparent that increasing the input to the receiver causes a decrease in the gain and thus tends to keep the output of V6 constant.

Currents reaching the discriminator cause d-c voltages across R81 and R83, by discriminator action. The junction of these two resistors is the negative end of each. R82 and R84 are connected in such a way that R81 and R82 are effectively in parallel with R83 and R84 for this application, and the negative end of the voltage developed across this combination is connected to the cathode of V9′. This voltage is not large enough to overcome the fixed bias but reduces it materially. R82 and R84 are provided to permit introducing the fixed bias on V9′ without affecting discriminator action and also without short-circuiting the audio-frequency output across R81 and R83.

The grid bias lead for V1 and V4 is supplied through resistor R13 with capacitors C14 and C15 connected to ground at its two ends to prevent radio- and audio-frequency feedback to the grid of these tubes. V1 and V4 also have individual filter resistors R37 and R53 respectively, between the grid and the common grid bias supply. Each of these two tubes has an individual radio-frequency by-pass capacitor connected from the grid end of its filter resistor to ground.

i. Squelch Circuit. A functional diagram of the squelch circuit is shown in Fig. 30.

The squelch circuit is designed to disable the receiver output when the desired carrier is not received. In this manner, hiss and undesirable background noise (normally present under a no-signal condition) are eliminated in the "no-transmission" intervals. In order to accomplish this more efficiently over a wide range of possible signal and background levels, a sensitivity control is provided. This is effective only when the squelch circuit is turned on, and normally enables the operator to adjust the threshold level (operating point) of the squelch circuit in such a way that the average background interference alone will not maintain the receiver in operating condition. Desired signals, however, not only will cause the set to become operative but also will light the CALL SIGNAL lamp.

The operation of the squelch circuit is accomplished by having plate current flow in the squelch tube V9″ when no carrier is being received. This plate current in V9″ flowing through resistor (R17) produces a d-c voltage which is applied as negative bias to the first audio-frequency amplifier V10′. This bias is sufficient to prevent any signal transmission beyond that point. Thus there is no receiver output. When carrier voltage is received, the current flowing through resistors R81 and R83 from discriminator action sets up a d-c potential which is applied to the grid of the squelch tube V9″ to prevent the flow of plate current. Thus the bias caused by that plate current is removed from the grid of V10′ and the audio amplifier operates normally. The following discussion shows in more detail how this is accomplished:

When there is no input to the discriminator, no signal voltage will be built up across either R81 or R83. With no signal voltage being received, noise voltage is developed across R81 and R83. If the SQUELCH switch is at ON, the amount of noise voltage is adjustable by means of P2, and the audio-frequency amplifier V10′ (Fig. 30) is then biased beyond cutoff by reason of the current (from the plate circuit of the squelch tube V9″) flowing through R17. The CALL SIGNAL light is then extinguished since no current flows in the plate circuit of V10′. It will be observed that the control grid of the squelch tube is positive with respect to the cathode (grid current flow is limited by R15 and R16). The cathode is connected to the junction of R25 and R26 while the grid is eventually returned to the junction of R26 and R27. This return path is through resistors R15 and R16, then through R81 and R82 in parallel with R83 and R84, to the voltage divider. Also the plate is returned through R17 and the switch D4 (at ON) to the junction of R27 and R28 which is positive with respect to both the cathode and the grid. Therefore, plate current flows in the squelch tube V9″ and through resistor R17 to produce a voltage drop through R17. The negative end of this voltage drop is at the junction with R11 and thus applies negative bias through R11 to the grid of the first audio-frequency amplifier V10′. This voltage is sufficient to bias V10′ below cutoff; hence, no plate current flows and the amplifier is "disabled." The by-pass capacitors C17 and C18 are connected to ground from either side of R16, to prevent intermediate-frequency or audio-frequency currents from flowing through R15 and R16 and actuating the squelch tube, since operation of this circuit is controlled mainly by the d-c component of the rectified input signal. Capacitor C12 serves to filter the plate circuit of V9″ in a similar way. Capacitor C20.2 provides an audio-frequency return path to ground from the cathode circuit of the first audio-frequency stage.

When a signal is being received, a voltage of intermediate frequency is developed across the tapped secondary L81 of filter unit FL4. This is applied to the two diodes of the discriminator V7. In one case a resulting electron flow occurs from the cathode (4) to the plate (3), through L81 (upper winding), R81, and back to the cathode. The other circuit is from the cathode (8) to the plate (5), through L81 (lower winding), R83, and back to the cathode. The voltages built up across R83 and R81 are such that the negative terminal of each is at the junction of the two resistors. For bias purposes, these two voltages are effectively connected in parallel by connecting two high resistors, R84 and R82, from the positive terminals of R81 and R83. The other ends of both R82 and R84 are then connected to the junction of R26 and R27 on the voltage divider.

The negative end of this potential effectively

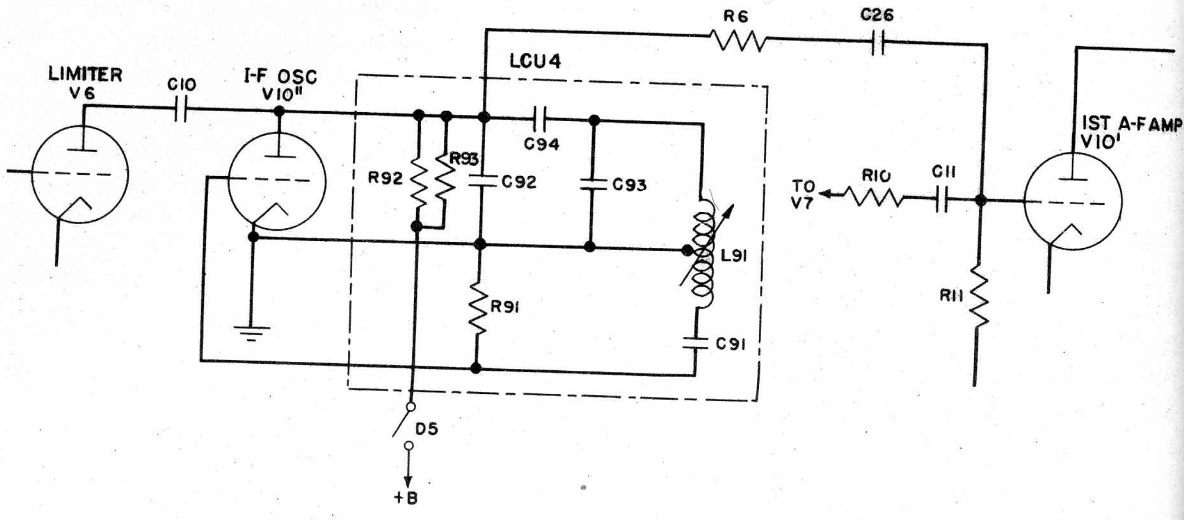


Fig. 31. Radio Receiver BC-683-A: Functional Diagram of I-f Oscillator

developed across R81 and R83 in parallel is applied through resistors R15 and R16 to the grid of the squelch tube V9″. It will be noted that this potential is in opposition to the grid bias (the voltage drop across R26 and R27) which is applied to V9″ whenever the SQUELCH switch is at ON. When no input exists at the discriminator, plate current will flow in V9″. When a signal is being received, however, the voltage developed across resistors R81 and R83 is sufficient to overcome the fixed bias and stop the flow of plate current in V9″; thus the effect of the squelch is eliminated and the audio-frequency amplifier will function normally.

The SENSITIVITY control is described as part of the voltage divider. It regulates the radio-frequency gain of the receiver to make it as high as possible without providing enough average noise voltage to "trip" the squelch tube.

j. I-f Oscillator. A functional diagram of the intermediate-frequency oscillator is shown in Fig. 31.

The intermediate-frequency oscillator employs a Hartley circuit which is quite similar to the radio-frequency oscillator of the receiver. Coil L91 is adjustable to permit tuning to 2.65 megacycles. Capacitor C93 provides the bulk of the tuning capacitance. Capacitor C92 provides temperature compensation and C94 is a blocking capacitor. Capacitor C91 provides feedback and resistor R91 provides grid bias.

