ELECTRICAL AND MECHANICAL ENGINEERING REGULATIONS
(CANADA)

TELECOMMUNICATIONS FZ 152/1

WIRELESS SET (CDN.) No. 9, Mk. I

Technical Description (Instruction No. 1)

NOTE:—This information is provisional and is supplied for the use of Maintenance Personnel pending the issue of more complete instructions. All errors of a technical nature should therefore be notified through the usual channels to National Defence Headquarters (MM2).

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Instruction No. 1

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WIRELESS SET (CDN.) No. 9 MK. I

Instruction No. 1

TECHNICAL DESCRIPTION

General

1. Wireless Set (Cdn.) No. 9, Mk. 1 comprises a Sender, Receiver, Supply Unit; Coil, Aerial Tuning No. 2, and a Carrier No. 3. The equipment has been designed for use in a wireless vehicle and will operate satisfactorily when stationary or when on the move. The set can also be operated as a ground station, sheltered by a tent. The set is the result of a redesign of Wireless Set, (Cdn.) No. 9. The performance has been improved, and the operation has been simplified.

2. All the associated equipment which is required for operation either in a vehicle or as a ground station is supplied with the set. This complete equipment is called "Wireless Set (Cdn.) No. 9, Mk. I, Vehicle and Ground Station."

3. The carrier dimensions and the positions of the mounting holes of Wireless Set (Cdn.) No. 9 Mk. I are identical with those of Wireless Set No. 9 British or Canadian, and the two complete stations may be interchanged. The Mk. I Sender, Receiver, and Supply Unit, can only be used in Mk. I Carriers (Carrier No. 3) and these individual units are NOT interchangeable with those of Wireless Set No. 9, British or Canadian.

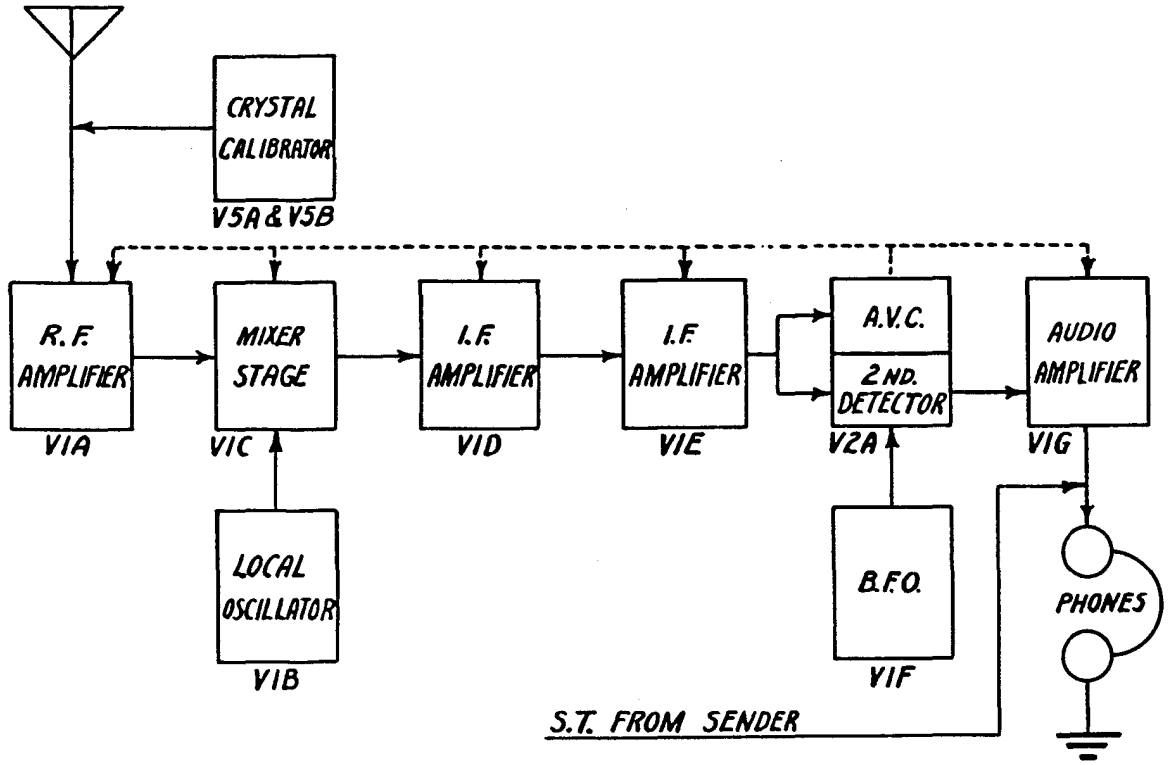


FIG. 1—BLOCK DIAGRAM OF RECEIVER

Brief Electrical Description

4. The receiver is an eight valve superheterodyne circuit. It consists of a stage of radio frequency amplification followed by a mixer valve. The local oscillator is a separate valve. Two stages of intermediate frequency amplification feed into a diode detector which is transformer-coupled to the audio output amplifier. Also feeding into the diode detector is a beat frequency oscillator. In addition to the actual receiver, there is a crystal calibrator circuit which is an integral part of the set but which has no influence on the receiver functions when not in use.

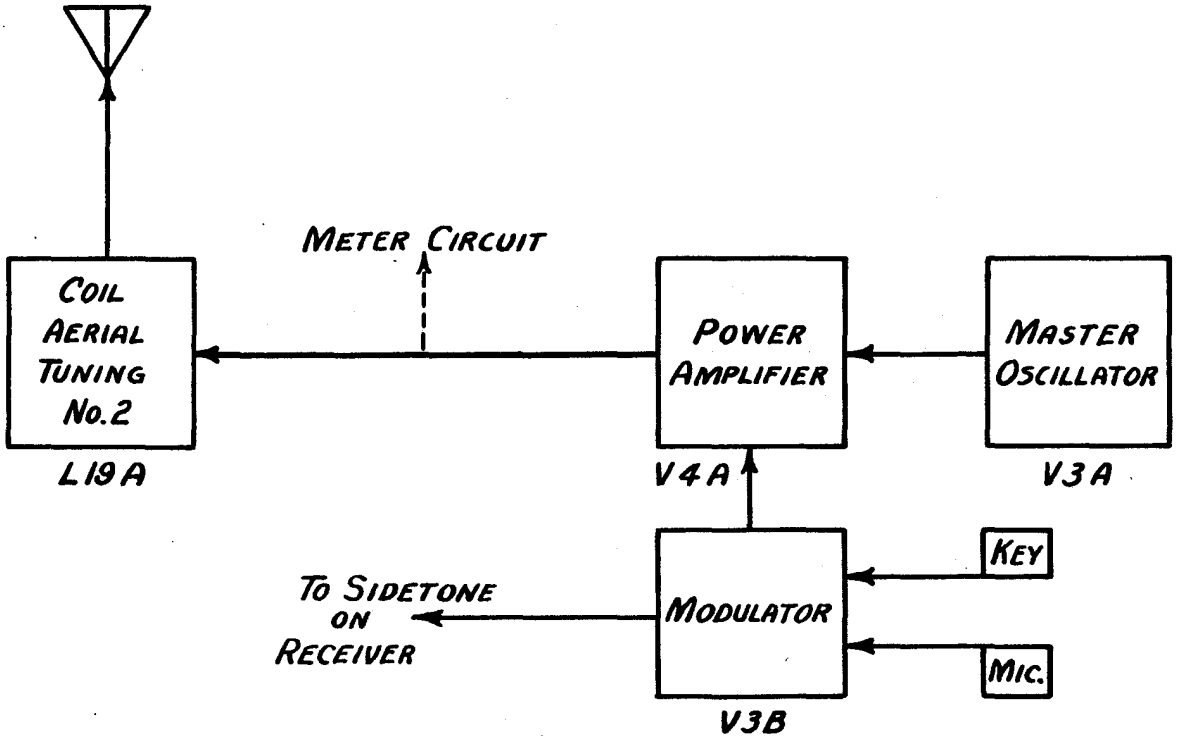


FIG. 2—BLOCK DIAGRAM OF SENDER

5. The sender consists of four main, self-contained units—the master oscillator, the amplifier, the modulator and the aerial tuning unit. The master oscillator uses a Colpitts' circuit arrangement and the R.F. developed in this circuit drives the P.A. valve which is grid modulated. The P.A. valve is matched to the aerial by the aerial tuning unit.

6. The Supply Unit receives 12V. from two accumulators and distributes H.T. and L.T. to the sender and receiver. Two H.T. dynamotors are used; one supplying H.T. to the sender, and the other supplying voltages to both receiver and sender. A three inch P.M. Speaker is installed in the housing of the Supply Unit but has no electrical connection to it.

Brief Mechanical Description

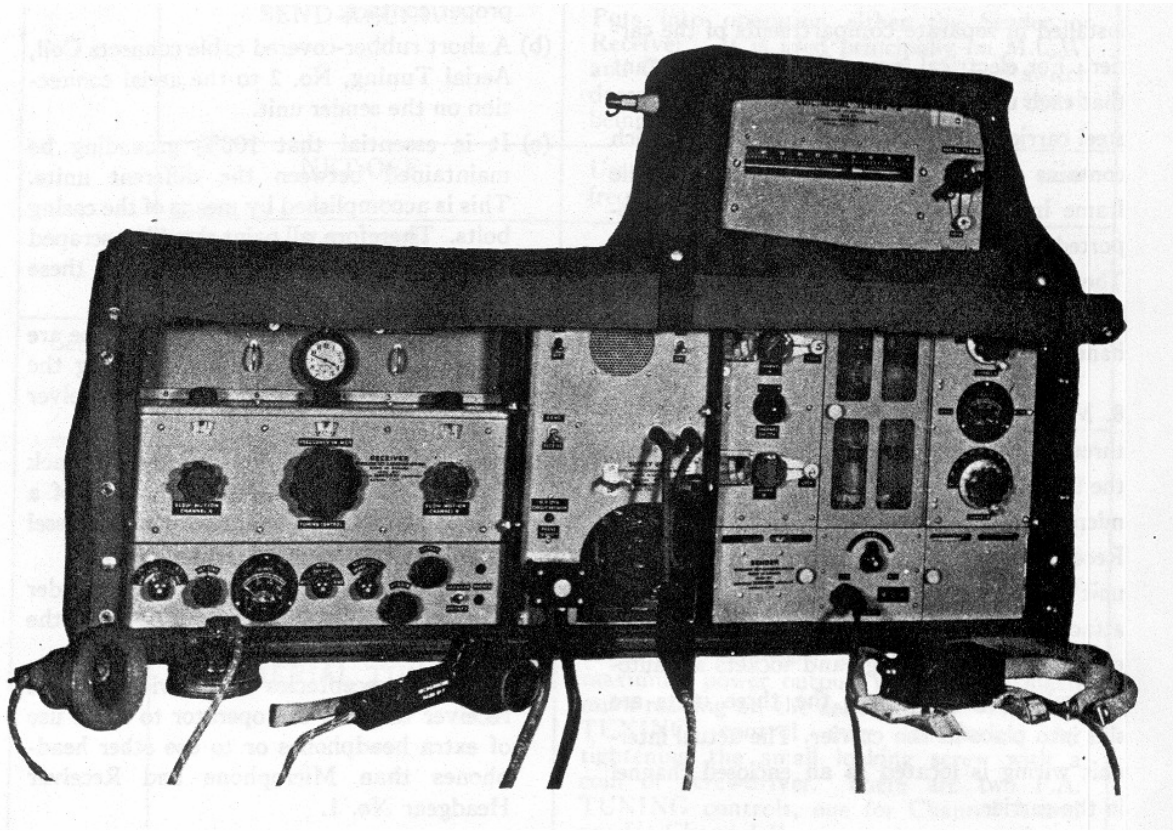


PLATE 1—MAJOR UNITS OF W.S. (CDN.) No. 9 MK. 1

7. The Wireless Set (Cdn.) No. 9 Mk. I comprises five major units which are physically distinct. These are the Sender, the Receiver, the Supply Unit; Coil, Aerial Tuning No. 2, and Carrier No. 3. The first three of these units are each enclosed in a metal case and are installed in separate compartments of the carrier. For electrical grounding, it is important that each unit be securely bolted in place. The steel carrier consists of two parts; one of which contains the wireless equipment and a cradle frame in which the whole equipment is supported through four rubber shock mounts. The aerial tuning coil fastens onto the outside of the carrier either on top or on the right hand side.

