ELECTRICAL AND MECHANICAL ENGINEERING REGULATIONS

TELECOMMUNICATIONS F 162

WIRELESS STATION No. 10

This issue, pages 1, 2, 1003A, 1010, 1011 supersedes pages 1, 2, 1010, 1011 of Issue 2

GENERAL DESCRIPTION

Issue 3, 8 Mar. 1946

Distribution—Class 910, Code No. 4

WIRELESS STATION No. 10

GENERAL DESCRIPTION

Notes: 1. *This issue, pages 1, 2, 1003A, 1010, 1011, supersedes pages 1, 2, 1010, 1011 of issue 2. Table 1007 has been amended and Fig. 1002A is additional.*

2. *This E.M.E.R. (Tels. F 162) has been downgraded to the RESTRICTED category in accordance with A.C.Is. 1635 of 1944 and 20 of 1945.*

CONTENTS

Distribution—Class 910, Code No. 4

DIAGRAMS

TABLES

GENERAL SURVEY OF STATION

Purpose

1. The Wireless station No. 10 is a mobile self-contained station, which provides eight two-way telephone circuits over a wireless link. Two complete stations are required to form a link. A high degree of secrecy is maintained by directing the radiation from each station into a narrow beam of width 3°–5°.

Facilities

2. Normally only seven circuits are used for traffic, the eighth being reserved for communication between the terminal stations for engineering purposes. Frequencies between 300 c/s and 3 kc/s may be handled. Circuits may be extended by any normal types of line transmission equipments. Where the path between wireless stations cannot be covered by a single link, intermediate relay stations, each consisting of two Wireless stations No. 10, may be used.

3. Spare units are carried for all the essential equipment in the station, so that continuous operation should be possible.

4. The expected range of the equipment is fifty miles, provided that the path between the aerials of the stations is optical. With quasi-optical paths, shorter ranges, which depend upon the size and position of the interfering obstacle, are obtained. The performance of the link is dependent upon the propagation properties of the radio path, so that great care must be exercised when selecting sites.

5. The trailer in which the equipment is fitted is demountable in sections so that it may be man-handled to a site which would otherwise be inaccessible.

Principles of operation

6. Two wireless carriers are established in the 6–7 cm. region one for each direction of transmission. Each carrier is modulated by a synchronizing pulse and a series of eight channel pulses. Each channel pulse corresponds to one of the telephone channels to be transmitted, the audio output from which is used to modulate the widths of the corresponding channel pulses, which in turn modulate the carrier wave.

Equipment (Fig. 1)

7. The main items of equipment and the function of each are set out in Table 1.

Equipment	*No. off*	*Function*
Wireless senders No. 10	2	One as sender generating carrier waves of length 6.3 or 6.6 cm. One as spare
Reception sets R.10	2	One as receiver. One as spare
Power supply units, receiver, No. 10	2	Power supply for Reception sets R.10
Signalling equipment, No. 10 (S.E.10), comprising :—	1	
Line and monitor unit	1	Connects the eight telephone circuits to pulser and separator units and provides monitoring and ringing facilities
Pulser unit	1	Produces width-modulated pulses for application to the sender
Separator unit	1	Separates and demodulates incoming pulses from receiver for application to telephone channels
Oscillator, testing, No. 10	1	Emergency single-channel signalling equipment, replacing S.E.10. Also audio oscillator for setting modulation levels on S.E.10
Tester, T.M.S., No. 2 (Decibel meter)	1	In conjunction with Oscillators testing No. 10 for setting modulation levels on S.E.10

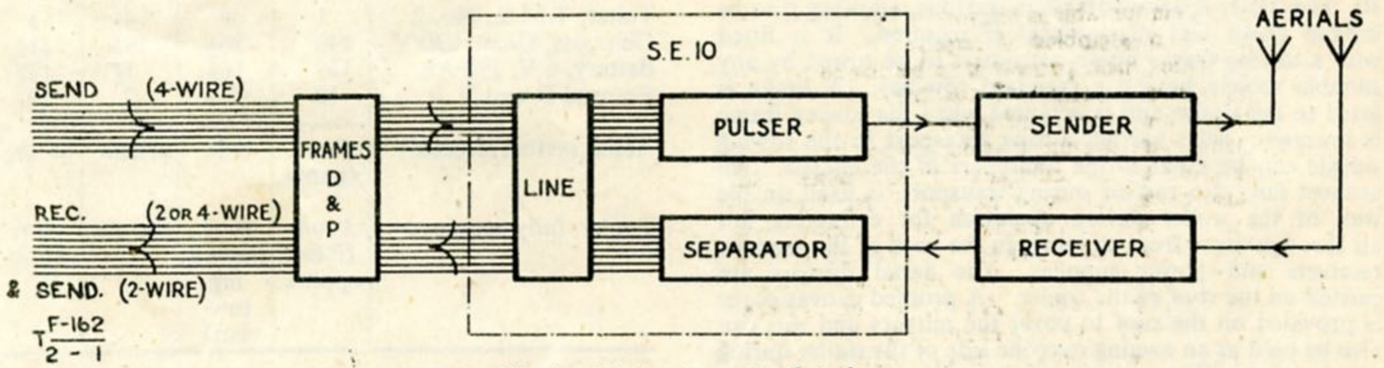

Fig. 1—Block schematic of station

Equipment	*No. off*	*Function*
Generating sets, Onan, 3kVA	2	One as supply for station. One as spare
Batteries, 6 V, 170 Ah	2	Start Onan generators. Supply 12 V for lights, fan and power point in trailer, and alarm system on S.E.10
Battery charger, 12V, 16 A, No. 1	1	Battery charging from A.C. mains
Transformer, auto, 1.75 kVA, No. 1	1	Transforms A.C. supply input to 230 V
Switchboard, A.C., change-over, No. 6	1	For connecting the supply to station and for carrying fuses
Frames, D and P	1	Protects apparatus from high voltages on the lines
Box terminal, signal office	1	10-pair cable terminal box for connection of external lines to frames D and P
4-ft. parabolic mirrors	2	One as sending and one as receiving aerial
Telephone set (F), Mk. II	1	For communication between stations.

Table 1—Main equipment in station

Power supply

8. The station is provided with two generating sets, type Onan, 3kVA, No. 1A or No. 2A, from which it can draw its power ; or alternatively, it may draw its power from the mains supply. In either case the input voltage to the equipment is controlled by a variac transformer on the switchboard, A.C., change-over, No. 6. This switchboard also provides facilities for switching into circuit either of the two generating sets or the main supply.

9. The A.C. voltage required for the variac, to give the desired output of 230 V to the equipment, must be in the range 110–240 V. It may be applied to the variac directly, or from the auto-transformer, which has a number of input taps.

Mechanical construction of trailer

10. The trailer is demountable in sections, allowing it to be broken down and reassembled if required. It is fitted with a towing frame which permits it to be towed by any suitable vehicle having a standard tow-bar. A brake is fitted to the trailer and is actuated when the towing frame is lowered ; jacks carried during transport in the towing vehicle can be fitted to the underpart of the chassis. An exhaust fan, also carried during transport, is fixed on the wall of the trailer during operation for extracting hot air through ducts from openings in the back of the senders, receivers and power supplies. The aerial mirrors are carried on the roof of the trailer. A proofed canvas cover is provided on the roof to cover the mirrors and this can also be used as an awning over the side of the trailer during wet weather. The interior of the trailer is divided into two compartments, the rear one housing the power supply equipment and the front one housing the wireless equipment. A removable panel in the side of the power supply compartment can be adjusted to a horizontal position so that the generators can be extracted. Spare parts lockers under the seats in the wireless compartment carry the test oscillator, inspection lamps and spares, including valves for the sets.

Layout of the equipment (Fig. 1026)

11. A general view of the interior of the trailer is shown in Fig. 1026 and the wiring between units is shown in Fig. 1012. The senders, receivers and receiver power supply units are fixed on a rack (wireless equipment rack) and the units of the Signalling equipment, No. 10, are fixed on a second rack standing alongside. The Oscillator, testing, No. 10, is carried in a box under the operators' seats.

12. A D and P frame is mounted on the front wall of the trailer. Further details of this equipment will be found in Signal Training, Vol. II, Part III. A 10-pair cable terminal box, erected outside the trailer, serves as a junction for incoming lines. A Switchboard, A.C., change-over, No. 6, whose circuit is shown in Fig. 1012, is mounted on the rear wall of the wireless compartment.

13. The power supply compartment houses two Onan generating sets, one of which serves as a spare. For details of these generating sets, see Power E412 and service manuals. Two 6 V, 170 Ah batteries supply 12 V for the trailer. They are charged from the generator in use, or from the mains by means of a Battery charger, 12 V, 16 A, No. 1, mounted on the rear wall of this compartment. A mains transformer on the front wall permits various mains input voltages to be used.

Weights and dimensions

14. The approximate weights and overall dimensions of the main items of equipment are set out in Table 2.

Apparatus	*Weight (lb.)*	*Length (in.)*	*Width (in.)*	*Height (in.)*
Sender No. 10	50	17¼	13¼	8¾
Reception set No. 10	30½	17¼	13¼	8¾
Receiver P.S. unit	46	17¼	13	8
Signalling equipment No. 10	600	33	24	44
Oscillator, testing, No. 10	36½	17½	13	8½
Tester, T.M.S., No. 2	1	9	4½	3
Gen. sets, Onan, 230 V	440	36½	19½	31½
Battery, 6 V, 170 Ah	110	16¼	7½	13¼
Frames, D and P	19	11¼	7	12
Aerial system (erected)	5 cwt. approx.	9 ft.	4ft.6in.	4ft.6in.
Trailer, fully equipped	3 tons 10 cwt. approx.	16 ft. (including tow-bar)	6ft. 3in.	10 ft. 6½ in.

Table 2—Weights and dimensions of main unit

PRELIMINARY DESCRIPTION

SENDER

Electrical

15. Ultra-high frequency oscillations are generated in a magnetron valve, controlled by a modulator valve to the grid of which is fed a train of width-modulated pulses from the signalling equipment.

16. The magnetron oscillator, which is a CV79 (6.6 cm. nominally) or CV89 (6.3 cm. nominally) according to the wave-length used, functions in a resonance mode type of circuit. For duplex working, the stations must radiate at different wave-lengths. For this reason, one uses a CV79 and the other a CV89.

17. The valve is arranged to oscillate in a resonator which is tuned to the valve resonant frequency. Inserted in the resonator is a co-axial line which transmits the oscillation into a wave guide and thence to the aerial system via a matching section. The power fed out to the aerial is 100–400 mW.