The intermediate-frequency oscillator operates as an autodyne detector. Some intermediate-frequency energy from limiter V6 is impressed upon the plate of the oscillator through a small coupling capacitor, C10. This energy modulates the oscillator, and the audio-frequency beat note produced is passed on to the first audio-frequency amplifier through R6 and C26. C26 is a coupling capacitor. R6 prevents a short circuit of the audio amplifier. The coupling capacitor C10 is small enough to prevent audio frequencies from appearing on the plate of the limiter. The oscillator is controlled by the TUNE-OPERATE switch, D5, which supplies plate voltage to V10″ through the load resistors R92 and R93.

k. Vacuum Tube Heater Circuits. A functional diagram of the vacuum tube heater circuits in the receiver is shown in Fig. 32.

These circuits are permanently grounded to the receiver chassis at three points, i.e., terminal 2 of V1, terminal 7 of V4, and terminal 2 of V3. Terminal 1 of plug PG2 is grounded also. When the dynamotor is installed in the receiver, the strap connections shown (which are included in the base of the dynamotor) modify the circuit as required for operation at the battery voltage indicated on the dynamotor. Thus, if 24-volt battery operation with Dynamotor DM-36-(*) is assumed, J801 of the dynamotor connects terminal 3 on plug PG2 to terminal 2; and the 24-volt battery is impressed across three parallel circuits (of series heaters) to ground: (V9, V7, V10, and V3), (V5 and V4), and (V8, V6, V2, and V1). If 12-volt battery operation with Dynamotor DM-34-(*) is assumed, J701 of the dynamotor connects terminal 3 on PG2 to terminals 12, 9, and 15 and straps terminal 1 to terminal 2. By these connections, the 12-volt battery is impressed across six combinations of heaters to ground: (V2 and V1), (V6 and V8), (V10 and V3), (V7 and V9), (V4), and (V5).

As mentioned in Paragraph 7*b*, a 12-volt dynamotor must be used with a 12-volt battery and a 24-volt dynamotor with a 24-volt battery. The connections within a dynamotor are so arranged that the circuit is automatically changed to adapt it to the battery voltage.

l. Dynamotor Filter Circuits. Filter circuits are provided in both the low- and the high-voltage sides of the dynamotors to overcome interference caused by the commutator as well as to provide the required degree of filtering. In the case of Dynamotor DM-34-(*), capacitors C703 and C704 together with L702 constitute a low-voltage filter to prevent commutator interference from the low-voltage end. C701, C702, C705, and C706 together with L703 and L704 accomplish a similar function on the high-voltage end. L701 together with C25 constitutes an audio filter to remove the audio-frequency ripple which exists at the output of the dynamotor.

For Dynamotor DM-36-(*), the corresponding components in the 800 series perform similar functions.

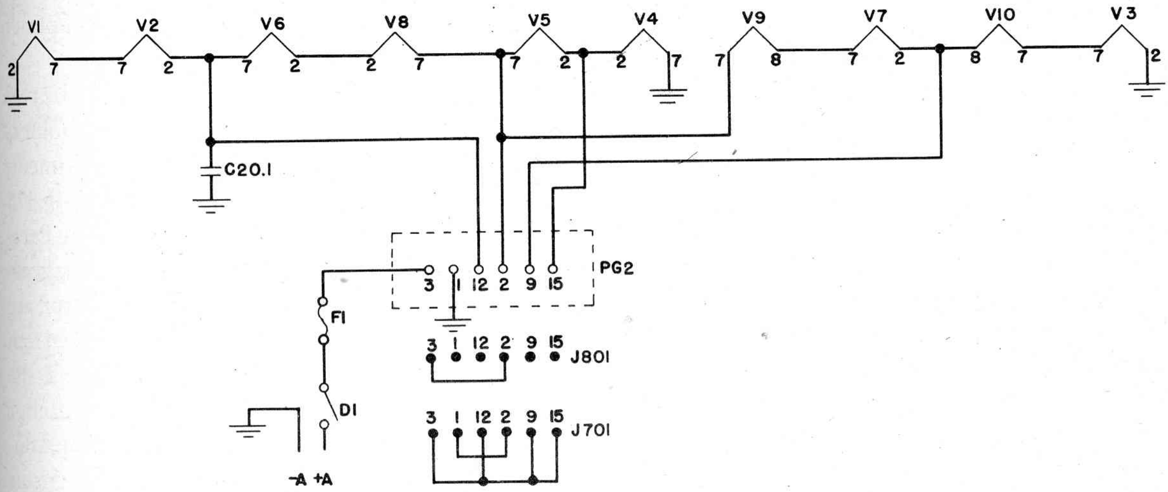


Fig. 32. Radio Receiver BC-683-A: Functional Diagram of the Heater Circuits

24. Functioning of Radio Transmitter BC-684-A.

a. Block Diagram. A block diagram of the transmitter is shown in Fig. 33.

The gang-tuning control, operated by the push button selector, selects any one of ten preselected crystals and connects it to the oscillator (V107). The oscillator output frequency (f_x) is amplified by the first radio-frequency amplifier (V101) and, along with the audio-frequency signals, is impressed upon a saturated iron-core modulation coil (MOD COIL).

The output of the modulation coil is rich in harmonics of the crystal frequency. After rectification by V102, the reason for which will be given later, the *twelfth* harmonic of the crystal frequency ($12\ f_x$) is selected and impressed upon a frequency tripler (V108). The tripler output ($36\ f_x$) excites a frequency doubler (V103). The doubler output ($72\ f_x$) drives the power amplifier (V104) at the carrier frequency ($f_c = 72\ f_x$). The proper one of ten pretuned an-

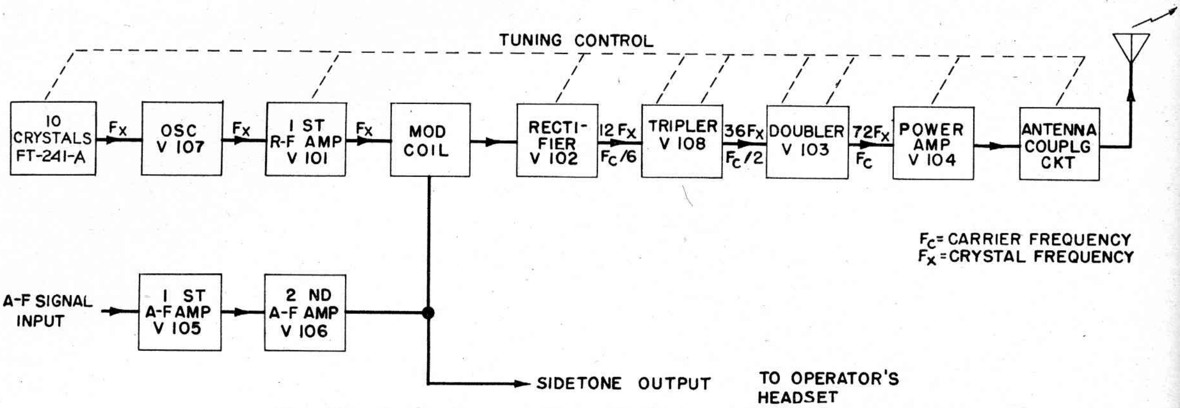


Fig. 33. Radio Transmitter BC-684-A: Block Diagram

tenna coupling circuits is selected by the gang-tuning control and connected to the antenna.

Speech signals from a microphone associated with the transmitter are amplified by a two-stage audio-frequency amplifier (V105 and V106).

A small amount of audio output from V106 is caused to pass through the headset circuit. This is called "sidetone." It enables the commander to hear all that goes out from his radio transmitter and prevents confusion where two people have microphones for the same transmitting set. Also, when the operator's ears are covered by a headset he does not have the normal sensation of hearing himself talk unless sidetone is provided.

b. Schematic, Wiring, and Apparatus Location Diagrams. Complete schematic, wiring, and apparatus location diagrams are given in Figs. 47-50, 74, and 75.

c. Crystal Oscillator and First R-f Amplifier. A functional diagram of the crystal oscillator (V107) and the first radio-frequency amplifier (V101) is shown in Fig. 34.