8. Many connections must be made among the three major units for distribution of power from the supply unit to the sender and receiver, for microphone and headphone wiring, for Send-Receive switching connections, etc. All inter-unit connections are made through plugs attached to the carrier, and sockets on the back of each unit. The plugs and sockets are automatically engaged when the three units are slid into place in the carrier. The actual inter-unit wiring is located in an enclosed channel in the carrier.

9. EXTERNAL CONNECTIONS:—

(a) Low Tension Plug No. 17 connects the +12V. batteries via a twin battery cable to the supply unit. This is a bakelite housed plug of the twin banana receptacle type, equipped with a locking bolt to ensure proper contact.

(b) A short rubber-covered cable connects Coil, Aerial Tuning, No. 2 to the aerial connection on the sender unit.

(c) It is essential that 100% grounding be maintained between the different units. This is accomplished by means of the casing bolts. Therefore, all paint should be scraped away around the holes through which these bolts pass.

(d) Two snatch plugs of the five-point type are provided on the supply unit allowing the use of two sets of Microphone and Receiver Headgear No. 1.

(e) Provision is made by means of a jack receptacle on the sender unit for use of a carbon microphone equipped with a pressel switch. (Microphone, Hand, No. 3).

(f) A jack receptacle is provided on the sender unit to receive a connector plug from the key. (Key and Plug Assemblies No. 9).

(g) Two jack receptacles are provided on the receiver to allow the operator to make use of extra headphones or to use other headphones than Microphone and Receiver Headgear No. 1.

TABLE 1—CONTROLS AND THEIR FUNCTIONS

Unit	Control	Function
Supply Unit	ON-OFF	Master switch which turns the complete Wireless Set on and off.
	SEND-RECEIVE	Puts into operation either the Sender or Receiver. It is used principally on M.C.W. and C.W. On R/T, the Mic. pressel switch does this automatically; the panel switch being left at RECEIVE.
	NET-OFF	Used to tune the sender to exactly the same frequency as the receiver.
	H.P. DYN CIRCUIT BREAKER	Protects the H.P. dynamotor against overload.
Sender	CHANNEL SWITCH	Selects either the CHANNEL A or CHANNEL B controls enabling the operator to change the sender frequency quickly.
	MASTER OSCILLATOR	Determines the sender frequency. The frequency is marked on the dial. When the control has been set it is locked in place by tightening the hand LOCK nut. There are two identical MASTER OSCILLATOR controls; one for Channel A and one for Channel B.
	P.A. TUNING AERIAL TUNING	These two controls tune the sender for maximum power output, indicated by maximum reading on the aerial meter. The P.A. TUNING control may be locked by tightening the small locking screw with a coin or screwdriver. There are two P.A. TUNING controls, one for Channel A and one for Channel B.
	AERIAL METER	An indicator which guides the operator when tuning for maximum power output.
	R/T MCW CW	Selects the type of transmission for the sender.
	HIGH-LOW	Located behind the lower right hand door of the sender. It provides for operation of the sender on either normal or reduced power output.
	KEY	Jack for Key and Plug Assembly No. 9
	MIC	Jack for Microphone Hand No. 3.

TABLE 1 (cont'd)

Unit	Control	Function
Receiver	TUNING CONTROL	Tunes the receiver to any frequency between 1.87 and 5.00 Mc/s. The frequency to which the receiver is tuned is indicated in the opening above the control. The tuning mechanism includes a two position mechanical flick device enabling the operator to preset the receiver at two frequencies.
	SLOW MOTION	When the TUNING CONTROL is locked at a flick position, small tuning adjustments can be made by turning the appropriate SLOW MOTION control. The dial numbers have no relation to frequency but are useful for reference.
	CW—R/T	Selects the type of reception desired. There are two positions for R/T reception and two for C.W. The AUTO position will normally be used. However, at the MAN position, there is slightly more volume and sensitivity.
	HET TONE	Varies the pitch of the incoming C.W. signal.
	METER SWITCH	Six position switch to enable the operator to check various L.T. and H.T. voltages.
	SELECTIVITY	Normally used at the FLAT position. Used to eliminate an interfering signal, by turning to SHARP.
	H.F. GAIN	Used as a volume control for MAN operation. For AUTO operation it should be left at maximum unless the distance between stations is very small.
	OUTPUT	Used to adjust the volume of the receiver when the selector switch is at AUTO. Left at maximum for MAN operation.
	SPEAKER-PHONES	Applies the receiver output to either the loud-speaker or the headphones.
	AERIAL TRIMMER	Used as a final adjustment to increase signal volume. This control may be locked by tightening with a coin, the small knurled screw at the left.
	LONG AERIAL—NORMAL	With some aerials at certain frequencies the AERIAL TRIMMER will not have much effect when this switch is at NORMAL. If no distinct peak is obtained when rotating the AERIAL TRIMMER, this switch should be put to LONG AERIAL.
	FREQUENCY CHECK	Selects the desired frequency output of the crystal calibrator.

DETAILED ELECTRICAL DESCRIPTION

Master Oscillator

10. The master oscillator, V3A, is the Colpitts' type, using a beam power tetrode, 6V6G. Associated with this valve are two identical Colpitts' circuits which can be preset to two different frequencies. It must be understood that the corresponding components are absolutely identical and that the two circuits are used only to allow an instantaneous change of frequency.

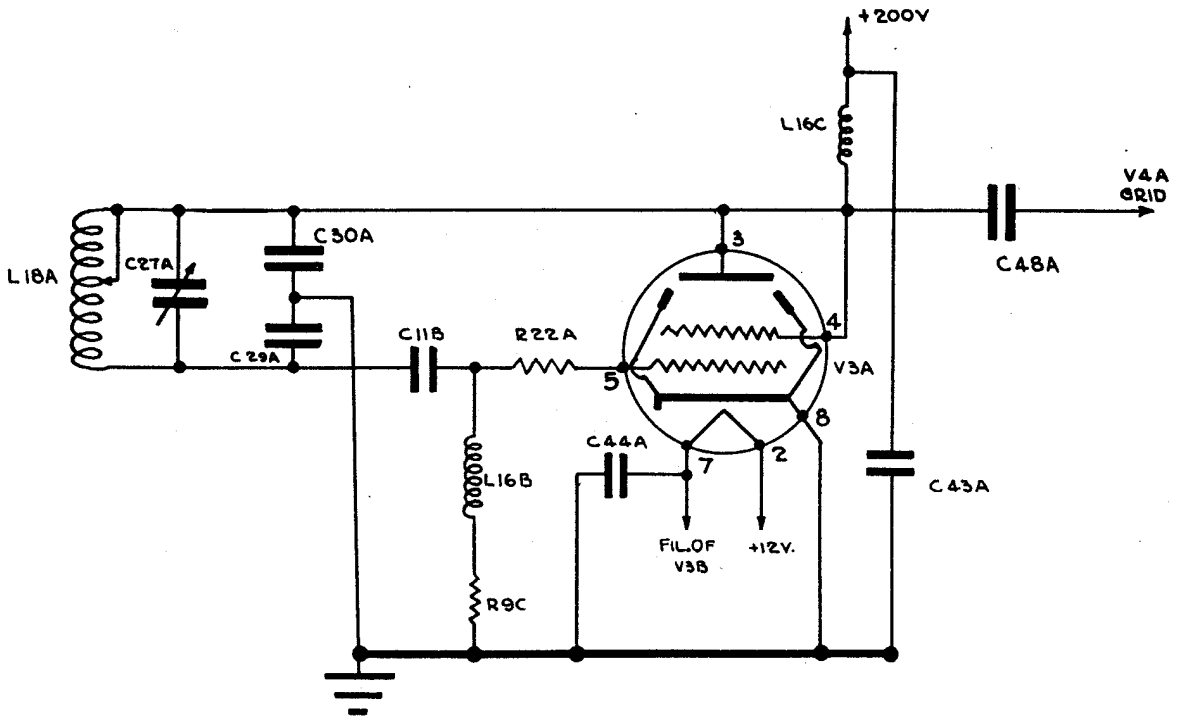


FIG. 3.—CIRCUIT DIAGRAM OF MASTER OSCILLATOR.

11. Variable inductance, L18A, is used on "A" band. A rotating contact, which rides along the winding when the coil is turned, adjusts the inductance of L18A. Fixed condensers C30A (500 uufd.), C29A (1000 uufd.) and trimmer C27A (140 uufd. variable) are in parallel with L18A. When using the "A" circuit, pilot light P1D (12V.) lights up. P1D receives its voltage through R46B (8 ohms.) which lengthens the life of the bulb. Similarly, when using the "B" circuit, P1E lights up and P1D is not lit. P1E receives its voltage from the same source as P1D. The "B" circuit is composed of continuously variable inductance, L18B; fixed condensers C30B (500 uufd.) and C29B (1000 uufd.); and trimmer condenser C27B (140 uufd. variable). In order to prevent errors, the controls of "A" band are red and those of "B" band are blue.

12. The master oscillator valve, V3A, is self-biased by the grid resistor, R9C (10,000 ohms). C11B (100 uufd.) is the grid coupling and D.C. blocking condenser, and R22A (50 ohms) suppresses any parasitic oscillations. C44A (.05 ufd.) by-passes any R.F. from the filament to ground. The plate and screen are tied together and receive their voltage through R.F. choke, L16C, from the +200V. supply. C43A (.02 ufd.) at this point is an R.F. filter. The output from the M.O. is coupled to the grid circuit of the power amplifier by C48A (50 uufd.) and R21A (130 ohms), a parasitic suppressor.

