

DETAILS OF COMPONENTS

Transmitter	C.S. I/F		Low Power	C.S. H/F		Spark Transmitter	GD
	Master Controlled	Self excited		Master Controlled	Self excited		
Frequency range	60 - 500	60 - 500	60 - 500	3000-16500	3100-15500	70 - 500	60 - 500
Power Supply.	20 KW alternator	20 KW alternator	11 KW alternator	20 KW alternator	20 KW alternator	20 KW alternator	20 volt battery
Filament Supply.	11 KW alternator	11 KW alternator	11 KW alternator	11 KW alternator	11 KW alternator	-	-
Valves Used. See Section J.	1 6N45A 2 6N32A 2 6N24 2 6N2	2 6N32A 2 6N24	1 6N45A 2 6N2	1 6N45A 2 6N32A 2 6N24 2 6N2	2 6N32A 2 6N24	-	-
Wave form.	C.W. and I.C.W.	C.W. and I.C.W.	C.W. and I.C.W.	C.W. and I.C.W.	C.W. and I.C.W.	Spark.	Spark.
Associated Wavemeters.	656 657	656 657	656 657	657	657	656 657	656 657
Approximate range in miles.	1500	1500	100	World wide at times.	World wide at times.	150	50
Date of design.	1923	1923	1923	1923	1923	1920	1922
Reference page.	RM11	RM13	RM14	RM17	RM21	CE6	CE2

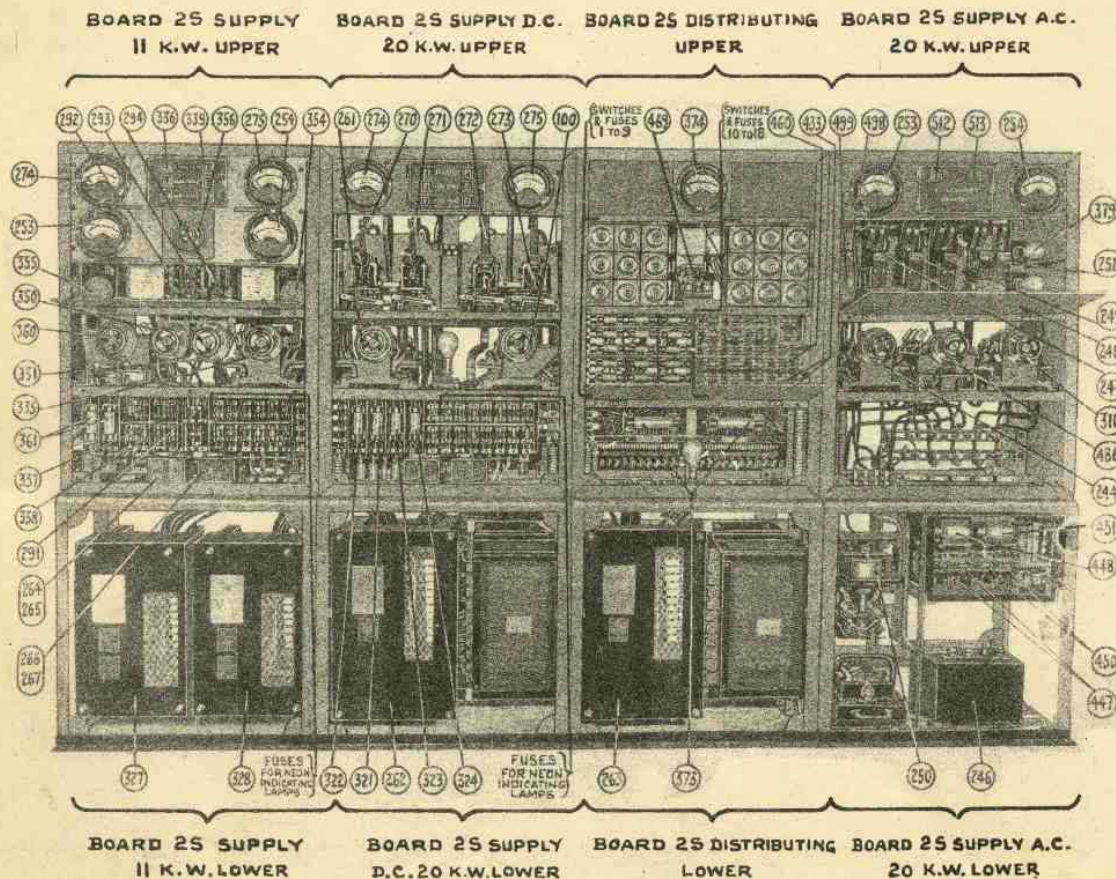


FIG. 2.