The frequency of the oscillator (V107) is controlled by any one of ten crystals in Holders FT-241-A placed in the crystal compartment. The crystal frequencies are in the range of 375 to 540 kilocycles, as listed accurately in Paragraph 3*d,* Table II. In the functional diagram the important components of the oscillator are the crystal, Y101 to Y110, capacitor C151 from the control grid of V107 to ground, and the tuned circuit C105-L102 in series with capacitor C104. The crystal is connected between the control grid and the junction of the tuned circuit and C104. The remaining components provide the proper screen grid and plate potentials, grid bias, and a high-frequency impedance (L117-R149).

The oscillator operates as a modified "grid-ground" oscillator in which the crystal is above ground because of the impedance of capacitor C104. The phase of the current through this

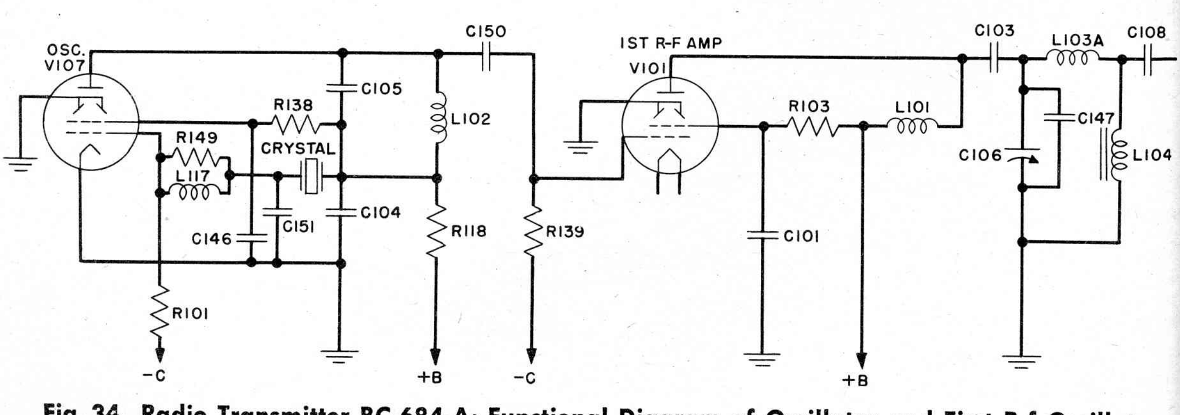


Fig. 34. Radio Transmitter BC-684-A: Functional Diagram of Oscillator and First R-f Oscillator

capacitor is such that some additional feedback is obtained, over that occurring in the usual grid-ground circuit. This causes more rapid crystal starting and increases the output.

The parallel-connected inductor and capacitor in the plate circuit of the oscillator, L102 and C105, are proportioned to increase the excitation on the grid of V101 at the higher frequencies over that which would be obtained otherwise. Capacitor C150 prevents the oscillator plate d-c voltage from appearing on the grid of V101.

Grid bias for the first radio-frequency amplifier V101 flows through resistor R139. The screen of V101 is kept at radio-frequency ground potential by by-pass capacitor C101. The d-c supply for the screen is obtained from the 400-volt supply through resistor R103. The plate circuit is fed through radio-frequency choke coil L101, and the load circuit (L103A, L104, and C106), is isolated by blocking capacitor C103.

d. Modulator and Rectifier. A functional diagram of the modulator and rectifier stages is given in Fig. 35.

Two important functions are performed by inductor L104, which is a small nonlinear coil specially designed for use in this transmitter. The coil, together with its associated tuning inductor and capacitors (L103A, C106, C147), serves as a harmonic producer; at the same time, it functions as a modulating element which causes the carrier-frequency output of the first radio-frequency amplifier to be phase-modulated in conformity with amplitude variations of the audio signal (output of the second audio-frequency amplifier, V106).

The radio-frequency input derived from the first radio-frequency amplifier causes a current of about 0.3 ampere to flow through parallel-resonant circuit L103A, L104, C106, and C147. L104 becomes magnetically saturated at a much lower current than this. When the instantaneous radio-frequency current exceeds the saturation value there is no appreciable increase of flux density and the inductance of the coil drops to a low value. Consequently very little voltage appears across it when the instantaneous current through it is higher than the saturation value.

Between the saturation value and zero current, the coil has a high inductance, and a change in current causes a relatively large change of flux density. Under this condition (that is, when the current passes through the *magnetization range* of the coil) there is a large change in the magnetic field; a high counter-voltage is induced across the coil. The current through L104, therefore, produces sharp voltage peaks each half cycle as the radio-frequency current wave passes through zero. The voltage peaks alternate in polarity each half cycle and are evenly spaced in time. The peaks have a distorted wave shape and contain many harmonics of the original (crystal) frequency.

Figure 36 shows how phase modulation may be produced by passing combined carrier and signal currents through L104. Figure 36a represents the current through L104 (crystal fre-

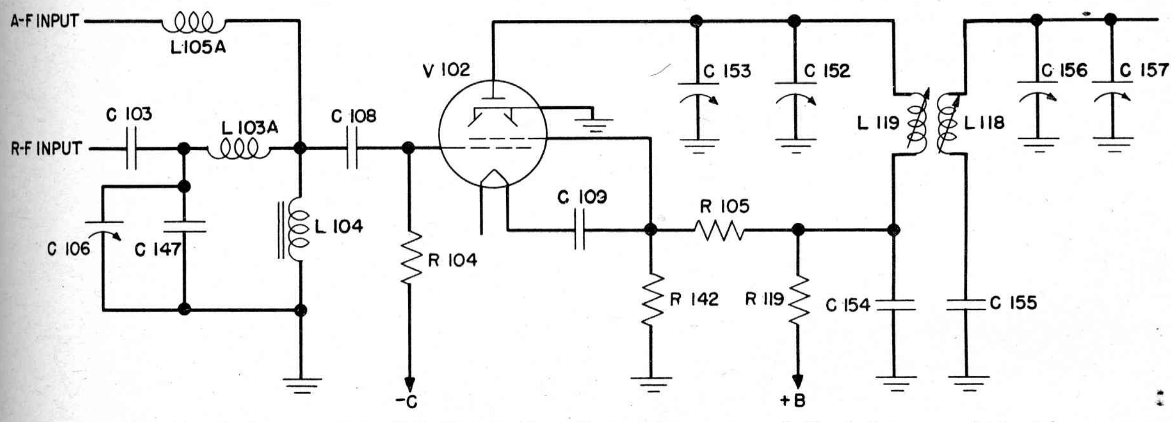


Fig. 35. Radio Transmitter BC-684-A: Functional Diagram of Modulator and Rectifier