18. A power supply of 230 V at 40–60 c/s is required by the sender. The consumption is 100 W.

Mechanical construction

19. The sender is housed in a metal case together with its power pack. The R.F. oscillator, which is a magnetron valve, is held in a rectangular resonator which is coupled via a co-axial cable to the sender wave guide (Fig. 2). The resonator is tuned by means of a piston bridge the position of which is adjustable by means of a rack and pinion controlled by a knob on the front panel, which is marked RESONATOR. The output co-axial cable terminates in a co-axial line matched by an adjustable bridge controlled by a knob marked LINE MATCHING. The

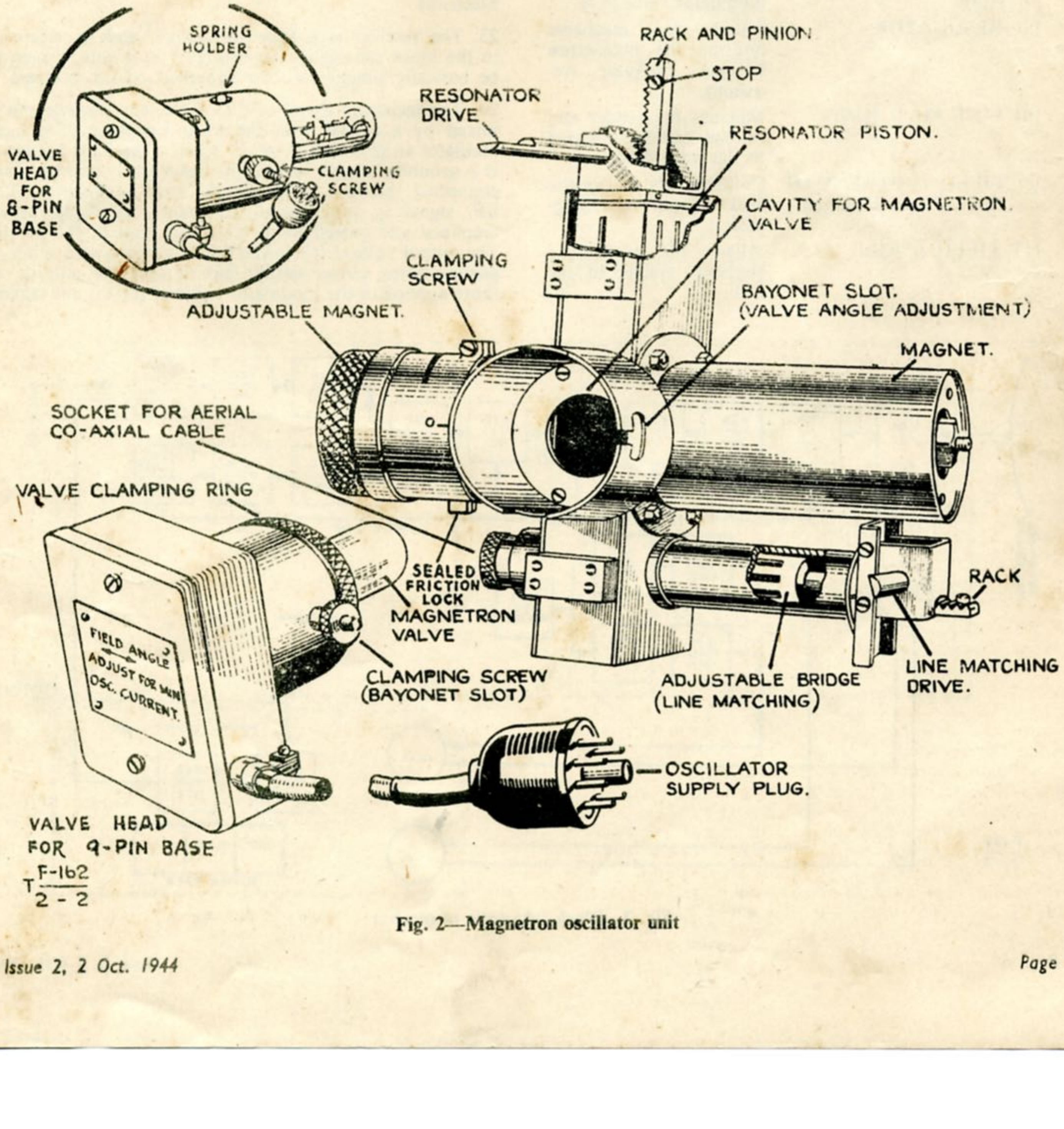

Fig. 2—Magnetron oscillator unit

magnetron is mounted between two cylindrical bar magnets giving a maximum field of about 700 oersteds. The position of one magnet is adjustable so that the field required for either the CV 79 or the CV89 type of valve may be obtained. The valve holder assembly may be rotated to align the electrodes correctly in the field (see paras. 66–69).

20. The H.T. and L.T. supplies to the magnetron valve are taken to an octal valve type socket on the front panel of the sender. A plug connected to the oscillator may be inserted in this socket.

21. The sender is cooled by an air blast which passes in at the bottom and out at the rear of the case.

Controls and sockets (Fig. 1019)

22. The various controls and sockets with their functions are given below :—

(*a*) SUPPLY ON-OFF (S2)	Input supply switch.
(*b*) MIN-MAX H.T. VOLTS (R4)	Controls H.T. to the modulator valve (V3).
(*c*) RESONATOR	Tunes the resonator housing the magnetron to the oscillator frequency.
(*d*) LINE MATCHING	Matches the sender end of the cable connected to the wave guide.
(*e*) FIELD STRENGTH (behind door on panel)	Controls the magnetic field across the magnetron.
(*f*) FIELD ANGLE	Aligns the magnetron electrode system in the field.
(*g*) H.T. VOLTS—OSC CURRENT — MOD. CURRENT key (S1)	Selects measurement shown on the meter. The meter in S.E.10 is normally used.
(*h*) AERIAL	For connection to wave guide via co-axial cable.
(*j*) MOD. INPUT	For connection from S.E.10.
(*k*) SEPARATOR TEST	Connected to S.E.10 at the separator input for testing the separator.
(*l*) Indicator lamp (P1)	Lights when power is supplied to the sender.

RECEIVER

Electrical

23. The receiver is a superheterodyne, and by reference to the block schematic diagram (Fig. 3) it will be seen to be basically similar to other superheterodyne receivers.

24. The incoming signal of 6.3 or 6.6. cm. wave-length is mixed by a crystal with the third harmonic of a local oscillator to give an I.F. of 45 Mc/s. The local oscillator is a grounded-anode triode with resonant concentric lines connected between grid-cathode and anode-grid. The I.F. signal is amplified in six stages, rectified, further amplified and passed to the separator unit in the S.E.10. The output voltage fed to the S.E.10 consists of a series of positive-going pulses similar but of opposite polarity to those applied to the modulator valve of the distant sender.

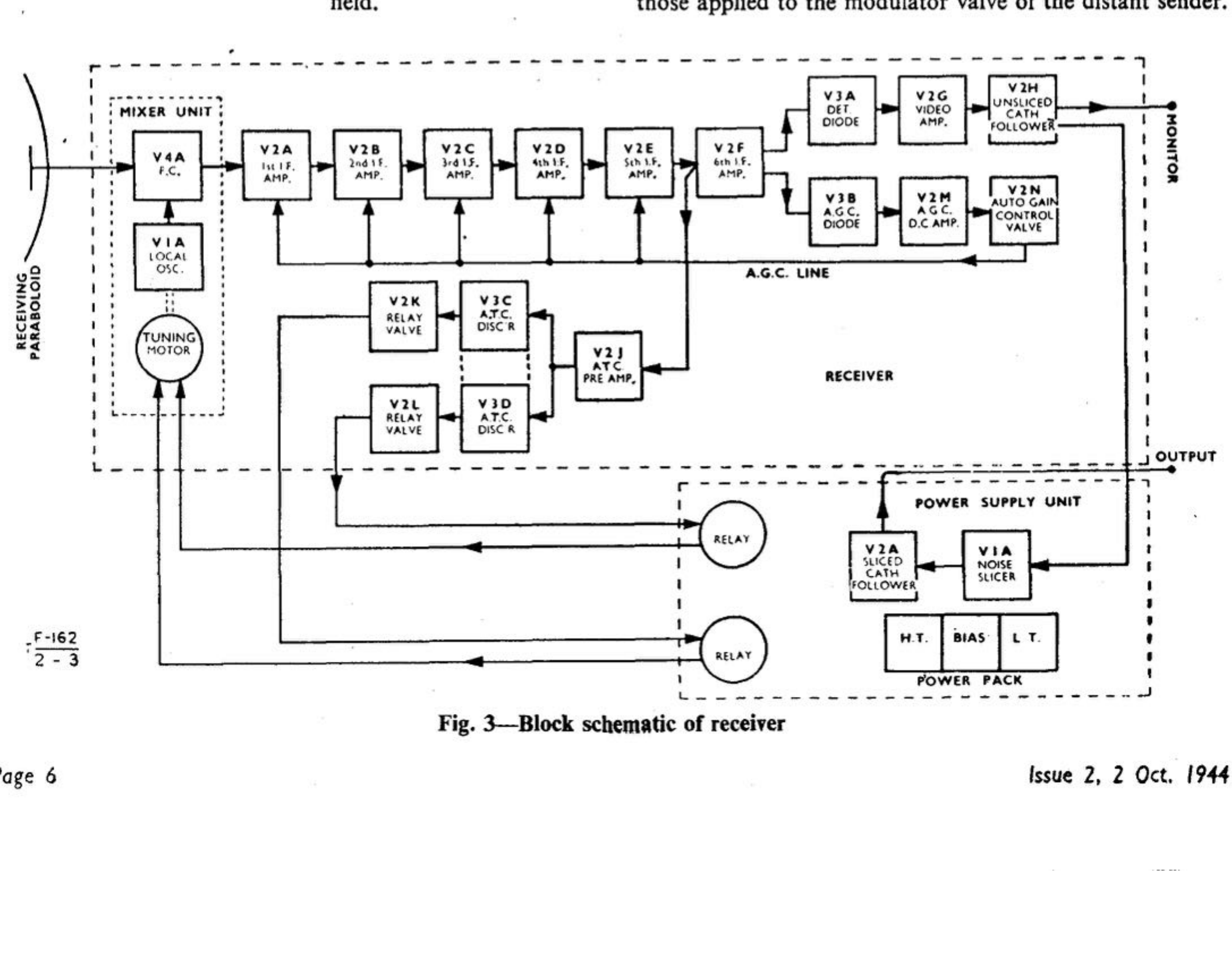

Fig. 3—Block schematic of receiver

25. Since the widths of the incoming channel pulses are $3\frac{1}{3} \pm 2$ μ secs the bandwidth of the receiver must be sufficient for it to pass narrow pulses with absolute fidelity. A bandwidth of 4 Mc/s is maintained throughout the R.F. and I.F. stages. Automatic tuning control is used so that the receiver remains in tune even if the distant sender frequency varies. Automatic gain control is also incorporated. Manual tuning is used for setting up the stations.

26. A power supply of 230 V, 40–60 c/s is required by the receiver. The consumption is 82.5 W when the H.T. switch is at OFF, and 157 W when the H.T. switch is at ON. The 230 V power supply is fed to a receiver power unit from which the necessary H.T. and L.T. voltages are derived.

Mechanical

27. The complete receiver consists of two units housed in separate cases. The first contains the receiver proper and the second contains the power supply and video frequency amplifier (the video frequencies are 50 c/s–2 Mc/s).

28. The mixer unit, which houses the local oscillator and signal frequency resonator, is fitted behind the receiver front panel. The local oscillator V1A is housed within the concentric lines which tune the oscillator. The oscillator circuit comprises three conductors mounted concentrically (see Fig. 4). Tuning is accomplished by means of ganged movable bridges, one between the anode-grid lines and the other between the grid-cathode lines. A signal frequency cavity resonator, which is tuned to the incoming signal frequency and houses the crystal mixer, is also tuned by an adjustable bridge ganged to the same control. The positions of these three bridges are adjusted by means of rack gearing. Automatic tuning is accomplished by a tuning motor which drives the ganged bridges through a worm reduction gear and is operated when the receiver is out of tune. An AUTO TUNING key is incorporated, which reverses the connections to the motor if the signal frequency is 45 Mc/s above the local oscillator frequency (2nd channel working), so that the A.T.C. (automatic tuning control) may be used under these conditions as well as for a signal frequency below the local oscillator frequency (1st channel working). The receiver may be tuned manually, after disengaging the motor clutch, by operating the flick lever in the centre of the TUNING knob. The positions of the bridges in the oscillator lines and wave guide are indicated by a counter mechanism operated from the rack and pinion assembly, the numbers being visible through holes in the front panel.

29. The receiver and power supply units are cooled by air blasts similar to that used for the sender.

Controls and sockets on receiver (Fig. 1021)

30. The following are the controls and sockets on the receiver, with their functions :—

(*a*)	TUNING	Manual adjustment of the tuning bridges.
(*b*)	Flick lever	Motor clutch lever, engaging auto-tuning control.
(*c*)	AUTO GAIN-MANUAL GAIN switch (S1)	Selects A.G.C. or manual gain.
(*d*)	GAIN CONTROL (R26A)	Manual adjustment of gain.
(*e*)	AERIAL PROBE socket	For connection to the concentric cable aerial feed.
(*f*)	Dials near TUNING knob	Show the tuning point.
(*g*)	12-pt. socket	For connection to the receiver power supply unit.
(*h*)	Concentric sockets to the right of the 12-pt. socket (red)	Output sockets for connection to the video amplifier in the power supply unit and the monitor unit in S.E.10.
(*j*)	OSC. ANODE VOLTS (TP1)	For connection to the meter on S.E.10.
(*k*)	SIGNAL LEVEL (TP2)	For connection to the meter on S.E.10. (Cathode current of A.G.C. valve V2N).