Modulator

13. The modulator valve, V3B (6V6G), acts as an A.F. amplifier when the selector switch, S11A, is at R/T position. However, when S11A is switched to M.C.W. or C.W., V3B becomes an audio oscillator. As an A.F. amplifier the control grid of V3B is connected through section 6 of S11A to the high potential end of the secondary of T4A; the low potential end being grounded, thus completing the grid circuit. Cathode bias is supplied by R31A (250 ohms), by-passed by C10B (12 ufd.). The plate and screen obtain their voltage from +200 V. supply. Since the filament of V3B requires 6.3V. as does the filament of V3A, they are connected in series to the +12V. supply. Voltage for the carbon microphone (See Paras. 56 and 57) is limited by R30A (35,000 ohms) in view of the fact that the output of a carbon type of microphone is greater than that of a dynamic microphone. The carbon microphone circuit is connected in parallel with the filament of V3B. C28A (100 ufd., 25 V. dry electrolytic) acts as a decoupling condenser, keeping the audio voltages out of the filament circuit. The screen is by-passed by C15B (1. ufd.) which acts as a filter in the +200V. line.

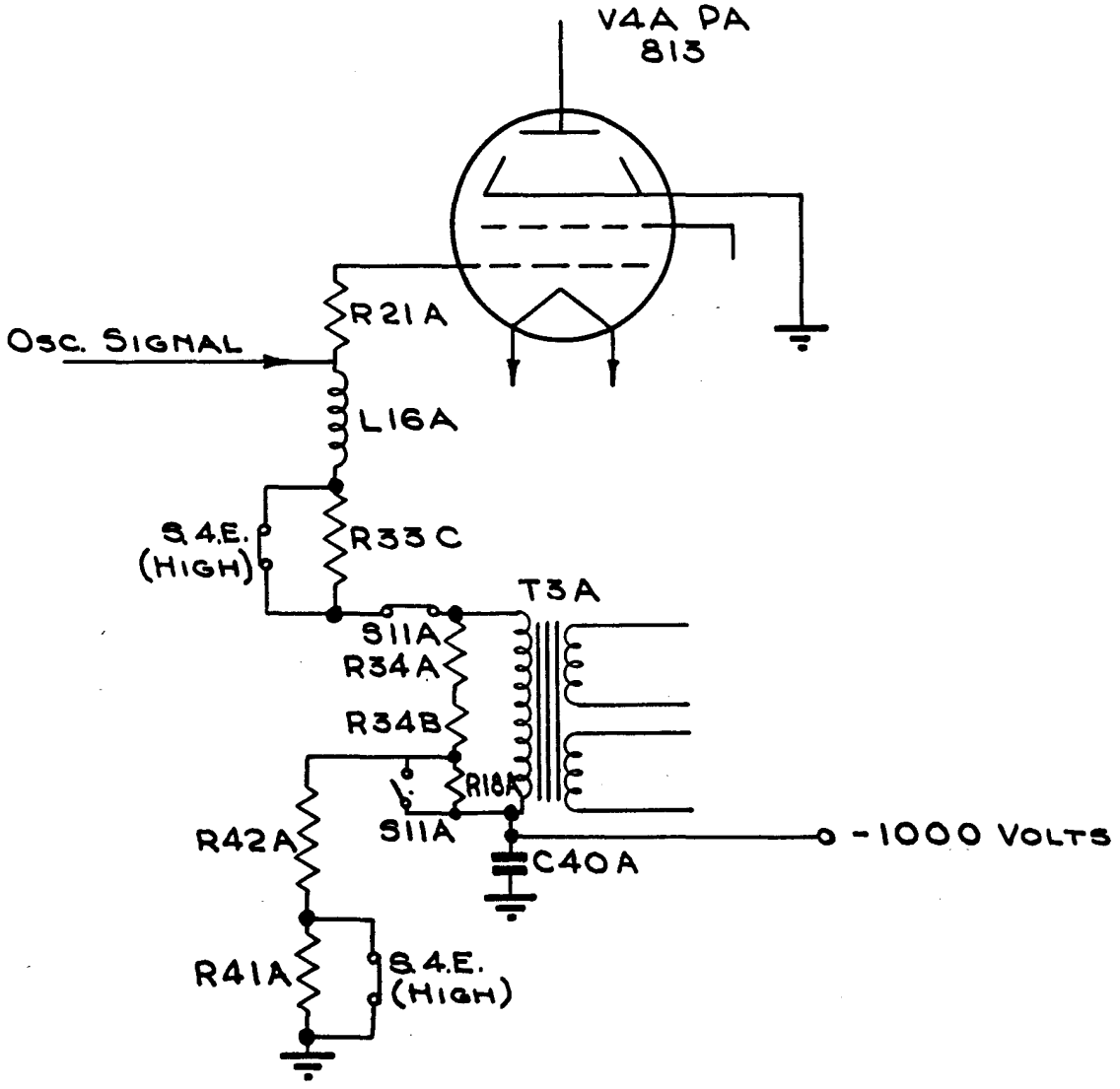


FIG. 4—GRID BIASING OF POWER AMPLIFIER ON HIGH POWER.

14. The output of V3B is fed to the primary of the modulation transformer, T3A, and the audio voltages induced in the secondary are used to grid modulate the power amplifier, V4A. R34A (10,000 ohms), R34B (10,000 ohms), and R18A (450 ohms) act as a load across the secondary. An extra winding is incorporated in T3A to pick off sidetone.

15. R18A (450 ohms), R42A (150 ohms) and R41A (1,500 ohms), in the modulator unit, form a bias bleeder network from the −1000V. line to ground. Bias for the P.A. valve, V4A, is taken from this voltage divider network through the modulation transformer, T3A. When the double-pole, double throw HIGH-LOW switch, S4E is switched to HIGH position, R41A and the audio voltage dropping resistor, R33C (15,000 ohms) are shorted out, thus lowering the bias on V4A and raising the audio output of V3B. C40A (5 ufd.) is the grid by-pass condenser. When S4E is switched to low power, the modulator load resistor, R33A (15,000 ohms) is switched into the circuit. R40A (4,000 ohms) acts as the meter multiplier on low power. R9A (10,000 ohms) is added in series with R40A on high power.

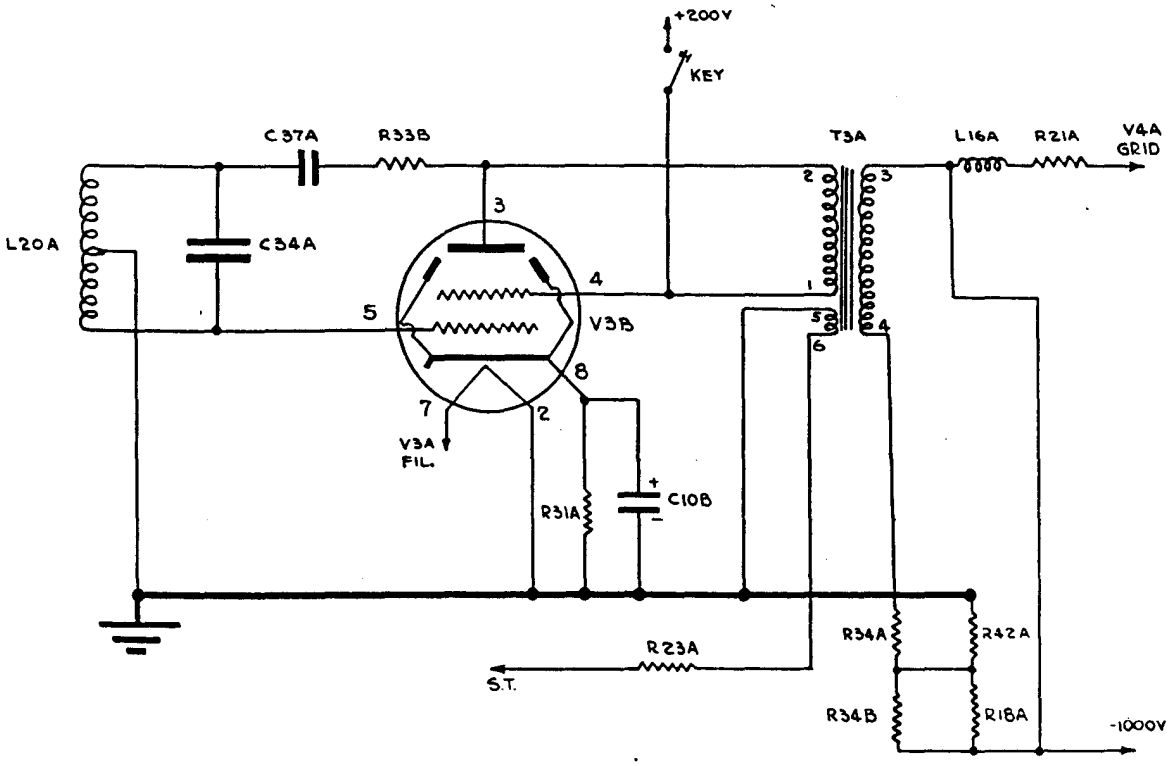


FIG. 5—V3B AS AN AUDIO OSCILLATOR

16. On M.C.W. and C.W., V3B functions as an audio oscillator, the plate being keyed through section 1 of S11A. In the 1st, 3rd, 5th, and 6th sections of S11A, the M.C.W. and C.W. positions are connected together. Section 6 of S11A removes the grid from the high potential end of T4A secondary and connects it to the plate through an oscillator tank circuit composed of L20A and C34A (.1 ufd.), an audio coupling condenser, C37A (.01 ufd.) and a feedback limiting resistor, R33B (15,000 ohms). Section 3 of S11A connects the centre tap of L20A to ground. Thus this stage becomes a type of Hartley oscillator. The primary of T3A, an iron-core inductance, parallels the oscillator tank circuit (connected to ground through the power supply), and the frequency of the oscillator, is lowered to supply

a suitable audio note. Section 2 of S11A, on M.C.W., changes the connection from T3A to the grid of the power amplifier to the junction of R34A and R34B, thereby reducing the gain of the transformer, T3A. On M.C.W., Section 4 of S11A, places R29A (25,000 ohms) in parallel with resistors R34B and R18A. Section 5 of S11A places R23A (5,000 ohms) in series with the sidetone lead thus cutting down the output to the receiver on M.C.W. and C.W.

17. On C.W., Section 2 of S11A connects the low end of the secondary of T3A to the grid of the power amplifier valve since no modulation is desired; while Section 4 of S11A shorts out R18A thus lowering the bias on the P.A. grid.