COMPOSITION OF PANELS

Type 48 is the main transmitting set for heavy ships and cruisers and will replace Type 363. The new set has four power boards which carry the necessary switches, fuses and instruments for the distribution of power to the set and W/T office. A photograph of these boards is shown in figure a. Their full title (which must be used for storekeeping purposes) is considered too cumbersome for instructional purposes and they will be referred to as Nos. 1, 2, 3 and 4 power boards in these notes as shown below.

No. 1	No. 2	No. 3	No. 4
Board 2S Supply 11 kW Upper	Board 2S Supply D.C. Upper	Board 2S Distributing Upper	Board 2S Supply A.C. Upper
Board 2S Supply 11 kW. Lower	Board 2S Supply D.C. Lower	Board 2S Distributing Lower	Board 2S Supply A.C. Lower

The transmitting circuits are carried in eight main valve panels which face the power boards and the rectifying and smoothing panels which are fitted in a convenient position inside the safety cage. A small panel containing the I/F neutralising condensers, etc., is secured to the back of the I/F main transmitting panel. Their storekeeping titles are shown below as well as the name by which the various panels will be referred to in these notes. Photographs of these panels are shown in figures f, g and z.

H/F Neutralising Panel.
Panel 3S H/F Main Neutralising

I/F Master oscillator	Transmitter 3S L/F	Transmitter 3S H/F	H/F Master oscillator
Panel 3S I/F Master oscillator	Panel 3S I/F Main Transmitting	Panel 3S H/F Main Transmitting	Panel 3S H/F Master oscillator
Grid signalling and absorbing	Filament Distributing	Spark Transmitter	I.F. Rectifying Panel
Panel 3S Grid signalling and absorbing	Panel 3S Filament distributing and control	Panel 3S Spark	Panel 3S Low Power Rectifier

Main Rectifying Panel	Smoothing Panel
Panel 3S Main Rectifier Upper	Panel 3S Smoothing Upper
Panel 3S Main Rectifier Lower	Panel 3S Smoothing Lower

The switches necessary for the control of the set are assembled in Board 2S Controlling, (see figure b) which is mounted on a stand and fitted in the central receiving room. "ON" and "OFF" pushes for the auto starters, the high power voltmeter (245) (see figure e.) and low power voltmeter (290) (see figure h.) are also fitted in the control board.

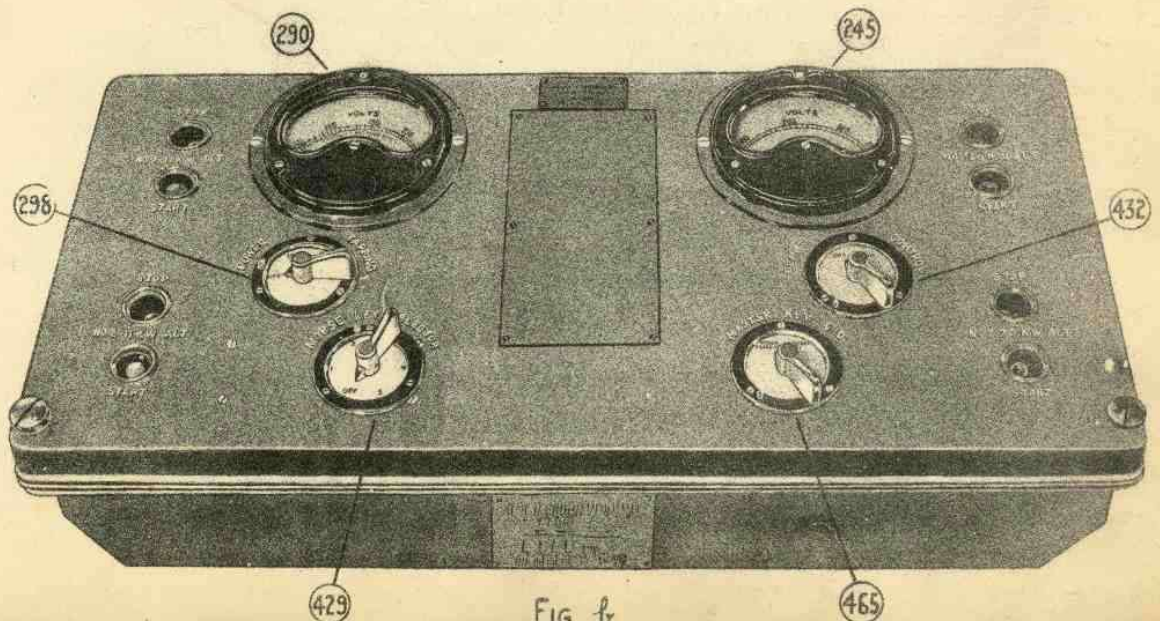


FIG. b.