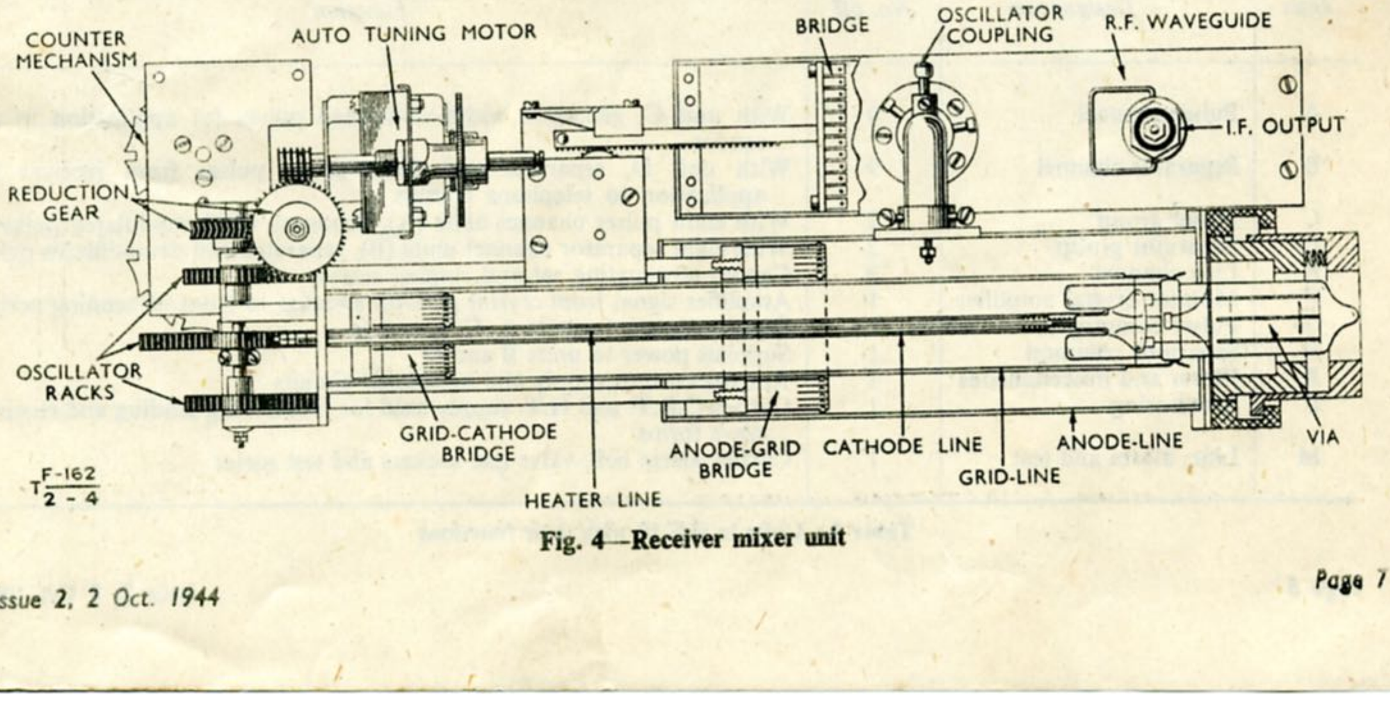

Fig. 4—Receiver mixer unit

(*l*) A.T.C.1 (TP4)	For connection to the meter on S.E.10. (Cathode current of relay valve V2L).
(*m*) CRYSTAL NEGATIVE (TP3)	For connection to the meter on S.E.10. (Output current of crystal mixer).
(*n*) EARTH (TP6)	
(*p*) A.T.C.2 (TP5)	For connection to the meter on S.E.10. (Cathode current of relay valve V2K).

Controls and sockets on receiver power supply unit (Fig. 1022)

31. The following are the controls and sockets on the receiver power supply unit, with their functions :—

(*a*) NOISE SLICER (R4A)	Adjusts the limiting level.
(*b*) ADJUST BIAS VOLTAGE (R17A)	Adjusts the bias of the valves.
(*c*) POWER ON-OFF switch (S3B)	Mains input switch.
(*d*) H.T. ON-OFF switch (S3A)	Permits the valve cathodes to be warmed up before H.T. is applied.
(*e*) AUTO TUNING	1ST CHANNEL when the local oscillator frequency is greater than R.F. signal. 2ND CHANNEL when the local oscillator frequency is less than R.F. signal. OFF when the manual tuning control is used.
(*f*) 12-pt. socket	For connection to the receiver.
(*g*) Concentric socket immediately below 12-pt. socket	To the video amplifier for connection from the receiver output.
(*h*) Lower concentric socket	Output from the video amplifier for connection to the separator.
(*j*) Left-hand lamp (P1B)	H.T. indicator lamp.
(*k*) Right-hand lamp (P1A)	Power indicator lamp.
(*l*) PHONE JACKS	Connected internally to the input from the receiver.
(*m*) H.T. CURRENT (TP4)	For connection to the meter on S.E.10.
(*n*) H.T. VOLTS (TP2)	For connection to the meter on S.E.10.
(*p*) BIAS (TP1)	For connection to the meter on S.E.10 (bias supply voltage).
(*q*) HEATERS (TP3)	For measuring A.C. heater voltage with an Avometer.

SIGNALLING EQUIPMENT NO. 10

ELECTRICAL (Fig. 5)

32. The Signalling equipment No. 10 (S.E. 10) is an intermediate equipment employing pulse width modulation, for connection between telephone circuits and Wireless sender No. 10 and Reception set No. 10. The output from the S.E.10 is fed to the sender for modulating the carrier frequency and consists of a synchronizing pulse followed by eight shorter channel pulses in succession, each width-modulated by the A.F. (audio frequency) input from the telephone circuit to which it is connected. The whole sequence is repeated at 9 kc/s group recurrence frequency (G. R. F.). The output from the wireless receiver fed to the S.E.10 consists of a similar series of pulses. These pulses are separated and demodulated in the S.E.10 which applies the resulting audio signal to the appropriate telephone channel. The S.E.10 also provides means for monitoring sending and received wave-forms. It may be adapted for either 2-wire or 4-wire working.

Unit	*Designation*	*No. off*	*Function*
A	Pulser channel	9	With unit C, generates width-modulated pulses for application to the sender
B	Separator channel	9	With unit D, separates and demodulates pulses from receiver for application to telephone circuits
C	Pulser group	2	With eight pulser channel units (A), produces width-modulated pulses
D	Separator group	2	With eight separator channel units (B), separates and demodulates pulses
E	Line channel	9	Carries terminating set and ringing relays
F	Monitor crystal amplifier	1	Amplifies signal from crystal pick-up situated in front of sending aerial
G	Pulser common	1	Supplies power to units A, C, F and M
H	Separator common	1	Supplies power to units B and D
K	Power and miscellaneous	1	Ringing current supply and associated circuits
L	Monitoring	1	Carries C.R.T. and H.T. supply used for monitoring sending and received wave forms
M	Line, alarm and test	1	Carries alarm bell, valve test sockets and test meter

Table 3—Units in S.E.10 with their functions

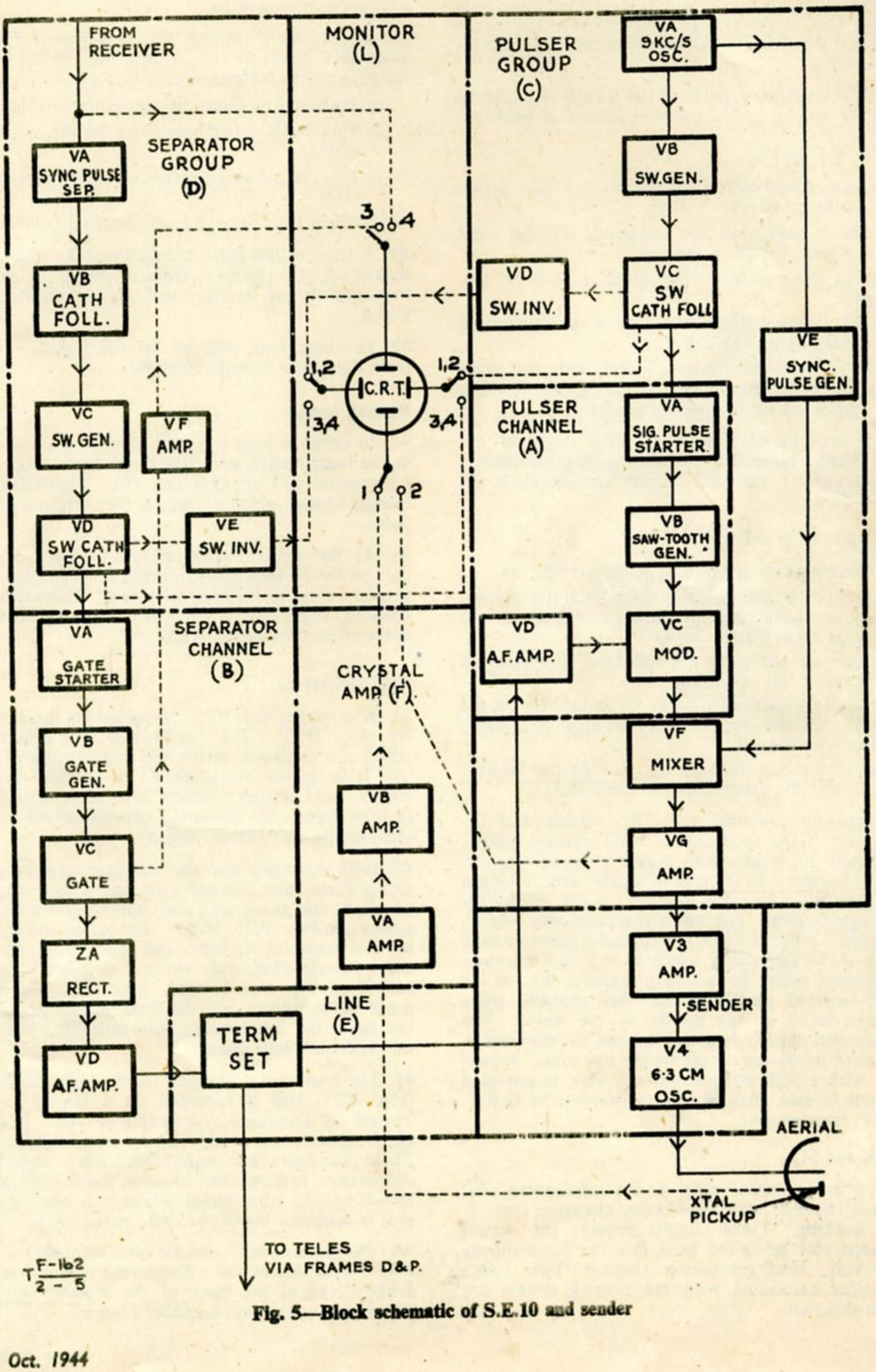

Fig. 5—Block schematic of S.E.10 and sender

33. A power supply of 230 V, 40–60 c/s is required by this equipment. The total consumption is 750 W. The alarm bell is supplied from the 6 V batteries via the A.C. change-over switchboard.

34. A block schematic diagram of the S.E.10 is shown in Fig. 5 and the function of each unit is set out in Table 3.

Pulser (units A, C and G)

35. The pulser group unit (C) generates a 9 kc/s group recurrence frequency which,

(*a*) provides a saw-tooth for triggering off the eight channel units (A) in succession

(*b*) produces the synchronizing pulse of 22 $\pm$ 2μ sec. duration

(*c*) provides sweep voltages for viewing the pulser and sender outputs on the C.R.T.

(*d*) combines the synchronizing pulse with the eight pulses produced by the channel units, thus forming the output fed to the wireless sender.

36. Each pulser channel unit (A), when triggered off, generates a channel pulse of $3\frac{1}{3}$ μ sec. mean duration which is width-modulated by the A.F. signal applied from the telephone circuit.

Separator (units B, D and H)

37. The functions of the separator group unit (D) are,

(*a*) to separate the synchronizing pulse from the channel pulses, and to use it to produce a saw-tooth in step with that at the distant pulser

(*b*) to trigger off the eight channel units in succession by means of this saw-tooth

(*c*) to generate a gate wave form for indicating on the C.R.T. that the channel pulse separation is being correctly performed

(*d*) to provide sweep voltages for viewing the receiver output and the gate picture on the C.R.T.