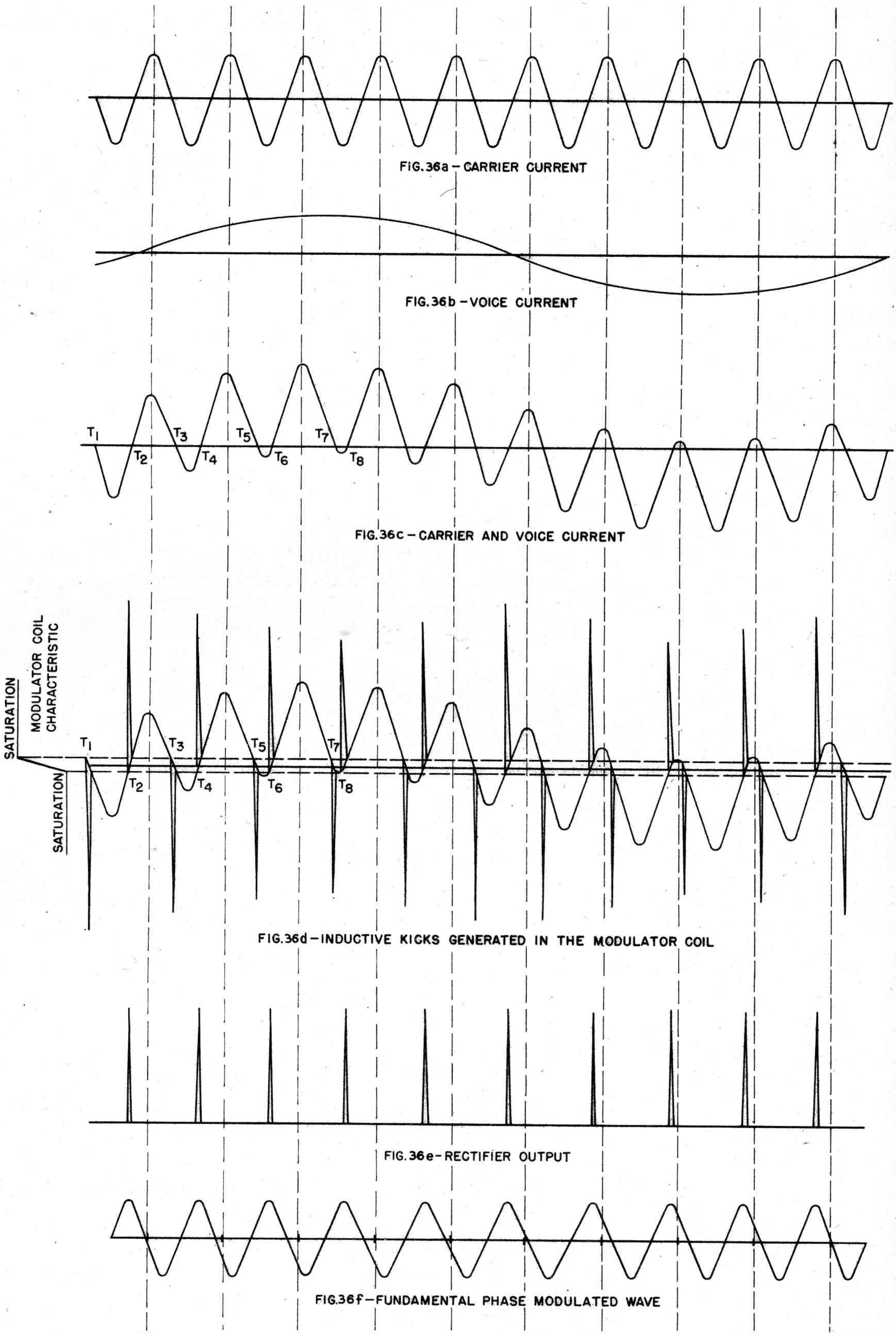


Fig. 36. Radio Transmitter BC-684-A: Method of Modulation

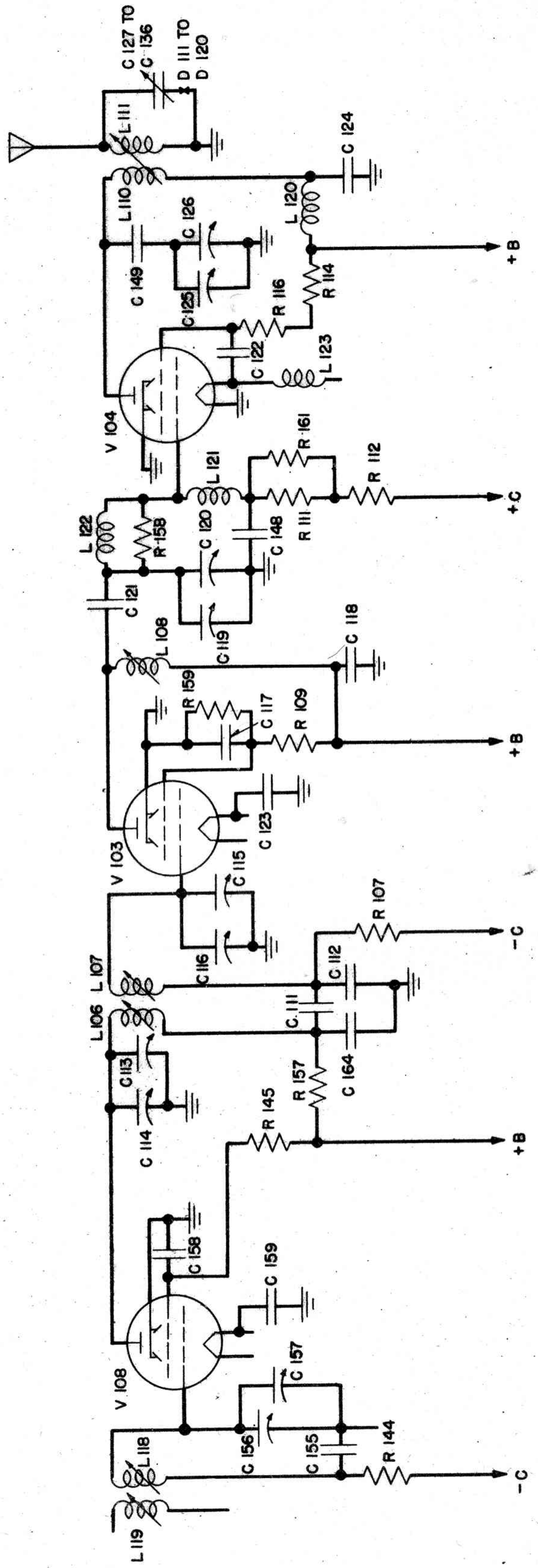


Fig. 37. Radio Transmitter BC-684-A: Functional Diagram of Tripler, Doubler, Power Amplifier, and Antenna Coupling Circuits

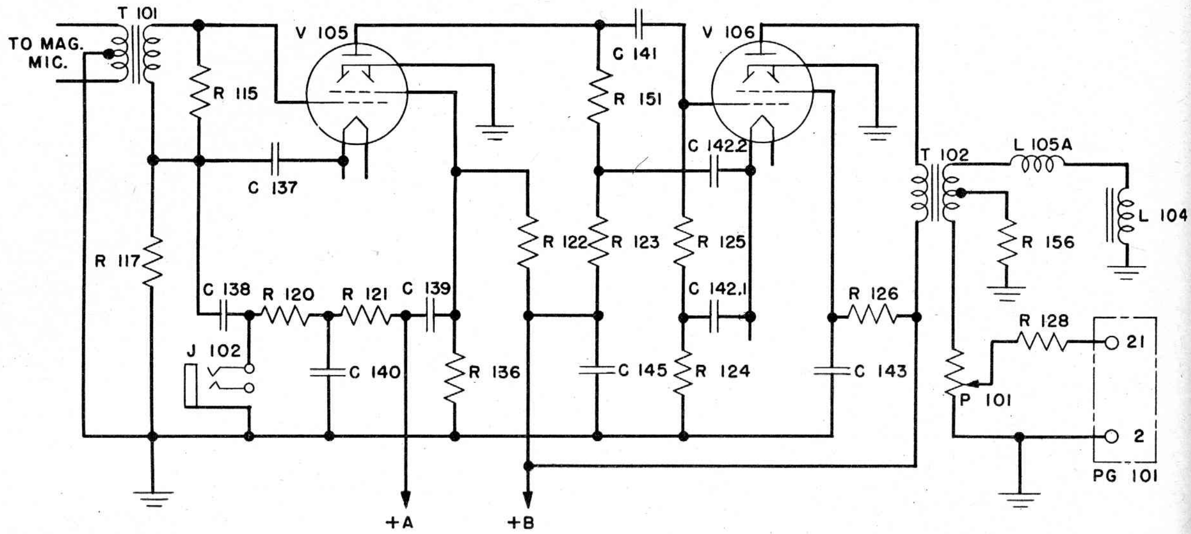


Fig. 38. Radio Transmitter BC-684-A: Functional Diagram of A-f Amplifier

quency) in the absence of any modulating signal. An audio-frequency (sine wave) signal is shown in Fig. 36b. As shown in Fig. 35, the two currents pass through L104 to ground. The combined current is shown in Fig. 36c. Figure 36d shows the inductive voltage peaks generated in L104 (near zero instantaneous coil current) by the combined current.