TYPE 48

20 KW. SUPPLY

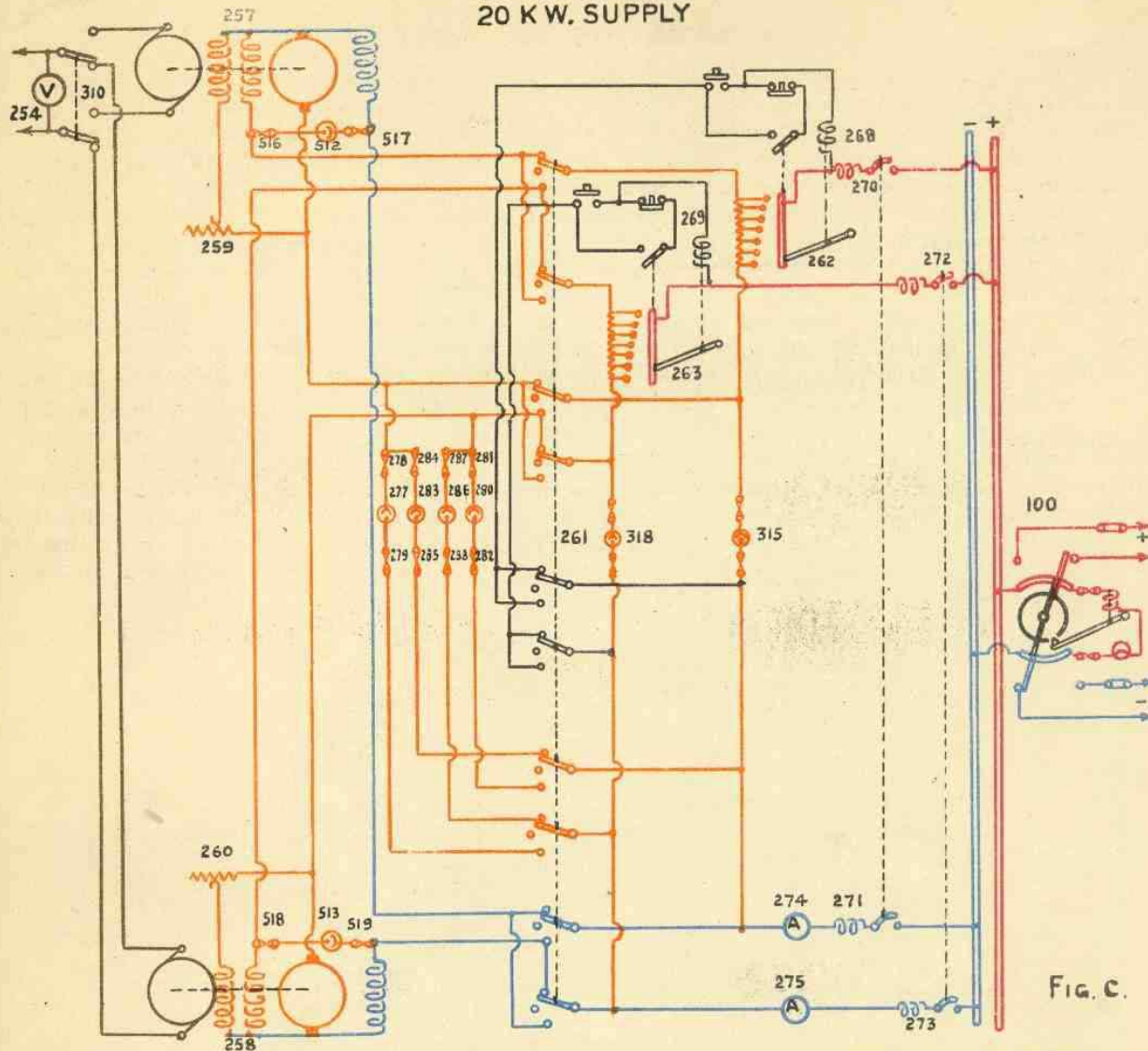


FIG. C.