38. Each separator channel unit (B) isolates and demodulates one of the sequence of eight channel pulses. When triggered off, it generates a gate pulse of 8 μ sec. duration and applies it to the grid of a gate valve. All the incoming channel pulses are applied to the suppressor grid of this gate valve. This valve conducts only when a gate pulse and a channel pulse are applied simultaneously. The arrival of the gate pulse, which is of longer duration than the channel pulse, immediately precedes that of the appropriate channel pulse, so that this channel pulse only is reproduced at the anode of the valve. The separated channel pulse is demodulated and the modulation is passed to the telephone circuit via the line unit. A low-pass filter, with a high attenuation at 9 kc/s, is provided in the output of each channel unit to prevent the G.R.F. causing A.F. interference.

Line unit (E and M)

39. The line unit contains eight 4-wire terminating sets, one for each channel, with U-links for changing from 2- to 4-wire working. These circuits prevent the output from the separator being fed back into the pulse during 2-wire working, thus preventing singing. Two relays and a rectifier associated with the ringing system are mounted in this unit.

Monitor unit (L and F)

40. The monitor consists of a six-inch C.R.T. with its associated power pack. A four-way switch permits the following wave forms to be monitored :—

(*a*) Pulse output from the sender aerial (SENDER)

(*b*) Output from the pulser unit to the sender (PULSE OUT)

(*c*) Input to the separator unit from the receiver (PULSE IN)

(*d*) Wave form from the separator unit (GATE)

41. A little of the pulse output from the sending aerial is picked up by a dipole in front of the aerial, rectified, and amplified in the monitor unit before application to the C.R.T.

42. The time base voltages for the C.R.T. are obtained from the pulser or separator units.

Ringing system

43. In order to ring a distant station, a 17-50 c/s current at the local station is rectified and operates a relay in the appropriate line channel unit (E). This relay applies a biasing voltage which suppresses the corresponding channel pulse.

44. At the distant separator, the absence of this pulse cuts off the current through the A.F. amplifier valve which carries a relay in its cathode circuit. This relay is thereby released, applying a 75 V, 50 c/s ringing current to the appropriate telephone circuit.

MECHANICAL

45. A complete S.E.10 is contained in three metal cases (see Fig. 1026). The removable units ride on runners which are mounted on the top and bottom of each unit. The front panels are protected by a cover held by four corner bolts during transit. The main chassis are held in their frames by a number of coin-slotted screws fitted into the top and bottom edges.

46. Both the pulser and the separator units consist of two group units, nine channel units and a power supply unit, of which one group and one channel unit are supplied as spares (see Figs. 1023, 1024). The group and channel units are mechanically separate, and slide into runners on the main chassis where they are held in place by coin-slotted screws at top and bottom. Electrical connections are made by connectors on the front panels and contacts at the back, the latter being automatically made when the unit is pushed into place.

47. The line unit is situated on the right of the monitor (Fig. 1025) and is mounted on a hinged front panel, opened by loosening coin-slotted screws. It consists of eight separate sub-units, one for each telephone circuit. These sub-units are removable, after unsoldering the connections to a terminal block at the rear of the unit and loosening two coin-slotted screws. A ninth (spare) sub-unit is mounted inside the case, at the back.

48. The monitor is removable after loosening a number of coin-slotted screws and withdrawing to the front. A long flexible lead at the back of the monitor supplies H.T. to the monitor crystal amplifier (unit F).

49. Various warning and indicator lamps on all assemblies, and an alarm bell and key mounted on the main frame to the right of the monitor and line units, give warning of power supply, H.T. and signal failure.

Controls and sockets on pulser (units A, C and G) (Fig. 1023)

50. The pulser controls and sockets with their functions are as follows :—

(*a*) GROUP ADJUSTMENT (PA)	Adjusts the position of all pulses simultaneously.
(*b*) PULSE POSITION (PA-PH)	Adjusts the position of the individual channel pulse.
(*c*) PULSE WIDTH CONTROL (QA)	Adjusts the mean width of the individual channel pulse.
(*d*) MODULATION LEVEL (PA)	Adjusts the depth of modulation.
(*e*) SIGNAL FAILURE ALARM (PJ)	Adjusts the neutralizing current through the relay RB.
(*f*) ON-OFF switch (SW)	Power supply switch.
(*g*) PILOT lamp (LPB)	Lights when power is applied to unit.
(*h*) SUPPLY FAIL lamp (LPA)	Lights when one power rectifier valve is faulty.
(*j*) GROUP FAILURE lamp (LPB)	Lights when no pulses are applied to the pulser output valve.
(*k*) SUPPLY FAILURE lamp (LPA)	Lights when the H.T. unit or the output valve fails.
(*l*) SWEEP sockets (CC and CD)	Provide time base sweep voltage for C.R.T.
(*m*) OUTPUT sockets (CB and CA)	For connection to the sender and the monitor unit.

Controls and sockets on separator (units B, D and H) (Fig. 1024)

51. The separator controls and sockets with their functions are as follows :—

(*a*) GROUP ADJUSTMENT (PA)	Adjusts the position of all gate pulses simultaneously.
(*b*) GATE POSITION (PA-PH)	Adjusts the position of the individual gate pulse.
(*c*) GATE WIDTH CONTROL (QA)	Adjusts the width of the gate pulse.
(*d*) VOICE OUTPUT (PA)	Adjusts the A.F. output to the telephone circuit.
(*e*) ON-OFF switch (SW)	Power supply switch.
(*f*) PILOT lamp (LPB)	Lights when power is applied to the unit.
(*g*) SUPPLY FAIL lamp (LPA)	Lights when one power rectifier valve is faulty.
(*h*) INPUT sockets (CA and CE)	For connection from the receiver ; one as spare.
(*j*) SWEEP sockets (CC and CD)	Provide time base sweep voltage for C.R.T. .
(*k*) GATE socket (CB)	For applying the gate picture to the monitor unit.

Controls and sockets on monitor (unit L) (Fig. 1025)

52. The monitor controls and sockets are as follows :—

(*a*) FOCUS (PB)	Adjusts the sharpness of the picture on C.R.T. screen.
(*b*) BRILLIANCE (PA)	Adjusts the intensity of the picture on C.R.T. screen.
(*c*) PULSE OUT—GATE-SENDER—PULSE IN switch	Selects the wave form monitored.
(*d*) Push-button switch below C.R.T. (KA)	Switches image on to the screen.
(*e*) ON-OFF switch (SW)	Power supply switch.
(*f*) SENDER socket (CA)	Applies the output from the crystal pick-up to the monitor amplifier.
(*g*) OUTPUT socket (CB)	Applies the pulser output to the monitor unit.
(*h*) Upper SWEEP sockets (CC and CD)	Apply the time base sweep voltage from the pulser unit.
(*j*) RECR. socket (CE)	Applies the output from the receiver to the monitor unit.
(*k*) GATE socket (CF)	Applies the output from the separator to the monitor unit.
(*l*) Lower SWEEP sockets (CG and CH)	Apply the time base sweep voltage from the separator unit.

Controls and sockets on line unit (E, K and M) (Fig. 1025)

53. The controls and sockets on the line unit, with their functions, are as follows :—

(*a*) RINGING lamp (LP)	Lights when the channel is being rung.
(*b*) SIGNAL FAILURE lamp (LP)	Lights when no signal is received.
(*c*) ALARM BELL OFF-ON—TEST	Bell circuit on-off switch. Also at TEST, the bell should ring, thereby testing the bell circuit.
(*d*) 2-WIRE, 4-WIRE (SA, SB, SC, SD)	Sockets for U-links.
(*e*) Valve sockets (VA, VB, VC)	For holding the valves to be tested.
(*f*) VA, VB, VC test points	For testing valves.
(*g*) METER + E −	For inserting U-link to connect + or − meter terminal to earth.

OSCILLATORS, TESTING, NO. 10

Electrical

54. The test oscillator provides an emergency single-channel signalling equipment which can be used in place of the S.E.10. Ringing facilities are not provided. The modulation used on this single channel may be :—

(*a*) Speech

(*b*) 800 c/s tone

(*c*) 1,600 c/s tone.

There is also available a 600 Ω source of tone at either 800 c/s or 1,600 c/s which, in conjunction with a Tester, T.M.S., No. 2, can be used for setting up the modulation levels on each of the eight channels of the S.E.10.

55. A 4-wire terminating set, included in the test oscillator, permits the latter to be used with a telephone set.

56. The power supply is from 230 V A.C. The consumption is 50 W.

Mechanical

57. The test oscillator chassis with front panel attached, slides into a metal case. On the chassis is also mounted the supply apparatus. A metal guard protects the controls on the front panel.

Controls and sockets on the test oscillator (Fig. 1020)

58. The controls and sockets on the test oscillator, with their functions, are as follows :—

(*a*) RECEIVER OUTPUT LEVEL (R22)	Controls the output level applied to the test oscillator from the receiver.
(*b*) INCREASE MODULATION (R17)	Controls the depth of modulation.
(*c*) TEST OUTPUT (R20)	Controls the output from TEST OUTPUT terminals.
(*d*) MODULATION (S1)	Selects speech, 800 c/s or 1,600 c/s for modulation output.
(*e*) SUPPLY ON-OFF switch (S2)	Main supply switch.
(*f*) Lamp (P1)	Indicates when the supply is switched on.
(*g*) FROM RECEIVER OUTPUT socket	For connection to the receiver when used as signalling equipment.
(*h*) MOD. OUTPUT socket	For connection to the sender when used as signalling equipment.
(*j*) TEST OUTPUT terminals	For applying 800 c/s or 1,600 c/s to the S.E.10 for setting the modulation levels of the latter.
(*k*) LINE, L1, L2 terminals	For connection to the telephone circuit when used as signalling equipment.

AERIAL SYSTEM (Fig. 1027)

Electrical

59. Two identical 4 ft. dia. parabolic mirrors are used, one as a sending and one as a receiving aerial. A circular wave-guide 2 in. in diameter passes through each mirror from the rear and carries a 5 in. dia. circular reflecting plate in front of its orifice. This reflecting plate lies in the focal plane of the paraboloid.

60. The wave guide attached to each mirror is connected to the corresponding apparatus inside the trailer through a length of flexible guide and a fixed guide which is terminated inside the trailer by a wave guide matching section carrying an adjustable piston. A co-axial cable connects this section to the sender or receiver. One end of the flexible guide screws on to the rear of the mirror, and the other end is screwed on to the fixed guide passing through the trailer roof.

61. The plane of polarization of the radiation in the guide may be varied by rotating the lower portion of the wave guide matching section inside the trailer, and thereby altering the direction of a probe attached to the co-axial cable and projecting into the guide.

62. In order to monitor the signal radiated by the sender aerial for tuning purposes, a crystal pick-up, No. 10, is fitted in the mirror. This consists of a small dipole and a crystal rectifier and is connected to the monitor unit in the S.E.10 via concentric cable. The dipole is mounted vertically inside the mirror and the crystal is housed immediately behind the mirror. Crystal pick-ups are mounted in both mirrors, so that the sending and receiving aerial systems are interchangeable, but only that in the mirror used for sending is connected to the interior of the trailer.

Mechanical

63. The two mirrors are mounted side by side in a frame on a turntable. The whole frame may be rotated about a vertical axis after slackening five wing nuts. In addition, small independent adjustments may be made to each mirror by means of adjusting bars at the ends of the horizontal and vertical diameters. Four further clamping nuts between the mirrors permit the frame to be slid to one side of the trailer roof ; after removing two supporting bars, it may then be laid horizontally for purposes of transit and may be clamped in this position by U-rods and nuts at each corner. Clips are provided for holding the supporting bars during transit.

64. The flexible wave guides and co-axial cable from the crystal pick-up are connected to sockets near the centre of the trailer roof. These sockets may be covered by caps when not in use. Two jacks, on a terminal strip under a small door near the sockets permit a meter or telephone to be connected to the inside of the trailer from the roof.

65. The crystal pick-up, No. 10, passes through a small hole in the mirror and is clamped in position by a collar on its mount.