The peaked voltage across L104 is rectified by a biased rectifier, V102, as shown in Fig. 35. The fixed bias on the grid of V102 is sufficient to eliminate all portions of the wave shown in Fig. 36d except the upper peaks. The rectified output of V102 is illustrated in Fig. 36e. The wave shown in Fig. 36f is representative of the fundamental component of the wave in Fig. 36e. The difference between the evenly spaced intervals on the "time axis" and the points of "zero current" represents the amount by which modulation has shifted the wave.

The wave in Fig. 36e contains a large number of harmonic frequencies, each of which is similarly phase-modulated. A tuned filter (C152, C153, L119, L118, C156, and C157) suppresses all but the *twelfth* harmonic of the crystal frequency. This is passed on to the tripler stage of the transmitter.

e. Tripler, Doubler, Power Amplifier, and Antenna Coupling Circuits. A functional diagram of the tripler (V108), doubler (V103), power amplifier (V104), and antenna coupling circuits is shown in Fig. 37.

The input to the tripler tube, the voltage across tuning capacitors C156 and C157, is at twelve times the crystal frequency, or one sixth of the output carrier frequency. Coupled anti-resonant circuits (C113, C114, L106 and C115, C116, L107) in the plate circuit of V108 and the grid circuit of V103 select the thirty-sixth harmonic of the crystal frequency and impress it upon the doubler stage, V103. The doubler output is tuned to the output carrier frequency by anti-resonant circuit L108, C119, C120. While capacitor C121 is included in the tuned circuit, it is of low reactance and is used only as a d-c blocking capacitor. The power amplifier, V104, is coupled to the antenna by coupled circuits C125, C126, L110 and L111, C127-C136. L122-R158 is included in the grid lead of V104 to suppress high-frequency parasitic oscillations.

f. A-f Amplifier and Microphone Circuits. The essential circuits of the audio-frequency amplifier and the microphone circuits are shown in Fig. 38.

The first audio-frequency amplifier tube, V105, may be excited by a microphone. This may be a carbon-type microphone (either Microphone T-17 or T-30) connected to J102, or a magnetic-type microphone (Microphone T-33) connected to J101. In either case, pressing the switch on the microphone energizes the dynamotor relay winding (S102) and closes its contacts to start the transmitter dynamotor. The voltage from a magnetic-type microphone is impressed across the primary of input transformer T101. The secondary of T101 is loaded by resistor R115. The voltage across R115 is impressed upon the input of V105 through capacitor C137.

Since the output of a carbon-type microphone exceeds that of a magnetic-type microphone, means are provided to care for this difference. A magnetic-type microphone may be plugged into jack J101 or a carbon-type microphone may be plugged into jack J102. The desired uniformity of excitation of V105 (in spite of differences in microphone output) is obtained by the voltage divider action of capacitors C137 and C138. C138 is smaller than C137 and the audio signal voltage across C137, which is the excitation for V105, is proportionally smaller. The d-c microphone current is obtained through a ripple filter (R120, C140, and R121), from the vehicle battery.

The output of V105 is coupled to the grid of V106 by capacitor C141 and resistors R151 and R125. R123 is a noise filter resistor for the plate of V105. Capacitor C145 serves as a ground return for the plate circuits of V105 and V106.

Output transformer T102 has two series-connected secondary windings. One winding supplies sidetone to terminal 21 on plug PG101 through resistor R128. The sidetone volume is adjusted by varying the setting of potentiometer P101. The second winding supplies modulating signals to the modulation coil, L104, through radio-frequency choke coil L105A.

g. Metering Circuits. A single meter, M101 (Fig. 74), may be switched to any one of several circuits in the transmitter by operation of switch D125. The panel switch D121 is used to connect the meter to D125 or to the thermocouple TC101 for indicating antenna current. The following six circuits may be checked by use of D125.

Switch Position	*Circuit*
1	Doubler grid
2	First r-f amplifier grid
3	Rectifier grid
4	Tripler grid
5	Power amplifier grid
6	Total plate and screen

25. Functioning of Remote Control Unit RM-29-D. A combined schematic and wiring diagram for the remote control unit is given in Fig. 76. The association of this unit with Radio Set SCR-608-A is also shown in the detailed system schematic diagram, Fig. 69, and is explained in Paragraph 27. For more detailed information on the functioning of the various components in Remote Control Unit RM-29-D, refer to Technical Manual TM 11-308 which covers this unit.

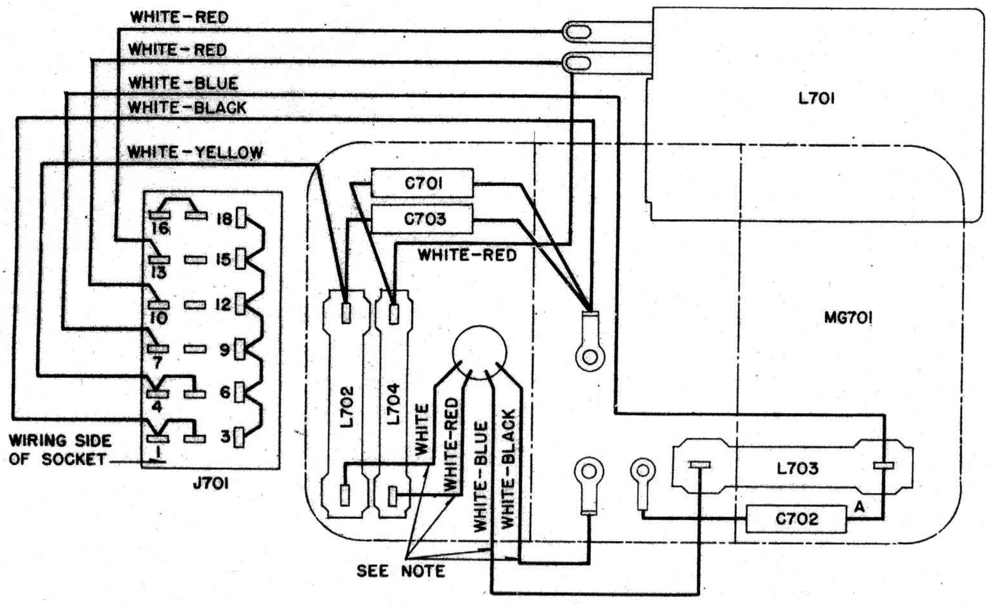
26. Functioning of Dynamotors DM-34-(*), DM-35-(*), DM-36-(*), and DM-37-(*). Four types of dynamotor are used with Radio Sets SCR-608-A and SCR-628-A. They are:

Dynamotor DM-34-(*): Receiver (12 volts)
Dynamotor DM-35-(*): Transmitter (12 volts)
Dynamotor DM-36-(*): Receiver (24 volts)
Dynamotor DM-37-(*): Transmitter (24 volts)

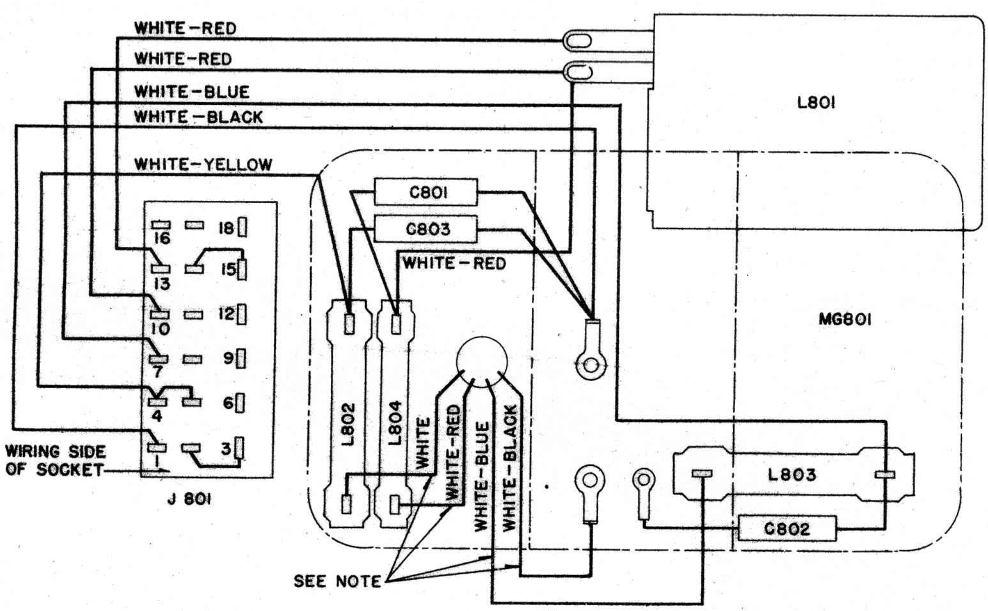
Each dynamotor combines the functions of a low-voltage (12-volt or 24-volt) d-c motor with a high-voltage (200 volts for the receiver; 600 volts for the transmitter) d-c generator in a single machine. Only one frame, one armature, one field winding, and one pair of bearings are required. The armature is wound with two separate windings, each of which is connected to its own commutator. Schematic and wiring diagrams of the four dynamotors are shown in Fig. 39. Apparatus location diagrams are shown in Fig. 40. Exploded views of the dynamotors are shown in Figs. 41 and 42. The parts numbers are given in Paragraph 41, Maintenance of Dynamotor.