Main Alternators 20 KW. See figure c. Circuit breakers (268)(271) and (272)(273) connect the main bus bars to the X size automatic starters (262)(263), (See page MA5), which control the main alternators for the main H.T. supply. The circuit breakers are set to "ON" by hand. An excessive current causes them to be broken by the action of the bobbin shown diagrammatically in series with the contact. They can also be broken by pressing an "OFF" push.

Neon indicating lamps (315)(318) are connected between the armature terminals of the starters and the negative contacts of the circuit breakers. These lamps are situated behind glass panels fitted in No.2 power board and indicate the starter or starters in use.

A ten pole change over switch (261) connects the starters (262)(263) to the main alternators and enables either starter to be used for either machine and both machines to be run simultaneously.

The motor end of the machines can be completely isolated by setting the C.O.S. (261) to "OFF". Six contact arms of this switch are used to connect the starters (262)(263) to the machines. Two other contact arms are connected in the control circuits for the operating coils of the automatic starters (262)(263). This arrangement prevents the starters from being switched on when the C.O.S. (261) is in the "OFF" position.

The remaining two contact arms connect the neon indicating lamps (277)(280) or (283)(286) in circuit to indicate the machine in use. These lamps are fitted behind glass panels below the "Starter" indicating lamps (315)(318). The plate which carries the glass panels is marked "Starter" "Machine" in positions to correspond with the indicating lamps and is hinged to provide easy access to the neon lamps for replacement. The combination of starters and machines in use is thus indicated by the starter and machine lamps grouped together in No.2 power board.

Neon indicating lamps (512)(513) are connected between the series and shunt fields of the motors. These lamps are fitted in No.4 power board and are situated behind glass panels which, when illuminated, indicate that power is being supplied to the alternators. The plate which carries the glass panels is marked "Alternators Running" and is hinged to provide easy access to the neon lamps and their fuses. The neon lamps will not light up until the voltage across their respective circuits is equal to the striking voltage of the lamps.

The alternator field regulators (259)(260) are fitted in a convenient position in the W/T office where they can be adjusted to obtain the correct output voltage from the alternators as indicated by the A.C. voltmeter (254) fitted in No.4 power board. The normal voltage required is 330 volts but the A.C. supply to the main transformer is governed by an auto-transformer as explained later.

TYPE 48 11 K.W. SUPPLY

RM5

Filament Alternators 11 KW (see figure d). Two pairs of fuses (321)(322) and (323)(324) connect the main bus bars to the Y size automatic starters (327)(328) respectively which control the 11KW alternators. Duplicate machines (496)(497) are fitted and ten contact arms of the sixteen pole machine and starter C.O.S. (325) connect the starters (327)(328) to the machines to allow either starter to be used for either machine and both machines to be run simultaneously.

Neon indicating lamps indicate the combination of starters and machines in use and are connected in circuit and operated in a similar manner to those for the main 20 KW alternators and starters but no "Alternators Running" lamps are fitted. The indicating lamps and D.C. ameters for the machines are fitted in No.1 Power Board.

The remaining six contact arms of the C.O.S. (325) are used to connect the A.C. output from the machines (496)(497) to the auto-voltage control circuits.

In addition to supplying the filament transformers the 11 KW alternators are used for supplying the L.P. rectifying system when using H/P, master controlled, or the low power transmitter (see page RMC). Reversing Boosters. (See Admiralty Handbook of W/T ^{(1938) vol. I} (1901) paragraph 251). Each automatic starter (327)(328) is connected to a "Hand-Auto" switch (350)(351) which enables the A.C. output voltage to be hand or automatically controlled. With the hand-auto switches (350)(351) in the "Hand" position the voltage is controlled by alternator field regulators (348)(349) and in the "Auto" position by means of the boosters and contactors

The A.C. output from the alternators is connected to the booster contactors by the machine and starter C.O.S. (325). This ensures that the appropriate booster is connected to the alternator in use irrespective of the combination of machine and starter.