TECHNICAL DESCRIPTION

SENDER

Magnetron oscillator V4

66. An exploded view of a magnetron oscillator is shown in Fig. 6. This diagram shows the layout of the principle electrode assembly of the valve. It shows the direction of the magnetic flux provided by permanent magnets and also the general direction of the electrons, when the voltage is applied to the anode. The axis of the cathode is parallel to the anode segments and also to the magnetic field. It will be seen from the diagram that the valve is split into two parts and that these parts are split up into segments to form the cylindrical anode. The magnetic field and anode voltage are both set to give values which cause the valve to oscillate. Under these conditions the frequency of the oscillations depends mainly upon the mechanical construction of the valve used.

67. Two types of valve are provided. For 6.6 cm. wavelength a CV79 valve is used, and for 6.3 cm. wavelength a CV 89 valve is used. The magnetic system is adjustable to suit either valve. The H.T. voltage provided is approximately 750 V and is adjusted to give a nominal valve current of 12 mA in each case. The maximum flux density of the field provided by the permanent magnet is about 700 oersteds.

68. To ensure that the anode and cathode are in line with the magnetic field the position of the valve can be adjusted by means of bayonet slots in the valve head adaptor. The valve is rotated until minimum current is observed on a meter connected to the test socket on the sender when the key is thrown to OSC. CURRENT, and the valve is then locked in position by means of a knurled nut (see Fig. 2).

69. The resonator, in which the valve oscillates, is tuned by a piston type bridge (see para. 19). In this resonator, there is a co-axial line which transmits the oscillations to the wave guide, thence to the aerial system.

70. For full explanation of the magnetron oscillator, see Tels. A 012.

Modulator V3

71. The sender circuit is shown in Fig. 1001. The magnetron oscillator V4 is parallel modulated by an ATS25 valve, V3. Rectangular negative-going pulses of 60 V peak amplitude are fed to the modulator grid V3 through the MOD. INPUT socket from the S.E.10. These pulses are width-modulated by the audio output from the telephone circuit.

72. Modulation is obtained by having a common resistance (R11, R12, R13, R14 and R15) in the anode circuits of the modulator valve V3 and the magnetron valve V4, so that when current is taken by valve V3, the voltage applied to the magnetron anode drops sufficiently to prevent the magnetron oscillating.

73. Normally the valve V3 (without any modulation on the grid) is taking anode current and the voltage drop across the common anode resistance is of the order of 300 V, so that the magnetron does not oscillate. When a negative pulse is applied to the grid of V3, however, the voltage drop due to the current taken by this valve is reduced, and the H.T. applied to the anode of the magnetron is increased so that it oscillates. The screen of valve V3 is held at a steady potential by means of the potentiometer comprising the resistances R5, R6, R7, R8, R9, R10, and is decoupled by condenser C4.

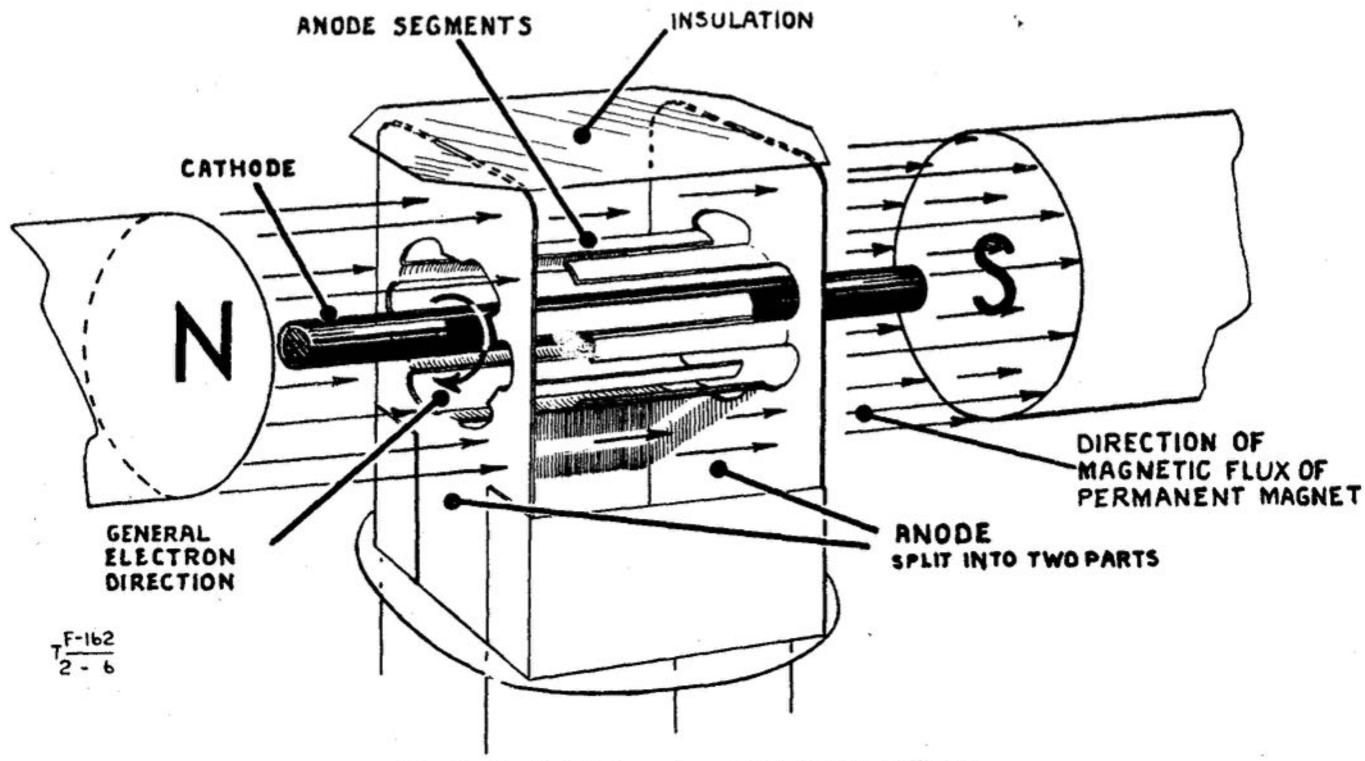

Fig. 6—Exploded view of magnetron valve oscillator

74. The input to the modulator is applied to the control grid across R20. R19 is for measuring purposes, the voltage across this resistance being applied to an external meter through a key, S1. Resistors R22 and R23 form a potentiometer used for checking H.T. volts, and the voltage across the resistance R21 gives a measure of the oscillator current.

75. A socket is provided in order that the signalling equipment may be tested independently of the receiver. This test point, SEPARATOR TEST, is in the anode circuit of V3 and, therefore, is 180° out of phase with the input to V3, thus providing the positive-going pulses required to operate the separator unit (see para. 126). The test point is isolated from the D.C. H.T. voltage by the condenser C5. The resistance R17 prevents a static charge from remaining on this condenser.

Power supply

76. The H.T. supply is obtained from a transformer associated with two half-wave rectifier valves, V1 and V2, giving full-wave rectification. The H.T. supply to the valves is controlled by the variable resistance R4 (H.T. VOLTS). R1 and R2 are bleeder resistances for discharging the reservoir and smoothing condensers C1, C2 and C3. The latter is sufficiently large to ensure that the radiated pulses are truly rectangular.

RECEIVER (Figs. 1002, 1003)

Mixer unit

77. The mixer unit consists of the following main components :—

(*a*) Signal frequency cavity resonator and crystal mixer

(*b*) Oscillator

(*c*) Drive and counter mechanism.

78. The signal frequency cavity resonator is tuned to the incoming signal and houses the crystal mixer CV101 or CV102 (V4A). The local oscillator (V1A) uses a CV90 valve operating at 18.3–20.4 cm., and the third harmonic of the fundamental frequency is mixed with the incoming signal to produce an I.F. of 45 Mc/s. The dimensions of this resonator between the crystal and oscillator input are such that the fundamental frequency of the oscillator is attenuated approximately 60 db. The output from the crystal mixer (V4A) is fed via a co-axial cable to the input of the I.F. amplifier.

79. Matching is accomplished on the R.F. wave guide by means of an adjustable bridge, operated externally. The signal from the mirrors is fed into the resonator by a probe, and the oscillator is coupled into the resonator through a co-axial line and adjustable probe.

80. V1A, the triode local oscillator valve, is housed within the concentric lines which tune the oscillator. The oscillator circuit comprises two co-axial lines mounted concentrically, the middle conductor being common to both (see Fig. 4.) The outer co-axial line tunes anode-grid of the valve, and the inner one tunes grid-cathode. Feedback is provided by the internal grid to anode capacity of the valve. The mode of operation is such that a standing wave of $\frac{3}{4}\lambda$ is present between the anode and grid lines and a standing wave of $\frac{5}{4}\lambda$ is present between grid and cathode lines. The system is tuned by means of movable ganged bridges, one between anode-grid lines and other between grid-cathode lines (see para. 28), and the bridge tuning the signal frequency cavity resonator is also ganged to the same control. The frequency of oscillation is mainly determined by the co-axial line between anode and grid, the grid to cathode line not having much effect on frequency.

81. The positions of the two bridges in the oscillator section, and of the bridge in the signal frequency cavity resonator are set to give maximum sensitivity over the whole band. Automatic tuning is accomplished by the tuning motor as described in paras. 28, 98 and 100.

I.F. amplifier

82. The I.F. amplifier has an overall voltage gain of approximately 500,000 so that a 10 μV input provides sufficient voltage for driving the second detector. H.T., bias and A.G.C. decoupling components are mounted on one plate above the chassis with connections to each of the I.F. stages, thus providing good screening and decoupling. The bandwidth of 3–4 Mc/s is obtained by the use of heavily damped band-pass I.F. transformers, with screened pentodes (A.R.P. 35s) to obtain a reasonable stage gain.

1st I.F. stage (V2A)

83. The I.F. input is fed through C6A to the grid of V2A. The input circuit is tuned by L2A. V2A obtains bias through R34B and R4D. A.G.C. is applied to the screen through R4A and R34A. The output is coupled through the 1st I.F. band-pass transformer, L3A and L4A, to the input of V2B. The windings of the transformer, L3A and L4A, are tuned to 46.5 Mc/s and 43.5 Mc/s and are damped by R6A and R6B so that the required bandwidth is obtained.

2nd, 3rd and 4th I.F. stages (V2B, V2C, V2D)

84. These stages are similar to the 1st I.F. stage, each of the primaries and secondaries of the I.F. transformers being tuned in the same way as L3A and L4A.

5th I.F. stage (V2E)

85. The input to V2E is tuned by L4D, and bias is provided through R34N and R4AC. The output voltage is developed across R33A and is resistance-capacity coupled to the 6th I.F. stage, V2F, through C1AP. A.G.C. is applied on the screen via R34P and R4AD.

6th I.F. stage (V2F)

86. A.G.C. is not applied to this stage. Bias is derived across the cathode resistance R10A. The grid circuit is tuned by L5A, which has a sharp peak at 45 Mc/s in order to fill in the response curve between the two other peaks caused by the preceding I.F. band-pass transformers. The anode circuit of V2F is tuned by L11A to 47 Mc/s, and the output is coupled by the diode transformer directly to V3A, the signal diode detector. L11A and L6A form the diode transformer, L6A being tuned to 43 Mc/s. The windings are damped by R6H and R6J respectively.

Signal detector (V3A)

87. A low-capacity diode forms the signal detector. It derives its input from L6A and is connected directly to it. Since it is necessary to maintain a bandwidth of 2 Mc/s, a low-value diode load (R12A) is used, with L10A as a compensating choke. From the diode, the output is fed through the R.F. filter to the input of the video amplifier stage.

Video amplifier (V2G)

88. The grid of V2G, an R.F. pentode, is fed from the output of the signal detector through C7A. Bias for this stage is provided by R15A in the cathode circuit so that the valve can provide sufficient drive for the low-level cathode follower. The output is resistance-capacity coupled to the cathode follower by R14A, C7B and R18B.

Low level cathode follower (V2H)

89. V2H is used as a cathode follower, its function being to match the high impedance of the video amplifier output to the required low impedance output circuit. R8B is the cathode load and bias resistance, the cathode being connected through R8B to the bias line so that a reasonably high cathode load can be used.