Power Amplifier

18. The P.A. unit uses a beam power valve, type 813. As the filament of the 813 requires 10 V., R19A (.4 ohms) is used to lower the +12 V. supply. C44B (.05 ufd.) is an R.F. by-pass in the filament circuit. Grid bias is supplied from the bias network in the modulator unit as described in Para. 20. Screen voltage is supplied from the +200 V. line. The screen is by-passed by C3AB (.1 ufd.). The beam plates are grounded. Plate voltage is taken from the +1000 V. supply through R.F. choke, L17A. S10A, operated by the door of the P.A. unit, opens and closes the +1000 V. line as a protective measure. C32A (.5 ufd) is an extra filter for H.T. The output of the power amplifier is coupled to the aerial tuning circuit by C18A (.001 ufd.). Channel switch S9B, selects either C42A (250 uufd.) on Channel A or C42B (250 uufd.) on Channel B, the P.A. tuning condensers.

19. R26A (10 meg.) is a static charge leak. S12A, the aerial switch, is operated by the 12 V. relay. It is normally in the receive position, but when the SEND-RECEIVE switch on the supply unit, or the pressel switch, if using Microphone and Receiver Headgear No. 1, is at SEND position, it connects the sender to the aerial tuning coil.

Aerial Tuning Coil

20. Coil, Aerial Tuning, No. 2 is self-contained in a separate case. It is simply a variable inductance which is equipped with a crank tuning mechanism. When the coil is rotated, a sliding contact wheel travels along the winding lengthening or shortening the inductance. The position of this wheel may be seen through the window against a calibrated dial.

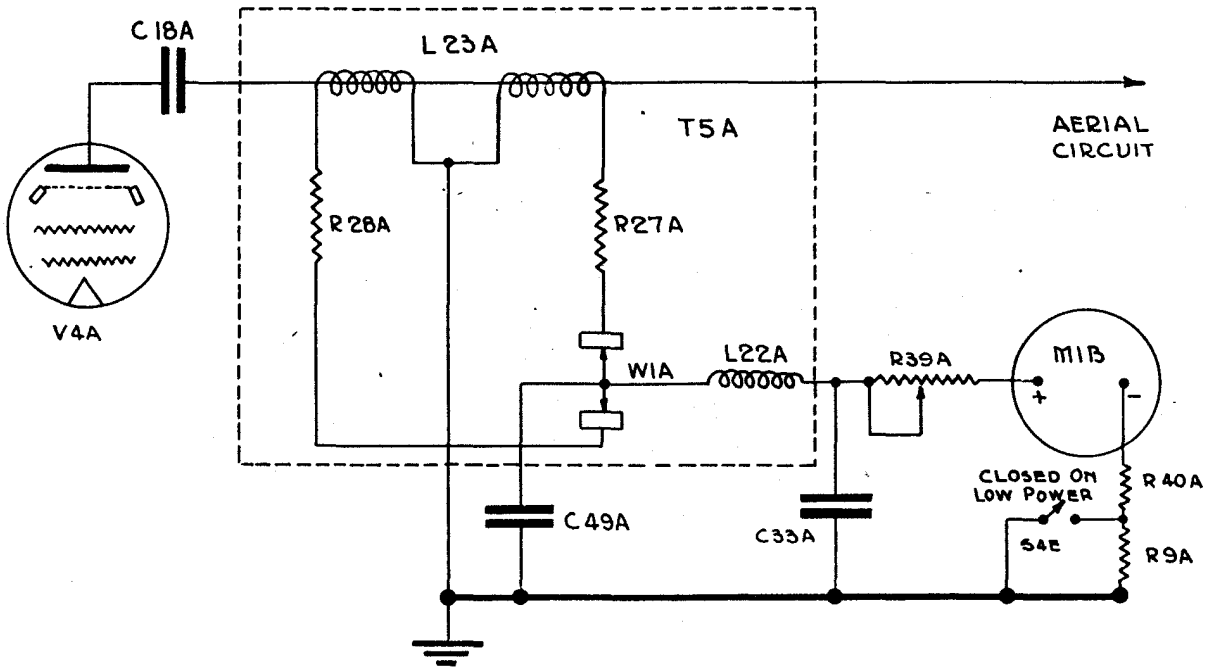


FIG. 6—METER CIRCUIT

Aerial Meter Circuit

21. R.F. aerial currents flowing through the primary of L23A induce voltages in the two secondaries whose junction is grounded. The unequal secondaries feed the full-wave dry rectifier, W1A, through damping resistors R28A (27 ohms) and R27A (330 ohms) which tend to distribute the load more evenly, C49A (1000 uufd.) by-passes the centre of W1A to ground, completing the R.F. circuit for each secondary and thus acting as a filter for the rectified D.C. The centre of W1A has a path to ground through R.F. choke L22A, R39A (20,000 ohms variable), the D.C. milliammeter, M1B, and meter multipliers R40A (on low power only) and R9A (See Para. 15) to ground.

Aerial Circuit

22. Switch S4B places C11A (100 uufd.) in series with the aerial or shorts it out of the aerial circuit, thus matching either a long or short aerial to the receiver. With the long aerial, C11A is placed in series with the aerial and when using a short aerial it is shorted out of the circuit.

23. L1A is the aerial coupling transformer and C1A, (75 uufd.) the aerial trimmer. C2A (20 uufd.) is an aerial coupling condenser. L1A and C2A form a mixed capacity and inductive coupling circuit. The first and foremost use of C3A (.1 ufd.) is to complete the R.F. circuit from the grid of V1A to ground. It also acts as a decoupling condenser in conjunction with R1A (100,000 ohms) through which A.V.C. voltage is applied to the grid of V1A. The secondary of L1A is tuned by C4A (440 uufd.) which is the first section of the three-gang tuning condenser. C41A (15 uufd.) is the trimmer.

R.F. Amplifier

24. V1A, the R.F. amplifier, uses an ARP3 type valve. The suppressor grid is tied externally to the cathode, which is by-passed by C3B (.1 ufd.). Cathode bias is taken from the bleeder network consisting of R13A (40,000 ohms) and H.F. GAIN control, R12A (10,000 ohms variable), from the + 150 V. line to ground. R2A (300 ohms) is a fixed minimum bias resistor. The screen and plate are at the same potential; since they obtain their voltage from the +150V. line through R3A (3,000 ohms). Due to working with a low voltage supply it is necessary to operate the screen and plate at the same potential to obtain satisfactory amplification. C3C (.1 ufd.) acts as the screen by-pass and in conjunction with R3A forms a decoupling network, preventing R.F. from entering the +150V. line.

25. The amplified output of V1A is fed from the plate to the primary of L2A, the permeability-tuned R.F. transformer. The R.F. voltages induced in the secondary of L2A are applied between the control grid and the cathode of the mixer valve, V1C. C6A (1830 uufd.) is a fixed tuning condenser, and is in series with C4B (440 uufd. variable), part of the ganged tuning condenser. This section of the ganged condenser is trimmed by C41B (15 uufd.). A.V.C. bias voltage is supplied to this stage through R1B (100,000 ohms). C3D (.1 ufd.) in conjunction with R1B forms an A.V.C. decoupling network.

Local Oscillator

26. V1B, the local oscillator, also uses an ARP3 type valve which is operated as a triode by connecting together the screen, suppressor and plate. The circuit employed is a conventional tuned grid, untuned plate oscillator. The grid coil is tuned by the fixed tuning condenser, C12A (795 uufd.) in series with C4C (440 uufd. variable), a section of the ganged tuning condenser. C50A (3–13 uufd. ceramic) is the trimmer for this section of the ganged condenser. L3A is permeability-tuned; this adjustment being made when aligning at the L.F. end of the band. C36A (40 uufd.) is the grid coupling condenser and R1D (100,000 ohms) is the grid leak. The cathode is connected to the junction of R1D and R2D (300 ohms), and is by-passed by C3R (.1 ufd.). +150V. is fed to the plate through R11A (5,000 ohms.) C3Q (.1 ufd.) completes the plate R.F. circuit and together with R11A forms a decoupling network to keep R.F. out of the +150V. line. The output of the local oscillator is taken from the grid of the local oscillator to the suppressor grid of the mixer valve.

Mixer

27. The cathode of V1C is raised above ground potential for cathode bias purposes by R4A (1,000 ohms), and is by-passed by C3E (.1 ufd.). The plate and screen are again operated at the same potential; +150V. being obtained through R5A (50,000 ohms). C3F (.1 ufd.) is the screen by-pass and decoupling condenser.

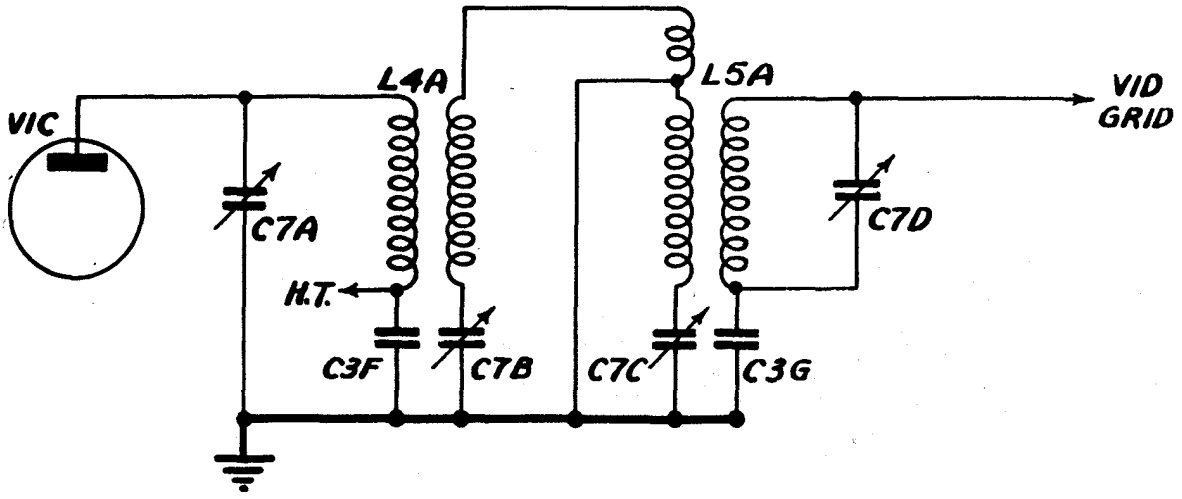
28. The R.F. signal which is applied to the control grid and the output of the local oscillator which is fed to the suppressor grid are mixed in valve, V1C. The local oscillator is made to oscillate at a frequency 420 Kc/s. higher than the incoming signal frequency. Thus there are four main frequencies present in the mixer valve; the frequency of the incoming signal, the frequency of the locally developed R.F. and the sum and difference of these frequencies. The I.F. stages are tuned to 420 Kc/s. which is the difference frequency, and it is this frequency which is fed through a shielded lead from the plate of V1C to the primary of the input I.F. transformer, L4A.