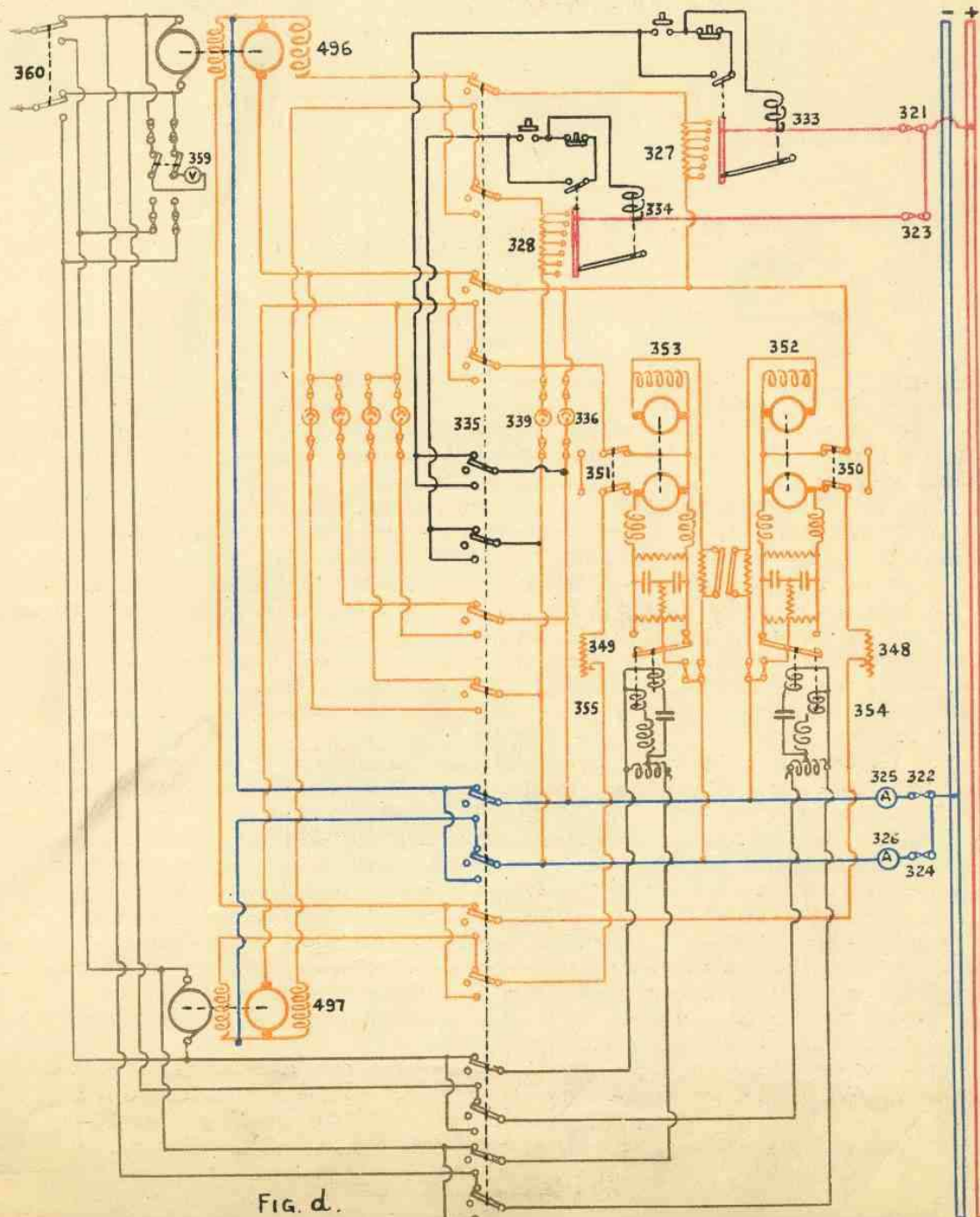


FIG. d.