Automatic gain control

90. Fixed grid bias is used on all the five automatically controlled I.F. stages, so that when the screen volts drop due to the control action (para. 93 below), the anode current also drops in proportion. The resistance and condenser network in each of the cathode circuits of the controlled stages is primarily to compensate for the change of input capacity caused when the A.G.C. changes the slope of the valve. Valve inter-electrode capacity is the main tuning capacity of the I.F. transformers.

A.G.C. detector diode (V3B)

91. V3B, a low-capacity diode, is used for rectifying part of the signal to provide the input to the D.C. amplifier (V2M) for A.G.C. The input is derived from L6A through C6B ; R11A is the diode load. The time constant of the output circuit (R18A and C1BE) is such that it does not respond to rapid changes of signal due to the modulation pulses or noise, but only to the peak level of the carrier. A positive delay voltage is applied to the diode cathode so that the A.G.C. does not operate on signals below a certain level. This delay voltage is obtained from a potential divider across the H.T. circuit and is about 6 V. The output from the diode is taken to the grid of the D.C. amplifier V2M through R21D.

D.C. amplifier (V2M)

92. This valve amplifies the output from the A.G.C. diode to improve the A.G.C. action.

Auto-gain control valve (V2N)

93. V2N is an R.F. pentode used to control the screen voltage applied to the first five I.F. stages. The screens of the first three controlled I.F. stages (V2A, V2B, V2C) are connected directly on to the anode of V2N, thus providing more control and a lower screen voltage than is brought about on the last two controlled stages, the screens of which are connected to the junction of R28A and R29A. The input to V2N can be switched by S1 to either MANUAL GAIN or AUTO GAIN. In the MANUAL GAIN position, the D.C. input is derived from a potential divider across the H.T. circuit, the manual GAIN CONTROL (R26A) being connected between the tap on the potential divider and the bias line. In the AUTO GAIN position, the output of the D.C. amplifier is applied to the grid of V2N. A potential divider (R27A and R11F) is connected from the anode of V2N to earth, the junction going to the grid of V2N in the MANUAL GAIN position. This potential divider serves to make the characteristic of V2N more linear and also more independent of the individual differences of valves used. C10D, the input resistance network and the valve form a feedback circuit with a time constant of sufficient length to ensure that the A.G.C. will not respond to low modulation frequencies nor to any very rapid changes in carrier level.

A.T.C. discriminator pre-amplifier (V2J)

94. V2J, an R.F. pentode, is used instead of V2F as a pre-amplifier for the discriminators V3C and V3D in order to avoid the video distortion which would result if the discriminator were connected in parallel with the signal and A.G.C. diodes (V3A and V3B). R10B provides a cathode bias. The input to this valve is derived from V2E through C1AP, the grid of V2J being in parallel with the grid of V2F. The anode circuit is tuned by L7A to 44 Mc/s, and a winding couples the output to the discriminator coil L8A, this winding forming the primary of L8A. From the anode of V2J, through an isolating condenser C3A, a connection is taken to the centre tap of the two secondary windings of L8A.

A.T.C. discriminator diodes (V3C and V3D)

95. The discriminator circuit provides the means for applying automatic tuning control to the mixer unit.

96. V3C and V3D, both low capacity diodes, together form a Foster-Seely discriminator stage (see Tels. A 013). The two secondary windings of L8A go one to each diode anode, and the centre tap is connected back to the anode of V2J and also to the diode loads R35A and R35B through the R.F. choke L1J. L8A is tuned to 45 Mc/s. By this arrangement the voltage applied to the rectifiers consists of two components, that induced in the secondary by inductive coupling, and that fed to the centre of the secondary from the anode of V2J through C3A. The phase relations between the two are such that at resonance, the rectified diode currents are equal in amplitude but flow in opposite directions through R35A and R35B, hence the net voltage output is zero. When the carrier deviates from resonance, the induced secondary current either lags or leads, depending upon whether the deviation is to the high- or low-frequency side. This phase shift causes the induced current to combine with that fed through C3A in such a way that more voltage is applied to one diode than to the other when the frequency is below resonance, and vice versa when the frequency is above resonance. This rectified voltage is applied to the grids of the relay valves V2K or V2L.

Relay valves (V2L and V2K)

97. V2L and V2K are R.F. pentodes. They are biased by a combination of cathode bias (R5F and R5G) and by grid bias applied through R35C and R35D. The valves are normally worked in an over-biased condition with the anode current cut off. When the I.F. deviates from 45 Mc/s, the unbalanced rectified voltage from the diodes appears on the grids of V2L and V2K, the polarity depending on which way the signal has drifted. The valve which receives the positive voltage is driven into anode current. In the anode circuit of each of the relay valves is a relay (mounted in the power unit) which operates when the associated anode current exceeds 3 mA. This causes the auto-tuning motor to run until the tuning bridges for

the R.F. wave guide and the oscillator are adjusted to bring the I,F. signal back to 45 Mc/s (see para. 98), restoring the balance of the rectified voltages at the diodes. Hence the anode current of the relay valve is cut off once more and the motor stops. C10B and C10C perform the function of slugging the relays and prevent hunting.

Auto-tuning motor

98. This induction motor operates on 24V A.C. and incorporates two sets of motor windings arranged in opposition. A worm gear on the motor shaft engages the rank and pinion assembly to adjust the R.F. wave guide and oscillator bridges. Each of the motor windings is connected to the operating contacts of one of the relays controlled by valves V2L and V2K in the power supply unit, and, as the I.F. signal deviates from 45 Mc/s, so the relays operate causing the motor to drive the tuning bridges to compensate for the drift of frequency. The motor can run only for a short period (less than 45 minutes) as a thermal cut-out is incorporated.

Power supply unit (Fig. 1003)

99. The main power transformer T1A has the 230V A.C. applied to its primary winding via S3B (POWER ON/OFF SWITCH). A tuned choke (L3B and C5A) is used for smoothing, followed by a normal smoothing circuit C1D, L3A, C1B and C1C. P1A and S3A, the H.T. indicator lamp and H.T. switch respectively, are wired in the earth return circuit. S3A breaks H.T. and bias simultaneously. The indicator lamp P1B is wired across the heater winding of T1A. The bias rectifier MR1A is a selenium metal rectifier arranged in a bridge circuit getting its A.C. input through R17A, a variable series resistance which serves as the bias adjustment control. The positive rectified output is earthed, the smoothing circuit in the negative line being of the normal choke input variety.

Auto-tuning motor supply and switching

100. The primary of the motor transformer T2A is connected in parallel with the primary of T1A. T2A has one secondary winding which supplies 24V to the auto-tuning motor. The two motor reversing relays are of the P.O. 3,000 type. The cores of the relay coils are connected to H.T. via R3B giving the same potential on the coil and the core, thus reducing the likelihood of a breakdown due to electrolysis.

101. The tuning motor is connected to the transformer via key S1A. When this key is at OFF, the motor is not supplied with current and the R.F. stage is tuned manually. The designations 1ST CHANNEL and 2ND CHANNEL are used to indicate that the local oscillator is working at a frequency of 45 Mc/s above and 45 Mc/s below the signal frequency respectively. In the former case, a rise in signal frequency would decrease the I.F., while in the latter, a rise in signal frequency would increase the I.F. Hence, a rise in signal frequency would cause the tuning motor to run in opposite directions for these two conditions if S1A were not included, since the direction is determined by the drift in I.F. Key S1A is, therefore, incorporated to reverse the connections to the motor for 2nd channel working. Thus the windings are always connected so that the discriminator current arising when the frequency drifts, tends to alter the local oscillator frequency in such a way that the I.F. is brought back to 45 Mc/s. Normally 1ST CHANNEL working is employed, the 2ND CHANNEL position of the key being used for checking purposes only.

Noise slicer (V1A)

102. The screened pentode V1A receives its input from the receiver cathode follower via C10A in the receiver. J1A and J1B, the phone jacks, are connected across the input circuit. The function of this stage is to improve the signal-to-noise ratio of the video signal fed to the S.E.10. The square modulation pulses with noise on the top and bottom are fed to V1A, which is operated in a short grid base condition. The bias is so adjusted by the NOISE SLICER control (R4A) that the pulses just lie on the linear portion of the characteristic and all noise on the positive or negative sides of the pulses fall within the grid current or anode current cut-off conditions and so is sliced off from the signal.

Cathode follower video amplifier

103. The output from the receiver power supply unit fed to the S.E.10 separator unit is developed across R9A in the cathode circuit of the cathode follower valve V2A.

SIGNALLING EQUIPMENT NO. 10

PULSER UNIT (Fig. 1004)

104. The wave forms at various points in this circuit are shown in Figs. 1014–1016. The majority of the interconnections between the units are made via 26-way connectors. These connections are shown in Fig. 1010.

VA, unit C, 9 kc/s oscillator

105. The first and second grids of this valve are connected in a Hartley circuit oscillating at 9 kc/s. The output is taken from the anode of the valve and fed to VB and VE (Fig. 1004).

VB, unit C, sweep generator

106. A saw-tooth generator valve (VB) is triggered off by the 9 kc/s oscillator. The sine wave voltage from the oscillator is applied to the grid of VB through the large condenser QFB and resistors YE and YF, the combination of these components giving a large time constant, compared with the period of the 9 kc/s oscillations.

107. As the applied sine wave voltage is of very much greater amplitude than the grid base voltage of VB, during the first positive half cycle of the sine wave the valve VB will conduct and draw grid current, thus charging the condenser QFB negatively and hence biasing the grid negatively. The grid will tend to keep this bias because of the large time constant of the grid circuit. A state of equilibrium is reached after the first few cycles with the grid biased highly negatively and with the valve conducting only on the peaks of the sine wave.

108. Whilst the valve VB is in a non-conducting state, the condenser QB, connected between anode and cathode of the valve, is charged through the high resistances YH, YG and PA from the H.T. supply. The rate of charging, and hence the maximum voltage attained by QB, depends

upon the setting of PA (GROUP ADJUSTMENT). When the valve VB is triggered off by the sine wave peak voltage, the condenser QB discharges rapidly through the low impedance of the valve. The voltage wave form in the anode circuit of VB is thus a positive-going saw-tooth with a slope depending upon the setting of PA and with a 9 kc/s recurrence frequency.

109. The time during which VB is in a conducting condition is determined by the value of YF. In order to ensure that QB is completely discharged before the next sweep starts, VB conducts for a longer period than is necessary to discharge QB, and the saw-tooth has a flat on it. Otherwise, any supply ripple that happens to exist across QB will appear on the time base sweep to the C.R.T. and make the monitor traces blurred.

VC, unit C, sweep cathode follower

110. This valve acts as a buffer stage between VB and the later stages, so that variations in voltage across the output of VC do not distort the wave form developed across QB.

111. The output from the cathode of VC is fed to all the VAs of the pulser channel units (A) and, via a potential divider network to the monitor sweep terminals and grid of the phase inverter VD.

VD, unit C, sweep inverter

112. This valve shifts the phase of the saw-tooth through 180° and applies it to the other monitor sweep terminal to provide a linear balanced sweep voltage. It is essential that this time base should be strictly linear in time if adjustments of the pulses for equal spacing in time be made by eye. Hence a circuit QD, YP, YN is provided to feed some of the output of VD back to its grid circuit, the amount and phase of this feedback being such that the sum of the two sweep outputs is linear.

VE, unit C, synchronizing pulse generator

113. The input to this valve is the 9 kc/s sine wave from the anode of VA. The grid circuit is similar to that of VB, i.e., grid current charges up the condenser QFF thus biasing the valve so that it will only conduct during positive peaks of the input cycle. A square negative pulse of 22 μ sec. duration is thereby developed across the anode resistance YW. This synchronizing pulse output is fed to the suppressor grid of VF. The circuits of VF and VG, unit C, are described in paras. 122, 123 below.

Pulser channel unit. Unit A. (Fig. 1004)

114. There are eight similar pulser channel units, a ninth being carried as a spare. A description of one unit is typical of them all. Voltage waveforms are shown in Fig. 1016.