Band Pass Filters

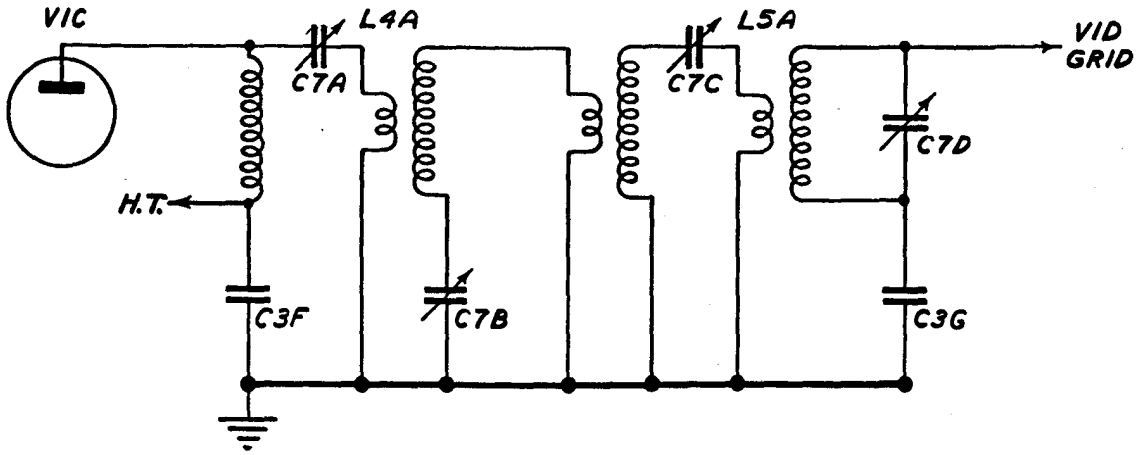
29. There are two stages of I.F. amplification, coupled by pairs of I.F. transformers, arranged as band-pass filters, and a single, tuned I.F. transformer feeding the 2nd Detector.

30. When the SHARP-FLAT switch, S1A, is at the SHARP position, the primary of L4A, tuned by C7A (100 uufd.) is loosely inductively coupled to the secondary of L4A. The secondary of L4A, tuned by C7B (100 uufd.), is link coupled to the primary of L5A. The primary of L5A which is tuned by C7C (100 uufd.) is, in turn, link coupled to the secondary of L5A, which is tuned by C7D (100 uufd.). This results in a band width of less than 7 Kc/s. Actually it will be found that the band width is approximately 4 Kc/s. (See Fig. 7 (a)).

31. When S1A is at the FLAT position, the primary of L4A is link coupled to the secondary of L4A. The tighter coupling between the primary and secondary of L4A and the fact that the primary of L4A is slightly detuned due to the addition of the coupling coil, results in a greater band width; slightly more than 7 K/cs. (See Fig. 7 (b)).



(A) S1A ON SHARP



(B) S1A ON FLAT

FIG. 7—SHARP FLAT SWITCH (S1A).

1st I.F. Amplifier

32. V1D (ARP 3) is a conventional I.F. amplifier. A.V.C. voltage is applied to the control grid through R1C (100,000 ohms). C3G (.1 ufd.) together with R1C forms an A.V.C. decoupling network. The suppressor grid is connected externally to the cathode. Like V1A, the cathode bias is derived from the bleeder network between the +150 V. line and ground, with R2B (300 omhs) acting as a fixed minimum bias resistor. The cathode is by-passed to ground by C3H (.1 ufd.). The screen and plate which operate at the same potential, receive their voltage through R3B (3,000 ohms) from the +150 V. supply. The screen is by-passed to ground by C3J (.1 ufd.).

33. The output of V1D is coupled to the control grid of the 2nd I.F. amplifier, V1E, by L4B and L5B, which are identical to the 1st band pass filter described in Paras. 30 and 31. Condensers C7G and C7H (100 uufd. each) trim the primary and secondary of L5B respectively.

2nd I.F. Amplifier

34. V1E, the second I.F. amplifier, also uses an ARP 3 type valve. R2C (300 ohms) is the cathode bias resistor and C3L (.1 ufd.) the cathode by-pass condenser. The suppressor grid is connected to the cathode. Reduced A.V.C. voltage is taken from the junction of R6C (50,000 ohms) and R17A (250,000 ohms) to the grid of V1E. C3K (.1 ufd.) is the A.V.C. decoupling condenser. The screen and plate receive their voltage from the +150 V. line through R3C (3,000 ohms). C3M (.1 ufd.) by-passes the screen grid to ground. The output of V1E is passed to the primary of the diode input transformer, L6A, whose primary winding is tuned by C7J (100 uufd.).

Detector Diode, V2A

35. V2A, a double diode valve, type 12Y4 (ARDD 1), is used as the second detector and to produce the A.V.C. voltage. One end of the untuned secondary of L6A is connected to the detector diode plate, the low potential end being connected to the cathode through load resistors R16A (25,000 ohms) and R4B (1,000 ohms). C9A (.002 ufd.) is the diode load by-pass condenser. The I.F. signal voltage induced in the secondary winding of L6A is thus applied between the detector plate and cathode of V2A, where it is rectified. The desired amount of audio is picked off by the moving arm on the OUTPUT control, R10A (100,000 ohms). This audio voltage is then coupled to the primary winding of the audio input transformer, T1A, by C3N (.1 ufd.).

A.V.C. Diode, V2A

36. A portion of the output of V1E is coupled from the plate end of L6A to the A.V.C. diode

plate by D.C. blocking condenser, C8A (50 uufd.). Since the cathode of V2A is connected to ground through R8A (600 ohms) no rectification will take place until the I.F. voltages applied to the A.V.C. diode plate are great enough to overcome the positive potential placed on the cathode by R8A. Therefore, no A.V.C. bias voltages will be produced until the signal input reaches a predetermined level (delayed A.V.C.).

37. When the strength of the incoming signal is sufficiently great to cause rectification to take place at the A.V.C. diode, a negative voltage will build up at the plate end of the A.V.C. load resistors, R6A (500,000 ohms) and R17A (250,000 ohms). This negative voltage is used to bias the control grids of V1A, V1C and V1D. A smaller value of bias voltage is taken from the junction of R6A and R17A to bias the grids of V1E and V1G. R6B (500,000 ohms) and C3S (.1 ufd.) form an A.V.C. filter to remove the A.C. component from the bias voltage. R6D (500,000 ohms) and C3AC (.1 ufd.) form an A.V.C. filter in the A.V.C. line leading to valves V1E and V1G. R15A (4 meg.) in the A.V.C. line to valves V1A, V1C, and V1D; and R15B (4 meg.) in the A.V.C. line to valves V1E and V1G are used to increase the time constant on C.W. AUTO. The time delay is increased so that A.V.C. voltage does not follow the large input changes between key up and key down conditions during normal sending. R1E (100,000 ohms) and C3T (.1 ufd.) form an additional A.V.C. filter as do R1F (100,000 ohms) and C3K (.1 ufd.) in the reduced A.V.C. line. (See Fig. 8).

38. Switch S2A has four positions, namely: "C.W.-MAN," "C.W. AUTO," "R/T AUTO," and "R/T MAN." In the first position (C.W. MAN) both A.V.C. lines are grounded and the gain is controlled manually by the H.F. GAIN control, R12A. In this position, plate voltage is supplied to the B.F.O. (V1F) causing it to operate. In the C.W. AUTO position, A.V.C. voltage is applied to all the valves mentioned in Para. 37 and plate voltage is supplied to the B.F.O. as in C.W. MAN. When S2A is at R/T AUTO, A.V.C. voltage is applied to the above-mentioned valves but R15A and R15B are shorted out of the circuit thus reducing the time delay. The B.F.O. plate voltage is removed since it operates only on C.W. In the R/T MAN position, both A.V.C. lines are grounded. (See Fig. 8).

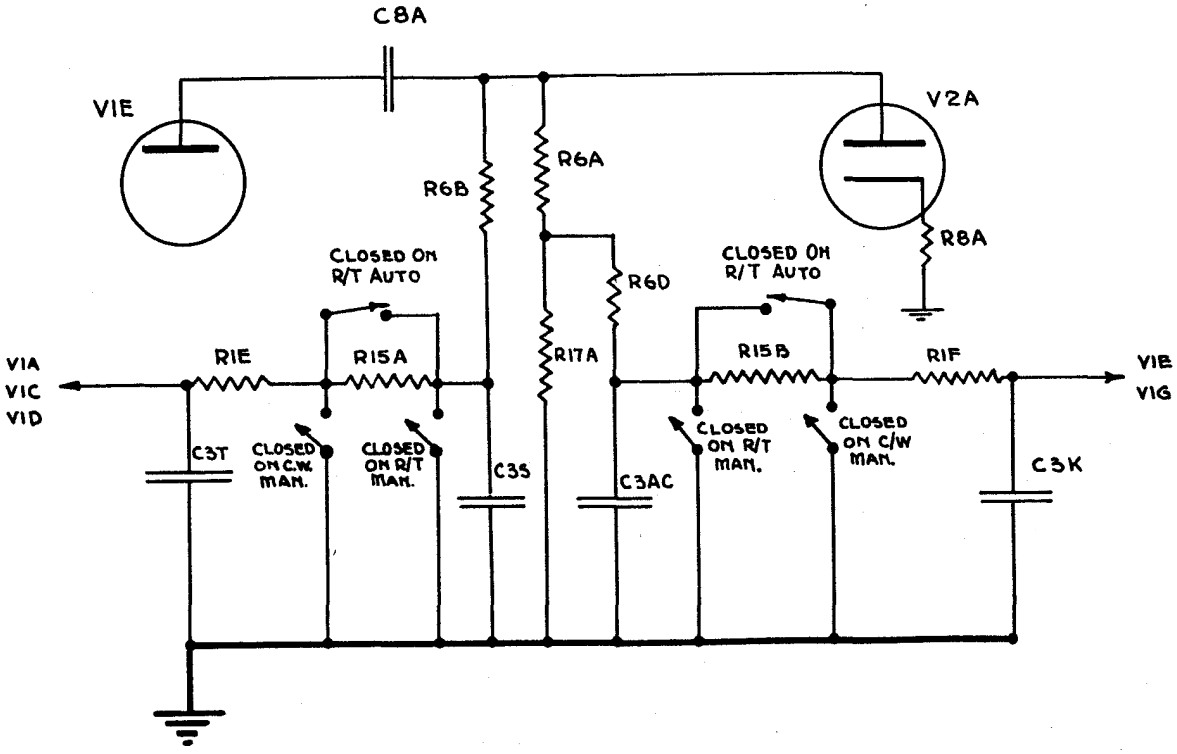


FIG. 8—SIMPLIFIED A.V.C. CIRCUIT

Audio Amplifier

39. T1A is an inter-valve, iron-core, audio transformer, and has a step-up ratio of 1:5. Audio voltages induced in the secondary of T1A are fed to the grid of V1G. R38A (2 meg.) across the secondary of T1A improves the frequency response.