27. Functioning of Control Circuits.

a. Radio Set SCR-608-A. Figure 69 is a system schematic drawing of Radio Set SCR-608-A showing control circuit wiring in the receivers, transmitter, and mounting. It also shows Remote Control Unit RM-29-D and field Telephone



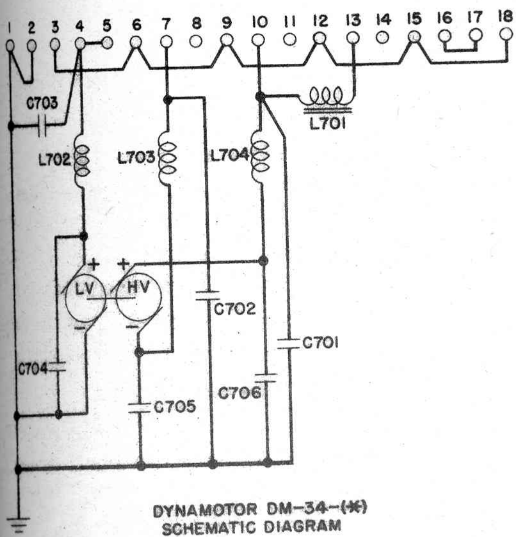
DYNAMOTOR DM-34-(*), WIRING DIAGRAM



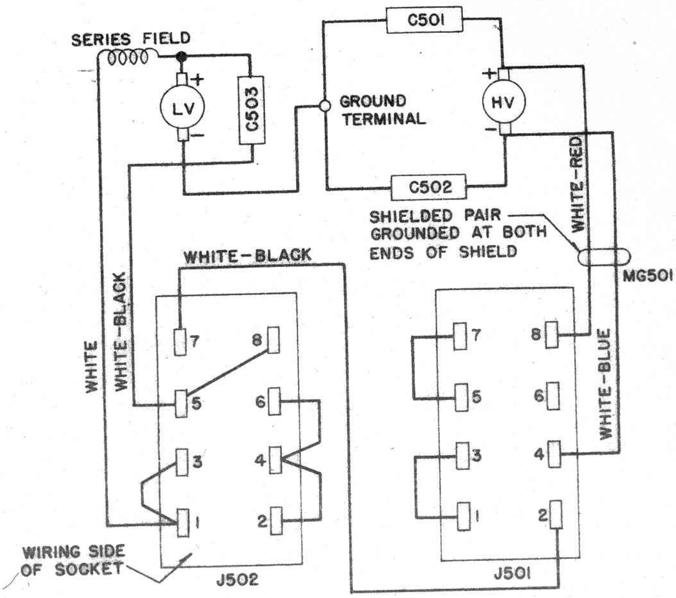
DYNAMOTOR DM-36-(*), WIRING DIAGRAM

NOTE:
THESE WIRES SHOULD BE KEPT AS FAR AS POSSIBLE FROM ALL OTHER WIRES.

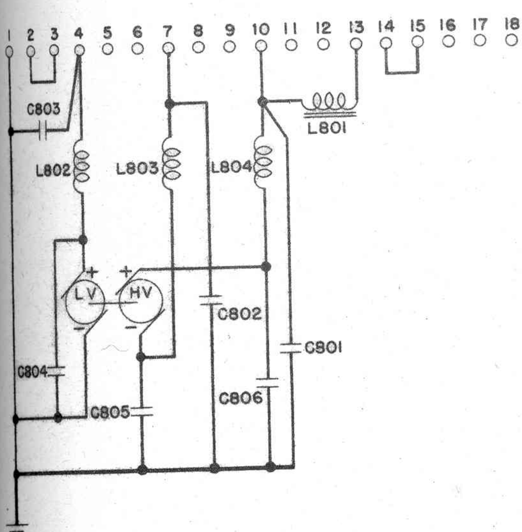
Fig. 39. Dynamotors: Schematic and Wiring Diagrams