VA, unit A, signal pulse starter

115. The grid of VA is supplied with a saw-tooth voltage from VC, unit C, and the cathode is biased to a positive potential by one of the potentiometers PA to PH on a pulser common apparatus (unit G) depending on the channel with which the valve is associated. At the start of the positive-going saw-tooth, the grid potential is below that of the cathode and the valve is cut off, so that its anode potential is a maximum. As the grid potential rises, a point is reached when anode current begins to flow and very shortly afterwards grid current flows. This prevents a further rise of grid voltage although the output potential from VC, unit C, continues to rise.

116. The sudden commencement of anode current results in a steep fall in anode voltage. This results in a similar fall in potential at the junction of QA and YD, but owing to the short time constant of the circuit QA, YD, this junction will rapidly return to its original condition. A pulse is, therefore, passed to the grid of VB, whose maximum width depends on the setting of the present, PULSE WIDTH CONTROL, QA. The time interval which elapses between the commencement of the applied saw-tooth and this pulse depends on the grid bias of VA and hence is determined, firstly, by which of the potentiometers PA to PH (unit G) is connected to VA (i.e., on which channel is being considered) and, secondly, to a lesser degree, by the adjustment of the potentiometer itself. Thus the VBs in the various channels receive the negative pulse on their grids in succession. VA is cut off again when the flyback of the saw-tooth occurs, and, although this results in a positive pulse at the grid of VB, it is unimportant in the working of the circuit, as will be shown later.

117. To reduce the potential difference between heater and cathodes of the VAs in the various channel units, the heaters are grouped and taken to separate heater windings whose positive potentials correspond approximately to the cathode potentials.

VB, unit A, saw-tooth generator

118. The grid of this valve is returned via YD to a positive potential so that in the static condition, grid current is flowing and the grid potential is approximately that of the cathode. When the positive pulse is applied to the grid of this valve, it is swamped by the grid current. When, however, the negative pulse is applied, grid current ceases to flow. The grid voltage begins to rise again, but is arrested at about earth potential by the flow of grid current. The width of the negative pulse applied to VB depends to some extent upon the wave form at the anode of VA and hence on the channel position under consideration. To compensate for this, the positive voltage applied to YD is fixed according to the position of the channel (140 V for channels 1–4 and 60 V for channels 5–8) and is arranged so that QA gives a suitable variation of pulse width, thereby standardising the channel units.

119. When VB is cut off by the negative pulse on its grid, QB commences to charge up, but VB conducts again before the charging is complete. This results in a saw-tooth voltage of the shape shown in Fig. 1016 at the grid of VC.

VC, unit A, signal pulse generator and modulator valve

120. The saw-tooth voltage developed by VB is applied to the grid of VC, and A.F. modulating voltages to the cathode (see para. 121 below). In the absence of A.F. modulation, the bias condition obtained is such that a pulse which is substantially square in shape and of $3\frac{1}{2}$ μ sec. duration is produced at the anode of VC. The outputs from all VC channel valves are passed through QFH to the grid of VF in unit C. It can be seen from Fig. 1016 that a rise and fall in VC cathode potential will produce a corresponding narrowing and widening of the pulse, the

variation in width being produced by a movement of the front of the pulse only. The cathode is supplied with A.F. modulation voltages by valve VD and thus the pulse is width-modulated by the audio signal. When it is required to ring on this channel, the pulse is suppressed by applying + 140 V to the cathode of this valve through the line unit (M).

VD, unit A, audio amplifier

121. This valve amplifies the A.F. modulating signals from the telephone circuit which are applied via the line unit, and acts as a limiter to prevent over-modulation. The modulation is adjusted to the required level by PA, in the input circuit (MODULATION LEVEL).

VF, unit C, mixer

122. As already described, the synchronizing pulse is applied to the suppressor grid of valve VF, and the eight channel pulses to the control grid. The valve is normally conducting since the grid is returned to + 180 V through YY. The negative pulses applied to it result in positive pulses at the anode, consisting of the synchronizing pulse followed by the eight channel pulses. It should be noted that the synchronizing pulse is produced on the positive peak of the 9 kc/s oscillation and since this peak also produces the fly-back and flat bottom of the saw-tooth voltage, the synchronizing pulse comes between consecutive sequences of channel pulses. The output (Fig. 1015) from VF is applied through a resistance capacity circuit QE, YAD, which sharpens the pulses, to the grid of VG.

VG, unit C, output amplifier

123. The positive-going input is fed to valve VG, which amplifies and squares-up the pulses, and results in an output consisting of negative-going pulses which are applied to the wireless sender.

124. In the cathode of VG are two relays which function in the following manner. With no input, VG takes about 35 mA, and with all channels producing pulses, about 20 mA. Under the latter condition RA/2 is operated, while the neutralizing current fed to the differentially wound relay RB/2 is arranged to prevent this relay from operating. If, however, more than six channels fail, relay RB/2 operates causing the alarm bell on unit M to ring via contact RB2 and the GROUP FAILURE lamp (LPB) to light via contact RB1. If the H.T. to the pulser fails, or if for any other reason VG no longer passes any current, relay RA/2 is released, the alarm bell rings via contact RA2 and the SUPPLY FAILURE lamp (LPA) lights via contact RA1 except in the event of power failure. The alarm bell rings, however, as it is battery operated. To adjust the current at which relay RB/2 operates, a resistance PJ is incorporated on the pulser common apparatus (unit G) and is adjustable from the front panel (SIGNAL FAILURE ALARM).

SEPARATOR UNIT (Fig. 1006)

125. The wave forms at various points in this circuit are shown in Figs. 1017, 1018.

VA, unit D, synchronizing pulse separator

126. The input to the separator consists of a long synchronizing pulse followed by eight width-modulated channel pulses, all these pulses being positive-going. This input is identical in form with that produced by the distant pulser, except that the latter are negative-going pulses. The input is applied to the condenser QEB.

127. Since the time constant of QEB, YC is long compared with that of the longest pulse, the junction QEB, YD follows the pulse shape exactly. Consider any positive pulse arriving at this juntion. The cathode of VA becomes positive with respect to the anode, so that the valve does not conduct, and QA starts to charge up through YD. Before QA has reached a steady potential, however, the end of the pulse arrives, the junction QEB, YD returns to its initial potential and QA starts to discharge. The anode of VA is now positive with respect to the cathode, and QA discharges rapidly through the valve. The result of this is to change the square pulse arriving at QEB to one with an exponential front and steep back at the grid of VB. The voltage built up across QA is greater for the wider pulses so that the synchronizing pulse develops about three times the voltage of a channel pulse.

VB, unit D, buffer cathode follower

128. This valve acts as a buffer between the sweep generator valve VC and the synchronizing pulse separator so that grid current flowing in VC will not affect the operation of the previous stage. The output is fed to the grid of VC.

VC, unit D, sweep generator

129. This valve produces a 9 kc/s saw-tooth voltage in the same way as VB in the pulser unit C (see paras. 106–108), the synchronizing pulse of large amplitude operating on this valve in a manner similar to that of the peak of the 9 kc/s oscillation in the pulser unit. The self-bias produced by grid current due to this large pulse prevents the channel pulses from having effect.

VD, unit D, sweep cathode follower

130. This valve acts as a cathode follower in a manner similar to that of VC in unit C (para. 110).

VE, unit D, sweep inverter

131. This valve changes the phase of the saw-tooth voltage by 180°, and improves the linearity of the saw-tooth as does VD in unit C (para. 112). VF amplifies the output of VC, unit B (see para. 140).

Separator channel unit. Unit B

132. There are eight similar separator channel units, a ninth being carried as a spare. A description of one unit is typical of them all. Wave forms in this unit are shown in Fig. 1018.

VA, unit B, gate pulse starter

133. This valve functions in a similar way to VA of unit A (para. 115), producing, at the grid of VB, a negative pulse whose maximum width depends on the setting of QA, GATE WIDTH CONTROL, and whose moment of arrival may be made to correspond with the appropriate signal pulse by the potentiometer PA-PH, unit H.

VB, unit B, gate pulse generator

134. The input to the grid of this valve is a sharp negative pulse. The anode is supplied from only 140 V so that it is saturated by a low grid voltage. A square positive-going pulse of about 8μ sec. duration, known as the gate pulse, is therefore produced at its anode. The width of this pulse depends upon the maximum width of the applied pulse and so is adjustable by the GATE WIDTH CONTROL, QA, and its moment of generation depends on the setting of one of the GATE POSITION potentiometers PA-PH (unit H) depending on which channel is being considered.

VC, unit B, gate valve

135. The gate pulse is applied to the control grid of this valve and the train of pulses from the receiver output to its suppressor grid. The gate pulse draws grid current, charging up condenser QEC, and so biases the valve negatively so that it cannot conduct except during the application of the gate pulse, this biasing arrangement being similar to that of VB, unit C (paras. 107, 108). In a similar way, current from the suppressor grid charges up QEA so that the valve will conduct only during the application of one of the input pulses. This valve will, therefore, only draw anode current if pulses are applied to both control and suppressor grids simultaneously. YB and QG, unit C, pass current when any one of the eight channel gate valves, VC, conducts and so provides a positive bias on the cathodes. This arrangement improves the action of the gate valves.

136. By adjusting the cathode bias of VA by means of one of the GATE POSITION potentiometers (PA-PH, unit H), it is arranged that the gate pulse arrives at the grid of VC immediately before the required channel pulse reaches the suppressor. The gate pulse of 8μ sec. duration is arranged to start before the finish after the channel pulse of $3\frac{1}{3} \pm 2\frac{1}{3}$ μ secs. duration. (This is equivalent to approximately 70% modulation). The modulation on the channel pulse is at its front edge so that the channel pulse must lie towards the rear of the gate pulse. Since anode current will flow only for the duration of the shorter pulse, that produced at the anode will be a replica of the channel pulse, and if the channel pulse is width-modulated, so will be the output from VC.

137. The width-modulated pulse output from the anode of VC is partially rectified by ZA and the D.C. component is used to counteract the 13 V negative bias on the grid of VD which constitutes part of the ringing system as described below (para. 145). The A.C. component of the output is also fed to the grid of VD via a low pass filter.

VD, unit B, audio amplifier

138. The modulated pulse output from VC is filtered by a 4 kc/s low-pass network UAA, UAB, and the resulting A.F. signal is passed to the grid of the amplifier valve VD. The amplitude of the output fed to the telephone circuit via the line unit is adjustable by means of PA (VOICE OUTPUT) in the grid circuit of VD.

139. The attention of the filter UAA, UAB, is such that the output to line does not exceed 10 mV at 9 kc/s or otherwise the incoming G.R.F. from the distant station will beat with the local G.R.F. to produce an audio beat note.

140. In order to facilitate the adjustment of the relative positions of the gate and channel pulses, the screen voltage of VC is monitored on the C.R.T. in the monitor unit (L). The screens of the VCs in all eight channels are passed to the amplifier valve VF in the common unit (D) and thence to the monitor unit. The production of this gate wave form is as follows. The gate pulse first arrives at the grid of VC in the channel under consideration and the valve conducts as far as the screen, so that the screen potential falls. The channel pulse now reaches the suppressor grid, the anode takes current, the screen current falls and the screen potential rises. At the end of the channel pulse, the screen once more takes all the current and its potential falls until eventually the gate pulse ceases and the potential rises to that of the supply. These potential variations are repeated in turn in all eight channel units, so that the wave form monitored on the C.R.T. is as shown in Fig. 1017.

Alarm circuits

141. The relay RA/4, unit K (Fig. 1008) is in the common H.T. supply to the VDs in all the channels and is released when more than six channels stop working or when H.T. or power failure occurs. In the first two cases the alarm bell in unit M rings through contact RA3 and the SIGNAL FAILURE lamp on the power and miscellaneous panel (LP unit M) lights through contact RA4 whereas in the latter case only the alarm bell rings. Contacts RA1 and RA2 disconnect the external telephone circuit from the ringing supply, thus preventing the absence of any channel pulse from ringing its corresponding telephone (see para. 145 below), when more than six pulses are absent simultaneously.