40. V1G (ARP3) is the output audio amplifier. The suppressor grid is connected externally to the cathode. Cathode bias is obtained by R8A (600 ohms) which is by-passed by C10A (12 .ufd. electrolytic). Reduced A.V.C. is applied to the control grid through the secondary of T1A. The screen, by-passed by C3P (.1 ufd.) receives its voltage through voltage dropping resistor R7A (20,000 ohms) from the +150 V. line. The plate is operating at approximately +150 V. which it receives through the primary of T2A, the audio output transformer.

41. The amplified audio is taken from the plate of V1G and fed to the primary of T2A and the audio induced in the secondary is fed through S4A, the SPEAKER-PHONE switch, to either the headphones or the speaker. Due to the fact that the resistance of the headphones is quite high while that of the speaker is comparatively nil, a tap is used on the secondary of T2A to match the speaker; the whole secondary winding being employed when using the headphones.

Sidetone

42. Sidetone from the sender is coupled to the headphones by C31A (.25 ufd.). The Telephone line is fed directly to the headphones.

Beat Frequency Oscillator

43. The beat frequency oscillator uses a parallel-fed modified Hartley circuit. V1F (ARP3), the oscillator valve, is a pentode with the screen, suppressor and plate tied together to form a triode. Cathode bias is supplied by means of R4[illegible] (1,000 ohms) which is by-passed by C[illegible] (.1 ufd.). The oscillator coil, L7A, is fixed-tuned by C39A (150 uufd.) and trimmed by C[illegible]K (100 uufd.). The frequency of the B.F.O. may be varied slightly by adjusting the HET TONE control, R14A (2000 ohms potentiometer), which is in series with R32A (500 ohms) and C38A (350 uufd.) across the grid portion of L7A. The plate end of L7A is coupled to the plate section of V1F through D.C. blocking condenser C9B (.002 ufd.). Plate voltage is supplied from the +150V. line through R1G (100,000 ohms) and R9B (10,000 ohms) when S2A is at C.W. positions.

Meter

44. The meter on the receiver has a range of 0–.5 Ma., with an internal resistance of 360 ohms. The meter switch, S3A, is a rotary, double-pole, 12-position switch. The switch has six usable positions, namely: MOD, TUNE, BAT., H.T. 1, H.T. 2, and BIAS. When switched to MOD position, the audio voltages induced in the sidetone winding of the modulation transformer are rectified by a full-wave Westector unit, W1B, and the rectified audio is fed through meter multiplier R24A (2,500 ohms), and through the meter to ground. On TUNE position, the meter is placed across diode load resistor, R4B. Thus, an indication is given of the position at which the strength of the incoming signal is at maximum. When S3A is switched to BAT., the meter measures the input L.T. voltage through meter multiplier R43A (30,000 ohms). R45A (600,000 ohms) and R45B (600,000 ohms) are the meter multipliers when reading H.T.1 (+150V.) and H.T.2 (+200V.) respectively. When S3A is at BIAS position, the positive side of the meter is grounded and the negative side is connected to the BIAS terminal in PL1A through meter multiplier R44A (300,000 ohms).

L.T. Circuit

45. All the valves have 12V. heaters. Thus, one side of each heater is grounded; the other is connected to the +12V. supply.

46. The indicator lamps have 12V. filaments with one side grounded and the other side connected through R46A (8 ohms) to the +12 V. supply. R46A lengthens the life of these bulbs.

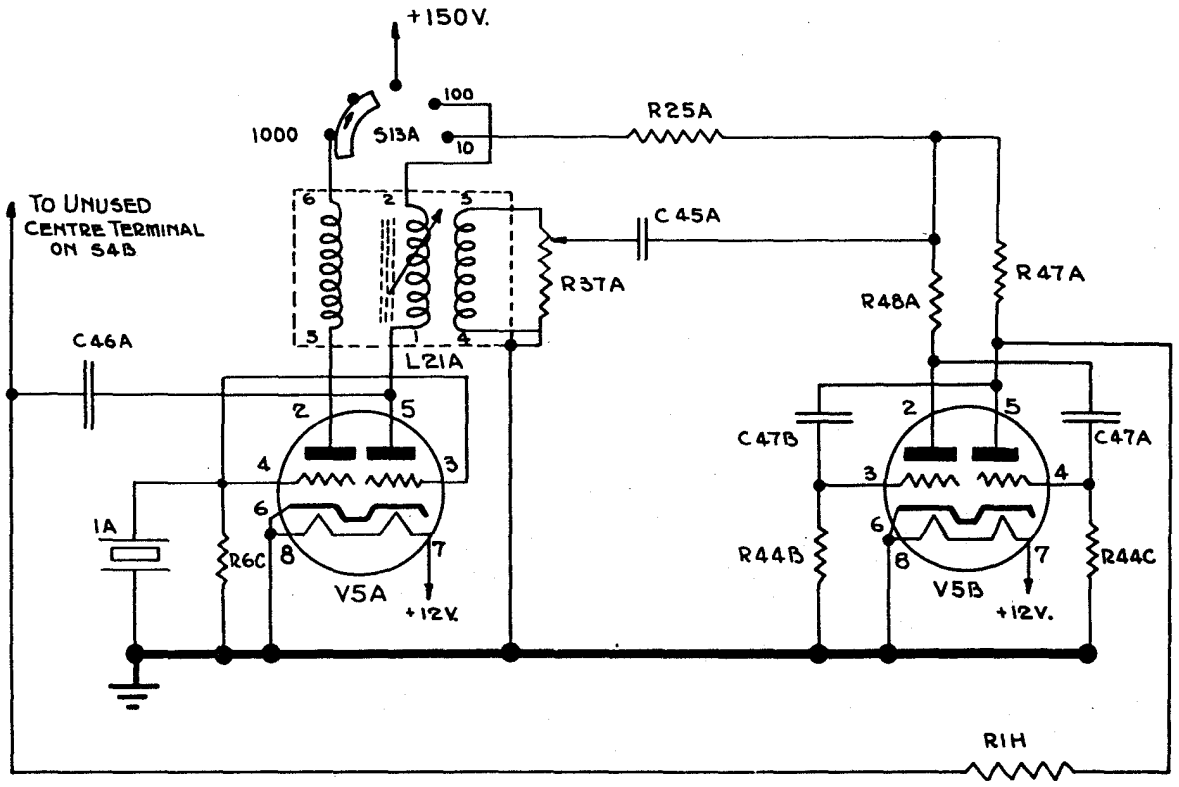


FIG. 9—CIRCUIT DIAGRAM OF CRYSTAL CALIBRATOR.

Crystal Calibrator

47. This circuit which employs two 12SC7 valves is designed to deliver beats at 1000, 100 and 10 Kc/s. corresponding to the 1000 and 100 calibration markings on the dial of the receiver. Any one of these positions may be turned on by means of switch S13A. The crystal will operate at either 1000 or 100 Kc/s. The crystal is connected between the grids of V5A, the oscillator valve, and ground. Across the crystal, 1A, there is R6C (500,000 ohms) acting as a grid leak. The heaters of V5A and V5B are on continuously with the receiver. When switch S13A is turned to the 1000 Kc/s. position, +150 volts is applied to one of the plates of the oscillator through one of the windings of coil L21A. This winding is tuned to 1000 Kc/s. and will influence the crystal to oscillate at this frequency. This winding being inductively coupled to the second winding in the coil, the output is taken from the second winding and fed to the receiver aerial through C46A (2 uufd). The action is exactly the same when S13A is turned to the 100 Kc/s. position except that the other plate of V5A is in operation, together with the second winding of L21A which is tuned to 100 Kc/s. and which is trimmed by means of an adjustable slug. The output of the 100 Kc/s. winding is coupled to the aerial circuit of the receiver by C46A. Turning S13A to the 10 Kc/s. position brings the multivibrator into action, but does not stop the oscillator from operating on the 100 Kc/s. position as the plate voltage is still being applied through the second winding of the coil.

Multivibrator

48. The purpose of the multivibrator is to deliver beats at 10 Kc/s. intervals. Multivibrators are very unstable and have to be locked to a certain frequency in order to be satisfactory. All multivibrators can be made to oscillate at the fundamental of the control frequency or at either the harmonics or the sub-multiples of the control frequency. The multivibrator, in this case, is locked to a sub-multiple of 100 Kc/s.

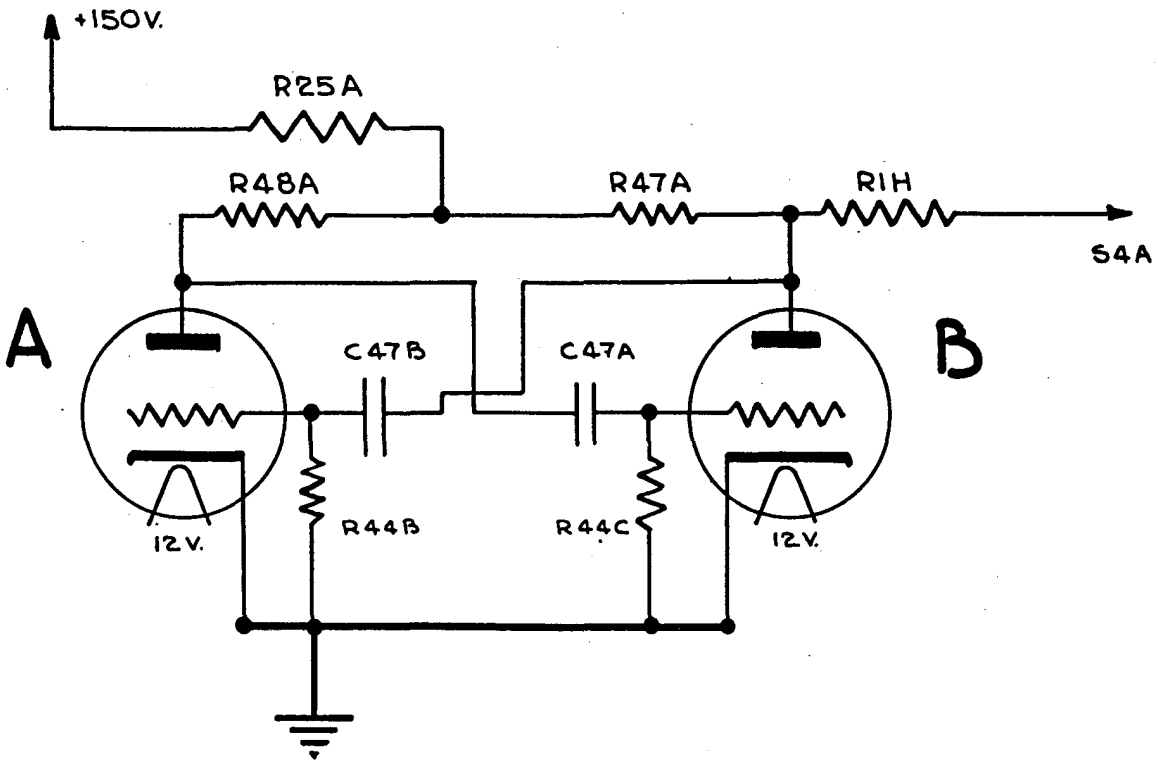


FIG. 10—SIMPLIFIED DIAGRAM OF THE MULTIVIBRATOR

49. The multivibrator which is a type of relaxation oscillator, is essentially a two stage, resistance coupled amplifier whose output is fed back into its input circuit. Owing to some momentary unbalance in the circuit the plate current in section B increases. The voltage drop across R47A (200,000 ohms) increases, in consequence of which the plate voltage of B is decreased. This lowering of plate voltage acts through C47B (80 uufd.) and makes the grid voltage of A more negative. The plate current of A now decreases and, due to amplification, this decrease in plate current is considerably greater than the originating plate current increase in B. Since a smaller plate current flows in A, there is a reduced voltage drop across R48A (10,000 ohms) and the plate voltage of A is increased. This increase in plate potential acts through C47A (80 uufd.) and makes the grid potential of B less negative. Consequently there is a further increase in the plate current of B and this is much larger than the initial increase, due to amplification. This action is cumulative, each further increase in B resulting in a further decrease in A, so that the plate current of A is very rapidly reduced to zero because the grid voltage of A becomes so highly negative. At the same time, the plate current of B increases.