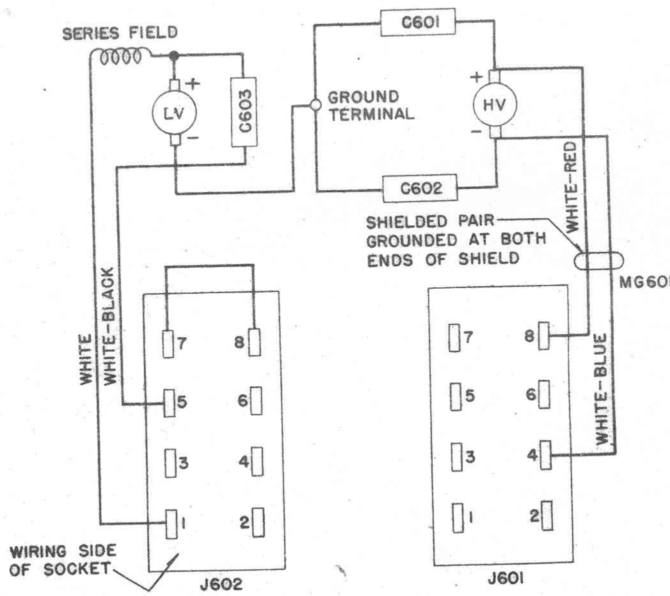
DYNAMOTOR DM-34-(*)
SCHEMATIC DIAGRAM



DYNAMOTOR DM-35-(*), COMBINATION WIRING
AND SCHEMATIC DIAGRAM



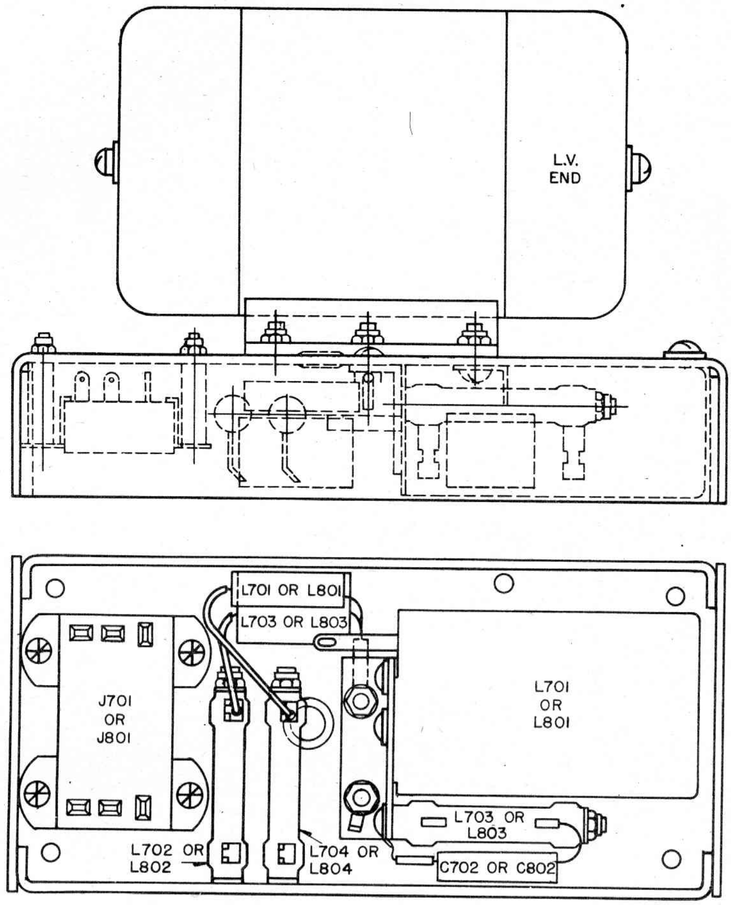
DYNAMOTOR DM-36-(*)
SCHEMATIC DIAGRAM



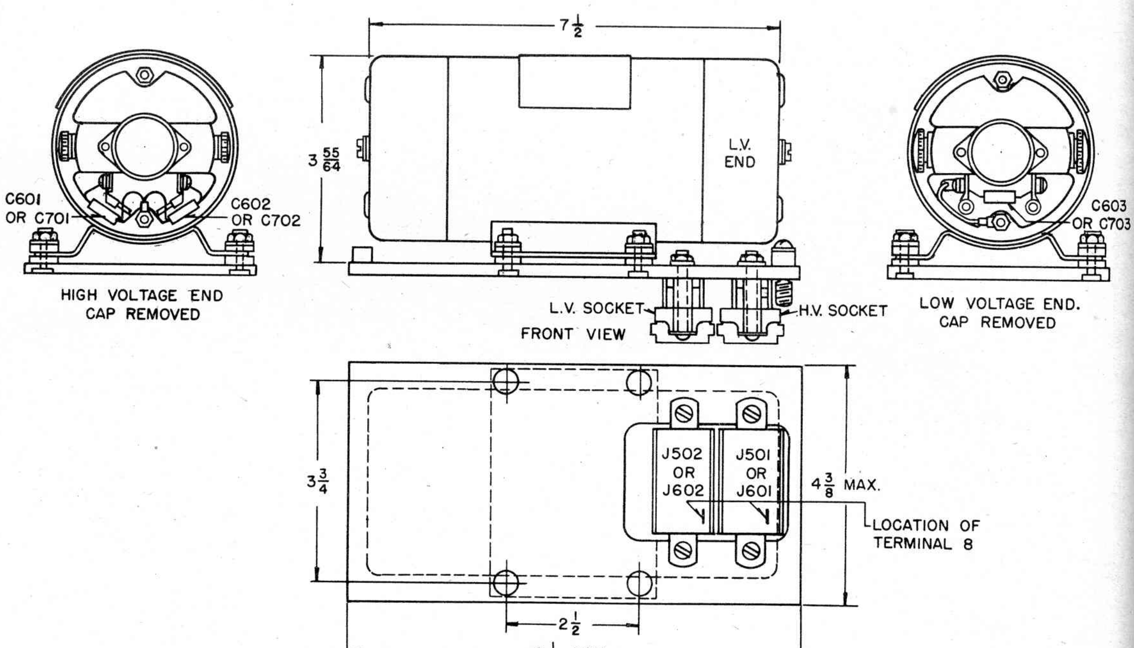
DYNAMOTOR DM-37-(*), COMBINATION WIRING
AND SCHEMATIC DIAGRAM

NOTE:
THE HIGH VOLTAGE LEADS FROM THE GROUNDED END OF SHIELDING TO THE PLUG TERMINALS SHALL BE COVERED WITH DIEFLEX FLEXIBLE VARNISHED TUBING NO. 9 OR EQUIVALENT.

Fig. 39. Dynamotors: Schematic and Wiring Diagrams



DYNAMOTOR DM-34-(*) AND DYNAMOTOR DM-36-(*)



DYNAMOTOR DM-35-(*) AND DYNAMOTOR DM-37-(*)