POWER UNITS

Pulser and separator power units (units G and H) (Figs. 1005, 1007)

142. These two units are almost identical in design. The only unusual feature is the provision of the relay RA/2. This relay is differentially wound, and carries the anode currents of the two rectifiers VA and VB. The currents oppose each other, and the relay is, therefore, not operated, until the unbalance reaches 20% of the total current, i.e., when one rectifier is taking 60% and the other 40%. When this occurs, RA/2 operates, the alarm bell rings over contact RA1 and the SUPPLY FAIL lamp lights through contact RA2. Two test points JA, JB (engraved VA, VB) are provided on the front panel and may be used to determine the actual current through each rectifier. YA alters the effective value of the reservoir condenser QA, and is adjusted under working conditions to give an output of 400 V H.T. The inductance LB is tuned by QC to 100 c/s for more efficient filtering.

LINE UNIT

Line channel unit (unit E) (Fig. 1008)

143. There are eight similar line channel units, a ninth being carried as a spare. A description of one unit is typical of them all.

144. U-links are arranged so that the points C may be connected to those marked 2 or 4 according to whether 2- or 4-wire working is required. The appropriate line terminals will then be used. The unit carries two

transformers, XA, XB. For 2-wire working these transformers are so connected that they form a 4-wire terminating set. For 4-wire working these transformers are independent and connect the pulser and separator units to the line. The transformer windings are tapped so that the equipment always presents an impedance of 600 Ω to the line.

Ringing system (unit E, K) (Fig. 1008)

145. In order to ring a telephone connected to the distant station, a ringing current of 17–50 c/s is applied to the local station via 4-WIRE IN or 2-WIRE terminals. In either case this current is rectified by ZA (unit E) and then operates a relay RA/1 (unit E). A voltage of + 140 V is applied via contact RA1 to the cathode of the modulator valve VC in the corresponding pulser channel unit (A). This cuts off VC and the corresponding channel pulse is suppressed. At the distant separator, the absence of the channel pulse results in no output from the corresponding gate valve VC, unit B. ZA no longer applies a positive bias to the audio amplifier VD so that this valve is cut off by — 13 V applied to its grid. A relay RB/4 in the corresponding line channel unit (E), in the cathode circuit of VD, which is normally held by the current through this valve, is now released. Contacts RB2 and RB4 transfer the output terminals (2- or 4-wire working) to a 75 V, 50 c/s ringing supply, while RB3 lights a pilot lamp LP (RINGING) which indicates on the S.E.10 which channel is being rung. In the case of 2-wire working the line is replaced by a 600 Ω resistance YA through RB1 to preserve the balance of the terminating set.

146. The 6.3V for the pilot lamps are obtained from the same transformer as the 75 V ringing supply and this, with the relay RA/4, is mounted in unit K at the rear of the case holding the monitor and line channel units.

Test circuits (unit M) (Fig. 1008)

147. A meter is built into the line, alarm and test panel (unit M) for testing purposes. Three sockets, of which the central one is earthed, lie immediately below the meter and enable either the positive or negative terminal of the meter to be earthed by means of a U-link, and a wander lead to be inserted in any desired test point is connected to the other terminal. Most valves have test points connected to the positive end of resistances in their cathode loads. In addition, three sockets for testing valve types ARP35, 6V6G and VR92 are mounted below the meter and resistances connected in the circuits of these sockets are such that normal valves should give a reading of 0.25 mA when inserted.

MONITOR UNIT (UNIT L, F) (Fig. 1009)

General

148. The monitor C.R.T. is an A.C.R. 13A and is mounted so that a horizontal time base is obtained when the sweep voltages are applied to the Y-plates. The reason for this is that the sensitivity of the Y-plates is greater than that of the X-plates and the sweep voltage obtainable would not give a long enough trace if applied to the X-plates, whereas the wave form voltages are sufficient to give an adequate deflection.

149. Voltages for the monitor power unit are derived from units G, H. The power unit is conventional, BRILLIANCE being controlled by PA, and FOCUS by PB. The push button KA is arranged so that the bias applied to the grid prevents a trace being visible on the screen unless the button is depressed. The grid is then connected to the slider of PA and the desired value of brilliance can be obtained. YA sets an upper limit to this brilliance thus preventing damage to the tube.

150. Voltages are applied to the plates of the C.R.T. through the four banks SA, SB, SC, SD of the 4-position switch, as described below. Banks SA and SB select the sweep voltages to be applied to the Y-plates and banks SC and SD select the signal voltages to be applied to the X-plates.

Position 1. Sender

151. The rectified signal from the crystal pick-up in the sender mirror (see para. 62) is amplified by a two-stage resistance-capacity coupled voltage amplifier (unit F) and applied to the X1 plate while X2 plate is earthed. At the same time a steady positive shift voltage of about 60 V is applied to this plate from the junction of YL, YM, unit F, across the 250 V supply, so that the wave form appears in the centre of the tube. The sweep voltage is obtained from the pulser unit as described in paras. 110–112.

Position 2. Pulse out

152. The output from the pulser unit is applied directly to the plate X2, while X1 is earthed. The sweep voltage is obtained from the pulser unit (paras. 111–112).

Position 3. Gate

153. The gate wave form from the separator unit is obtained as described in para. 140. and is applied directly to plate X2 while X1 is earthed. The sweep voltage is obtained from the separator unit as described in paras. 129, 131.

Position 4. Pulse in

154. The output from the receiver to the separator is fed directly to plate X2 while X1 is earthed. If the unsliced pulses are to be observed, the monitor unit is connected to the receiver, while if the sliced pulses are to be examined, connection is made to the output from the alternative input socket on the separator. The sweep voltage is obtained from the separator (paras. 129, 131).

OSCILLATORS, TESTING, NO. 10 (Fig. 1011)

20 Kc/s oscillator V4

155. This consists of the valve V4 operating in a Hartley type oscillator circuit at a frequency of 20 kc/s with a trimming condenser C20 capable of giving ± 500 c/s adjustment. This stage gives a sinusoidal output of approximately 100 V R.M.S.

Saw-tooth generator V3

156. A saw-tooth generator V3 is triggered off by the 20 kc/s oscillator. Its mode of operation is similar to that of VB in the pulser (unit C) of the S.E.10 (see paras. 106–108). The output, which consists of a positive-going saw-tooth with a 20 kc/s recurrence frequency is fed to V2.

Pulse output stage V2

157. The positive-going saw-tooth wave form voltage is applied to the grid of the valve V2 through a small condenser C5 and, as the saw-tooth wave is of very much greater amplitude than the grid base voltage of V2, limiting occurs and a negative-going rectangular pulse is produced at the anode.

158. The time duration of this pulse depends upon the bias applied to the grid of V2, i.e., on the voltage developed across R4 and R17 by the discharge of C5. If the grid of V2 becomes more negative, then a greater amplitude of saw-tooth voltage must be applied to the grid of the valve before it conducts. Thus, the pulse becomes narrower as the bias becomes more negative and conversely, as the bias becomes less negative the pulse becomes wider.

159. The pulse at the anode of V2 appears across a 5 kΩ load R2 and its peak amplitude when loaded externally by 5 kΩ is about 70 V. The output from V2 is fed via a co-axial cable to the sender.

Tone oscillator or microphone amplifier V5

160. The grid lead B4 of the valve V2 is connected to the slider of the potentiometer R17 (INCREASE MODULATION) which is connected across the secondary of the transformer T2. The primary of T2 is in the anode of the A.F. amplifier valve, V5. The A.F. voltage which appears across the transformer T2 varies the grid bias of V2 and hence modulates the width of the pulse output from V2.

161. The valve V5 also performs the function of an A.F. oscillator. The circuit is connected in such a way that in the 1,600 c/s or 800 c/s position of the key S1 the circuit functions as a Hartley oscillator, the tuned circuit being connected between the screen grid and the control grid of V5. In the SPEECH position of the key S1, the transformer T1, which acts as the tuned circuit for either the 1,600 c/s (with C14) or 800 c/s (with C14 and C15), is switched so that it becomes the step-up input transformer between the 4-wire terminating set transformers T3 and the grid of V5.

Circuit reference	*Value*	*Remarks*		
		Tolerance	*Rating*	*General*
		CONDENSERS		
C1 and 2	2μF	15%	1 kV D.C. wkg.	
C3	10 μF	15%	1 kV D.C. wkg.	
C4 and 5	0.1 μF	15%	1 kV D.C. wkg.	
C6	6 μF	15%	150 V D.C. wkg.	
C7	1 μF	15%	150 V D.C. wkg.	
		INDUCTANCES		
L1				
L2				
		LAMP		
P1			6 V, 40 mA	
		RESISTORS		
R1 and 2	1M Ω	± 20%	1 W	
R3	35 Ω	± 5%	½ W	
R4	5k Ω			
R5–10	33k Ω	± 10%	1 W	
R11	1k Ω	± 10%	12 W	
R12–15	20k Ω	± 10%	12 W	
R16	100 Ω	± 10%	½ W	
R17	1M Ω	± 20%	½ W	
R18	1k Ω	± 10%	12 W	
R19	0.75 Ω	± 2%	½ W	
R20	4.7k Ω (to be modified to 47k Ω)	± 20%	1 W	
R21	3 Ω	± 2%	½ W	
R22	1.5M Ω	± 5%	1 W	
R23	220 Ω	± 20%	½ W	
		SWITCHES		
S1				C6–30
S2				2-pole
		TRANSFORMERS		
T1				
		VALVES		
V1 and 2				AU5
V3				ATS25
V4				CV79 or CV89

Table 1001—Main components in sender (Fig. 1001)

WIRELESS STATION No. 10

DATA SUMMARY

PURPOSE

To provide eight telephone circuits over a wireless link.

DESCRIPTION

Semi-mobile self-contained station.

Main equipment : Wireless sender No. 10
Reception set No. 10
Signalling equipment No. 10
Oscillator, testing, No. 10
Generating set, Onan, 3kVA

PHYSICAL DATA

	Trailer (loaded)	*Wireless rack*	S.E.10	*Generating set*
Weight	3 ton 10 cwt.	253 lb.	600 lb.	440 lb.
Height	10 ft. 6½ in.	55½ in.	44 in.	31½ in.
Length	*16 ft. 0 in.	17¼ in.	33 in.	36½ in.
Width	6 ft. 3 in.	13 in.	24 in.	19½ in.

* Length including tow-bar.

FREQUENCY

Receiver coverage : 6.15–6.8 cm. (4,880–4, 410 Mc/s.)
Sender wave-length : 6.3 or 6.6 cm.
Group recurrence : 9 kc/s.

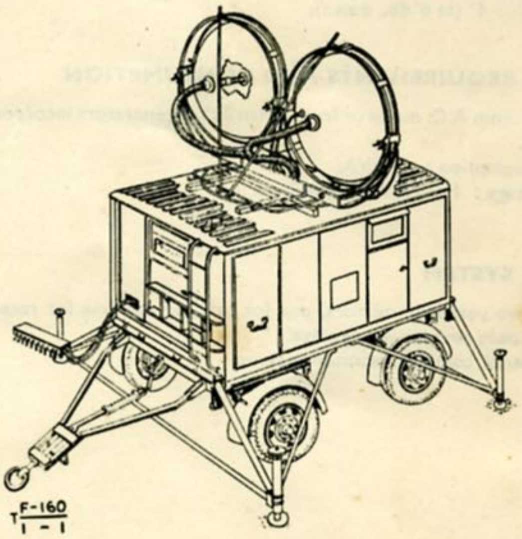

Fig. 1.—Exterior view of complete equipment

PERFORMANCE

Power and type of output : 100-400 mW passed to sender aerial
Range : 50 miles optical.
Beamwidth : 4° (at 6 db. down).

POWER REQUIREMENTS AND CONSUMPTION

Operated from A.C. mains or from Onan 3kVA generators incorporated in station.
Total consumption : 1¼ kVA.
Mains voltage : 110-250 V at 40–60 c/s.

AERIAL SYSTEM

Type : Two parabolic mirrors, one for sending and one for receiving, fed by flexible circular waveguides.
Sender aerial contains monitor pick-up.

VALVES (Working)

Type	*Senders*	*Receivers*	*S.E.10*	*Test osc.*
ARP35	—	28	88	4
6V6G	—	2	10	—
VR92	—	8	2	—
5U4G	—	2	4	1
AU5	4	—	—	—
ATS25	2	—	—	—
CV79 or CV89	2	—	—	—
CV90	—	2	—	—
ACR13A	—	—	1	—
CV101 or CV102	2	2	—	—
VU120	—	—	1	—

REMARKS

Two stations required to form link.

END