50. This state of unbalance does not continue. C47B discharges and the grid potential of A becomes less negative and plate current begins to flow again. This increase in plate current of A results in an increased voltage drop across R48A and plate voltage of A decreases. This drop in plate voltage acts through C47A and grid potential of B becomes more negative and plate current decreases. The decreased voltage drop across R47A causes plate voltage of B to increase. This increased plate voltage acts through C47B and makes the grid voltage of A less negative. The plate current of A increases and due to amplification the increase is greater than the first increase that started in this phase. Again this action is cumulative for each further increase in plate current of A there is a further decrease in plate current of B. Hence the plate current of B falls to zero rapidly due to the high negative bias, while the plate current of A simultaneously attains finite

value which of course is limited by R48A. C47A discharges making the grid voltage of B less and plate current of B begins to rise. The operation is now back to the point at which it started and the cycle recommences and keeps on going.

51. The frequency of oscillation of the multivibrator depends mainly on the time constant caused by condensers C47A and C47B, and resistances R44B (300,000 ohms) and R44C (300,000 ohms). V5B is oscillating very unstably and must be stabilized. The output of V5A which is oscillating at 100 Kc/s. accomplishes this. The output from V5A is inductively coupled to a third winding in L21A and across this winding is a potentiometer R37A (5000 ohms) from which point the necessary amount of R.F. is taken and coupled to the plates of V5B through C45A (.01 ufd). The multivibrator can now be stabilized by adjusting R37A. Care must be taken in this adjustment as the multivibrator can be forced to oscillate at other sub-multiples of 100 Kc/s. The adjustment should be checked by counting the number of beats to every 100 Kc/s. position making sure that there are ten beats, no more, no less. The output from the multivibrator is connected to the receiver aerial circuit through R1H (100,000 ohms) a plate resistor. Plate voltage for the vibrator is supplied through the common load resistor R25A (5,000 ohms).

Aerials

52. The aerial rods "F" are 4-ft. rods which are supplied in three different diameters so that they can be fitted together to form a whip aerial. A 16-ft aerial comprises two bottom sections, one middle section and one top section. This is the longest aerial which can be supported on Aerial Base C-1.

53. Adaptors, V, Laport is a "V" shaped metal connector by which two similar 8-ft. whip aerials may be supported from the one base in a 39 degree angle. The resultant effect is that of lengthening the aerial.

54. Antennae, Vertical, 34-ft. Steel and the 20-ft. mast which accompanies it are fully described in a pamphlet contained in Bag, Aerial Gear, Canadian. This aerial is to be used whenever a ground station is established.

55. Four horizontal aerials cut to different lengths, and with insulators attached, cover the frequency range of the Wireless Set. They can be used with the equipment in a stationary vehicle, or with the ground station. The horizontal aerials will radiate rather better than the 34-ft vertical, but no one aerial will cover the frequency range of the set. The reading of the aerial meter is very small when horizontal aerials are used. However, this does not indicate low output power. An adjustment can be made to increase the meter sensitivity. Approximate frequency coverage in Mc/s. of horizontal aerials is as shown in Table 2.

TABLE 2—FREQUENCY COVERAGE IN MC/S.

Aerials Used	Wireless Set in Vehicle-Aerial connection through the Aerial base	Wireless Set as Ground Station
Aerials 250-ft. No. 1	2.2 —3.2	2.2 —3.2
Aerials 185-ft. No. 1	3.2 —4.7 1.87—2.2	3.2 —4.7 1.87—2.2
Aerials 150-ft. No. 2	1.86—2.7	1.87—2.6
Aerials 110-ft. No. 1	1.87—3.4	1.87—3.3

Audio Equipment

56. Microphone and Receiver Headgear Assemblies No. 1 are supplied for use with the set. They are equipped with snatch plug connectors. The microphone uses the same type of unit as the headphones except that it is equipped with a special tin cover. These units are the moving coil type; each unit having a resistance of approximately 50 ohms. Provision is made for the use of two sets of headgear, although there is a small reduction of receiver volume if this is done. When this assembly is used, the headphones are connected in series and consequently there is 100 ohms across the secondary of the receiver output transformer.

57. Microphone Hand, No. 3 may be used. This is equipped with a pressel switch, and is a carbon type of microphone. Consequently, the quality of transmission will not be as good as that obtained when using the dynamic type.

58. Receivers, Headgear, M.C., Canadian, also may be used. They are 100 ohm headphones of the diaphram, magnetic type.

Remote Control System

59. Wireless Remote Control Units No. 1 (Canadian), are used to send and receive messages from a remote position. Full technical details are contained under a separate E.M.E.R. title.

Supply Unit

60. When the ON-OFF switch, S5A, is switched to the ON position, +12 V. is supplied to the motor winding of the low power dynamotor, MG2A, and to the valve heaters of the receiver and sender. The input voltage to the motor winding is filtered by a pi-filter consisting of L8A, C3AA (.1 ufd.) and C16A (400 ufd. electrolytic). C16A acts as a smoothing condenser. C3X, C3Y and C3Z (.1 ufd. each) suppress any hash interference in MG2A. The H.T. output of MG2A is filtered by C20A (8 ufd. electrolytic), and chokes L10A on the positive side and L10B on the grounded negative. L9A in series with L10A acts as an extra filter and in conjunction with R20A (1,000 ohms) drops the output of MG2A to +150 V. for the receiver. +200 V. is taken from the junction of L10A and L9A for the sender. The +150 V. line and the +200 V. line are by-passed by condensers C15C (1. ufd.) and C15A (1. ufd.) respectively.

61. When the SEND-REC. switch, S4C, is closed, the circuit of relay S7A is completed to ground. S7A closes the first set of parallel contacts, thus completing the circuit of relay S8A to ground. S8A becomes energized and attracts the contact arm which closes the circuit from +12 V. to the motor winding of the high power dynamotor, MG1A. The thermal circuit breaker, S6A, in the input line to MG1A, gives protection against overload. It will be noted that the microphone pressel switch may be used to close this circuit instead of the SEND-REC. switch, S4C. The input on MG1A is filtered by C35A (1. ufd.). +1000 V. and −1000 V. is taken from the high power dynamotor to PL3A which is connected to the sender. C17B (.3 ufd.) is an interference suppressor. The +1000 V. line is by-passed by C17A (.3 ufd.).