Fig. 40. Dynamotors: Apparatus Location Diagrams

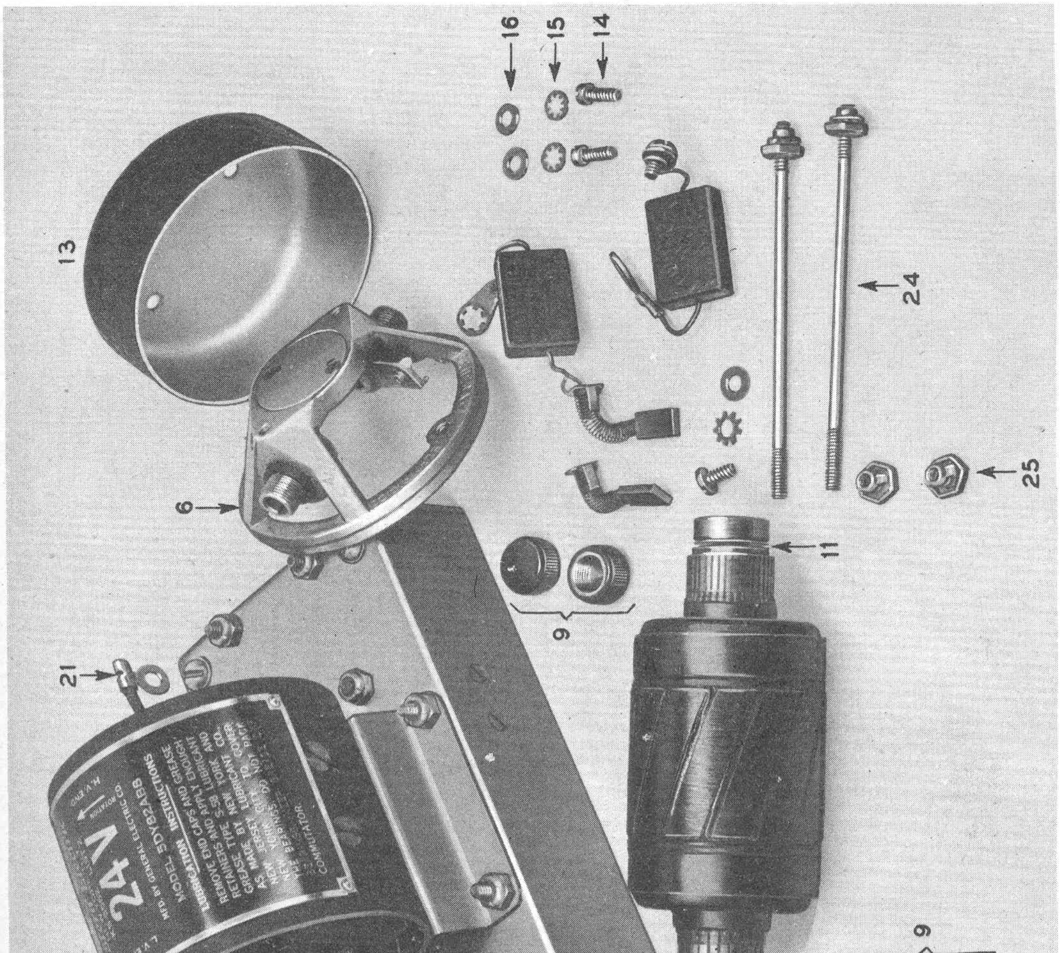


Fig. 41. Dynamotor DM-34-(*) or Dynamotor DM-36-(*): Exploded View

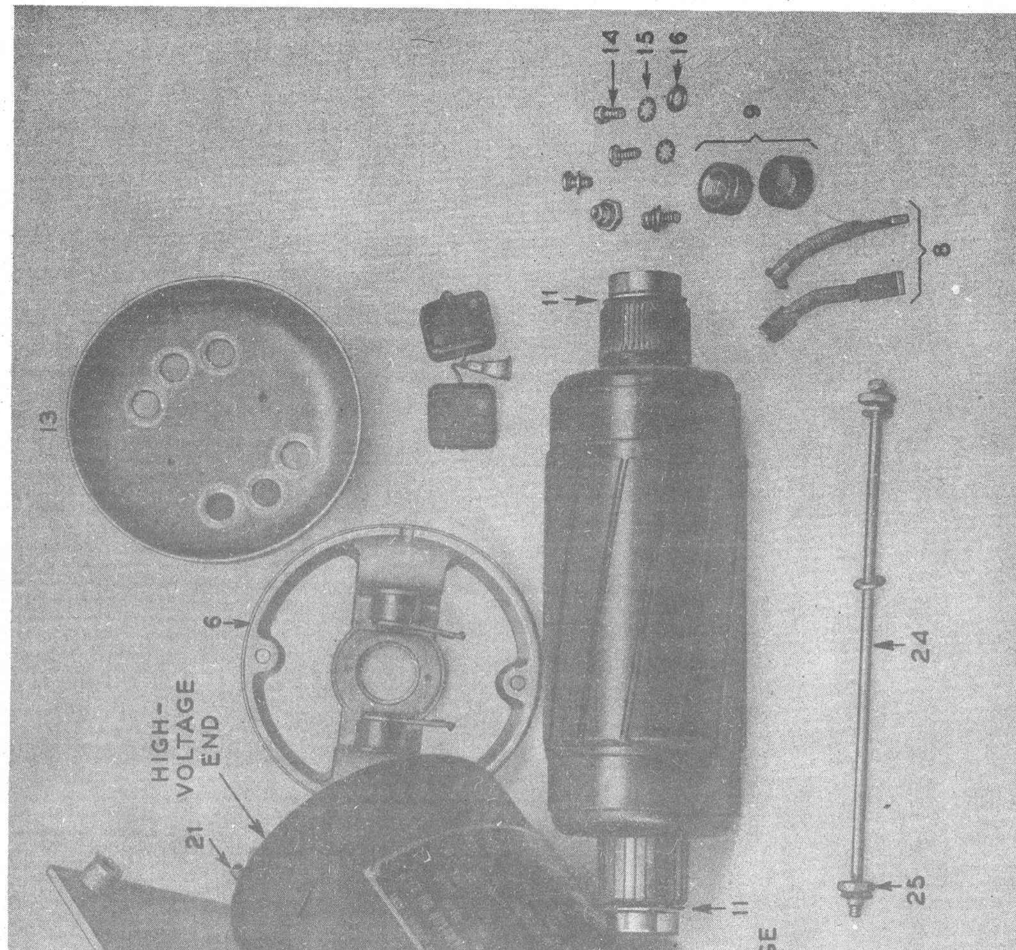


Fig. 42. Dynamotor DM-35-(*) or Dynamotor DM-37-(*): Exploded View

EE-8-(*), so that the wiring of a complete system is included. Refer to Fig. 69 for the discussion which follows.

Connections to the vehicle battery are shown at the lower right of the mounting. The negative side is grounded and the positive lead goes to terminal 1 of mounting receptacles J401, J402, and J403. On the corresponding plugs of the receivers (PG1), terminal 1 connects to the ON-OFF switches D1, and on plug PG101 of the transmitter, terminal 1 connects to the ON-OFF switch D124.

When a receiver ON-OFF switch D1 is closed, the receiver vacuum tube cathodes are heated and the receiver dynamotor starts. The output of either or both receivers is available at receiver headset jacks J1 and J2, when the OUTPUT TO PHONES switches D2 are at ON. Interconnection between headset jacks of the two receivers is over the lead connecting to terminal 21 of PG1. This lead also connects through the mounting to terminal 21 of the transmitter plug PG101, which goes to a winding on transformer T102 of the transmitter to provide sidetone in the receiver headsets when transmitting. Receiver output volume is adjusted by VOLUME control P1, and sidetone level is adjusted by potentiometer P101 in the transmitter. The receiver loudspeakers are turned on or off by switches D3. The antenna connection to the receivers is from the TR binding post on the mounting through terminal A1 of J403 and PG101, through a break contact of the transmitter antenna relay S101, through terminal A2 of PG101 and J403, through terminals A1 of J401 or J402 and PG1, to the grid of vacuum tube V1. Transmitter relay S101 is energized when transmitting, so that the receivers are disconnected from the antenna.

When the transmitter ON-OFF switch D124 is closed, the pilot lamp lights and the vacuum tube filaments are heated. When a carbon-type Microphone T-17 (or T-30) is plugged into jack J102 and the RECEIVER TUNE-OPERATE switch D122 is at OPERATE, the transmitter is ready for operation. Closing the microphone switch energizes dynamotor relay S102, thus starting the transmitter dynamotor. At the same time relays S101 and S103 in the transmitter are energized. S101 is the antenna relay which transfers the antenna connection from the receiver to the transmitter, applies plate voltage to the power amplifier tube V104, and grounds the bias lead of the oscillator V107. S103 is the receiver disabling relay which, when operated, short-circuits the output of both receivers (leads from S103 contacts through terminals 7 and 22 of PG101 and J403, through terminal 7 of J402, J401, and PG1, to transformers T1 in receivers). Speech signals from the microphone through J102 are amplified in the audio amplifier tubes V105 and V106 and are impressed on the radio-frequency tubes via transformer T102. The lower secondary winding on T102 provides sidetone to the receiver headsets as previously described.

If a magnetic-type Microphone T-33 is used, it is plugged into jack J101 instead of J102. Closing the microphone switch grounds the dynamotor relay S102 winding over leads marked A and B and speech signals are impressed on the audio input transformer T101 via leads marked C and D. Otherwise, operation of the transmitter is the same as that described for the carbon-type microphone.

To furnish carrier-frequency voltage for setting push button selectors in the transmitter and the receiver without putting the transmitter "on the air," the RECEIVER TUNE-OPERATE switch D122 is provided in the transmitter. In the foregoing discussion of operation of the transmitter, it was stated that switch D122 was at OPERATE. When this switch is set to RECEIVER TUNE (after the ON-OFF switch is turned to ON), the transmitter dynamotor relay S102 is energized and the dynamotor starts without a microphone plugged in. The antenna relay S101 and receiver disabling relay S103 do not operate, however, so that carrier voltage is not applied to the antenna and the receiver output is not short-circuited.

Radio Set SCR-608-A may be used with Remote Control Unit RM-29-D and field Telephone EE-8-(*). These are also shown in Fig. 69, and a brief description of their function is given here.

Plug PL-55 of the remote control unit is plugged into a headset jack of the receiver and Plug PL-68 is plugged into the carbon-type microphone jack of the transmitter. A headset is plugged into Jack JK-34-A of the remote control unit and a carbon-type microphone is plugged into Jack JK-33-A. Leads to the field telephone are connected at terminals L1 and L2. With Switch SW-185 of the remote control unit at RADIO, Jacks JK-33-A and JK-34-A are connected directly through to Plugs PL-68 and PL-55, respectively. When the transmitter and the receiver are turned on, operation is as previously described, except that speech signals pass through the remote control unit. The secondary of transformer C280 is not connected, so that no voice communication with field Telephone EE-8-(*) is possible. The field telephone station may ring the Ringer MC-131 in the remote control unit, however.

To communicate with a remote station, Switch SW-185 of the remote control unit is thrown to TELEPHONE, which disconnects Jacks JK-33-A and JK-34-A from Plugs PL-68 and PL-55 and connects them to transformer C280, also connecting Battery BA-27 in series to provide talking battery supply for the microphone at the remote control unit. When a remote station is to be called, the handle on the crank of Generator GN-38 is lifted and rotated to the right.

To allow the remote station to transmit and receive over Radio Set SCR-608-A, Switch SW-185 in the remote control unit is set to THROUGH. In this position, the speech signals from the field telephone may be passed to the transmitter by pressing the ANTI-HOWL switch SW-175 in the remote control unit. The ANTI-HOWL switch must be released for speech signals from the receiver to be passed to the field telephone. It is not possible to transmit from the remote control unit when Switch SW-185 is at THROUGH, but the speech signals can and must be monitored with a headset in Jack JK-34-A.

b. Radio Set SCR-628-A. The functions of Radio Set SCR-628-A are exactly the same as Radio Set SCR-608-A except that only one receiver is furnished. With this difference the foregoing discussion of the functioning of Radio Set SCR-608-A applies to Radio Set SCR-628-A.