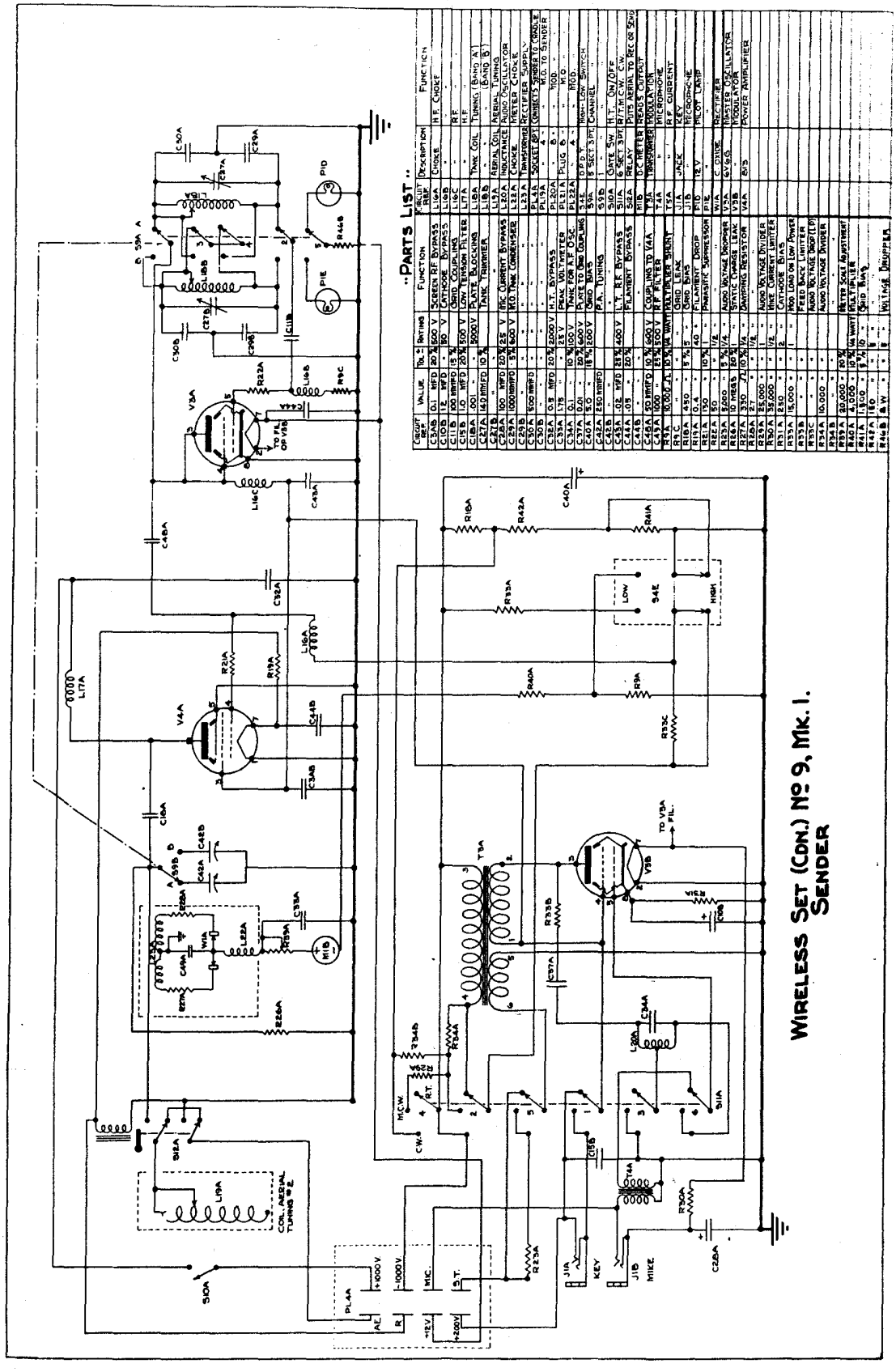


FIG. 11—CIRCUIT DIAGRAM OF SENDER

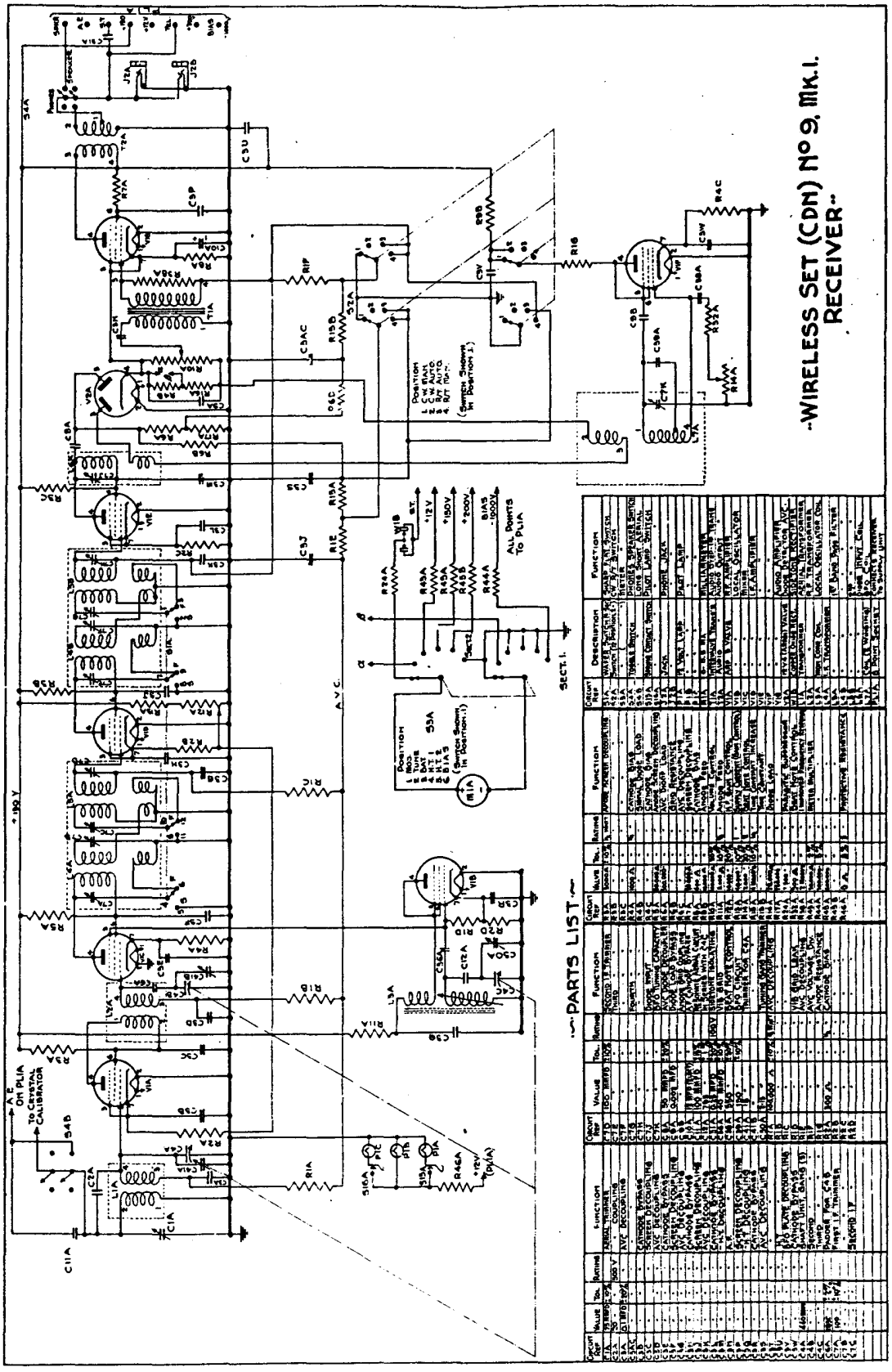


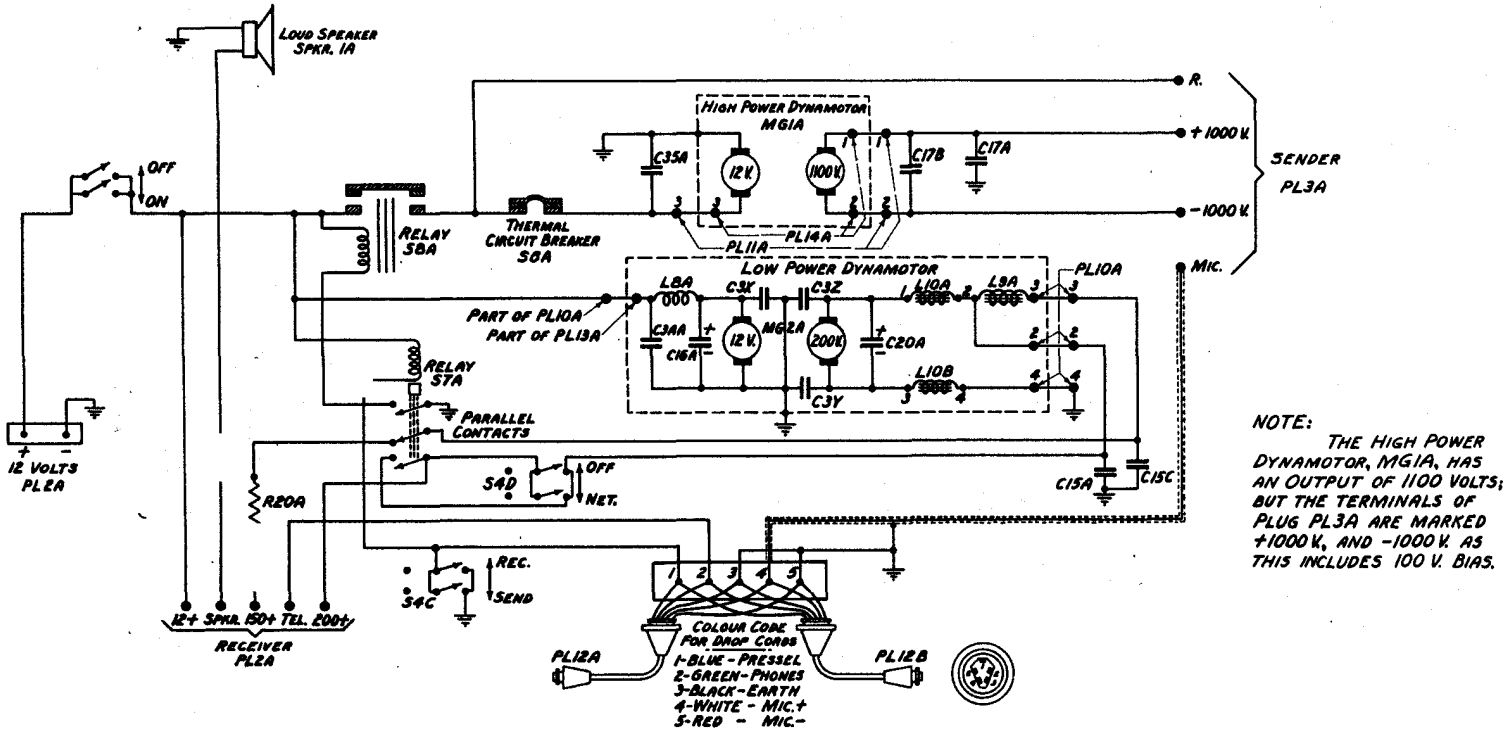
FIG. 12—CIRCUIT DIAGRAM OF RECEIVER

PARTS LIST

CIRCUIT REF	VALUE	TOL.	RATING	FUNCTION
C3	.1 Mfd.	± 20%	500 V.	INTERFERENCE SUPPRESSOR
C[illegible]	"	"	"	" "
C3Z	"	"	"	" "
C3AA	"	"	"	" "
C15A	1. Mfd.	"	"	H.T. SMOOTHING
C15C	"	"	"	FILTER & SMOOTHING
C16A	400 Mfd.	"	12 V.	L.T. SMOOTHING
C17A	.3 Mfd.	−0 +20%	1500 V.	INTERFERENCE SUPPRESSOR
C17B	"	"	"	" "
C20A	0. Mfd.	−0 +100%	400 V.	H.T. SMOOTHING
C35A	1. Mfd.	± 20%	750 V.	INTERFERENCE SUPPRESSOR

CIRCUIT REF	VALUE	TOL.	RATING	FUNCTION
R20A	1000 Ω	± 5%	5 WATT	VOLTAGE DROPPING
L8A	22·5 μH			INTERFERENCE SUPPRESSION
L9A	11. H.			H.T. SMOOTHING
L10A	3 H.			"
L10B	"			"
MG1A	1100 V.			H.P. DYNAMOTOR
MG2A	200 V.			L.P. DYNAMOTOR
	DESCRIPTION			
S4C	TOGGLE D.P.D.T.			SEND-REC.
S4D	" "			NETTING
S5A	" "			ON-OFF
S8A	THERMAL UNIT			CIRCUIT BREAKER

CIRCUIT REF	DESCRIPTION	FUNCTION
S7A	RELAY SOLENOID	SEND-REC.
S8A	RELAY	DYNAMOTOR
SPKR.1A	3" P.M.	SPEAKER
PL2A	5 POINT SOCKET	CONNECTS S.U. TO CRADLE CONN'TR.
PL3A	4 POINT SOCKET	" " " SENDER
PL9A	2 POINT PLUG	CONNECTS 12 V. BATTERY TO S.U.
PL10A	4 POINT SOCKET	" L.P. DYNAMOTOR " "
PL11A	3 POINT SOCKET	" H.P. " " "
PL12A	5 POINT SOCKET	" HEADGEAR TO S.U.
PL13A	4 POINT PLUG	" L.P. DYNAMOTOR TO S.U.
PL12B	5 POINT SOCKET	" HEADGEAR " "
PL14A	3 POINT PLUG	" H.P. DYNAMOTOR " "



NOTE:
THE HIGH POWER DYNAMOTOR, MG1A, HAS AN OUTPUT OF 1100 VOLTS; BUT THE TERMINALS OF PLUG PL3A ARE MARKED +1000 V. AND −1000 V. AS THIS INCLUDES 100 V. BIAS.

FIG. 13—CIRCUIT DIAGRAM OF SUPPLY UNIT

END