TYPE 48
20 K.W. SUPPLY

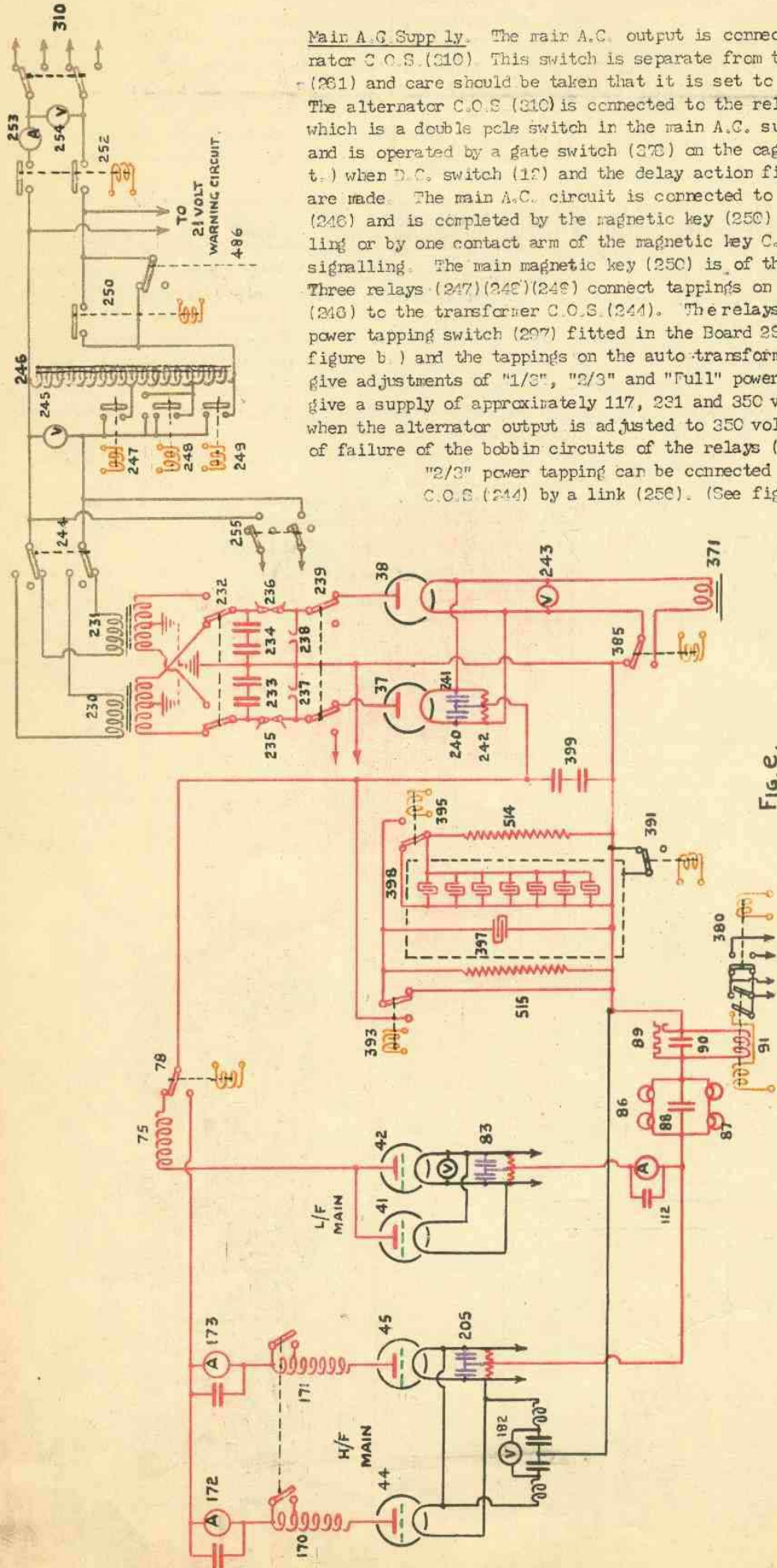


Fig. e.

Main A.C. Supply. The main A.C. output is connected to the alternator C.O.S. (310). This switch is separate from the machine C.O.S. (261) and care should be taken that it is set to the machine in use. The alternator C.O.S. (310) is connected to the relay switch (252) which is a double pole switch in the main A.C. supply to the set and is operated by a gate switch (370) on the cage door (see figure t.) when D.C. switch (12) and the delay action filament switch (375) are made. The main A.C. circuit is connected to an auto-transformer (246) and is completed by the magnetic key (250) for primary signalling or by one contact arm of the magnetic key C.O.S. (496) for grid signalling. The main magnetic key (250) is of the plug-in type. Three relays (247)(248)(249) connect tapings on the auto-transformer (246) to the transformer C.O.S. (244). The relays are operated by a power tapping switch (207) fitted in the Board 2S Controlling (see figure b.) and the tapings on the auto-transformer are arranged to give adjustments of "1/3", "2/3" and "Full" power. These tapings give a supply of approximately 117, 231 and 350 volts respectively when the alternator output is adjusted to 350 volts. In the event of failure of the bobbin circuits of the relays (247)(248)(249) the "2/3" power tapping can be connected to the transformer C.O.S. (244) by a link (250). (See figure w.)

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20 K W. SUPPLY (CONT.)

RM 7

This link (253) is fitted in No. 4 power board and has two positions marked "A" and "B". In the "A" position the link (253) is connected in the D.C. supply to the bobbins (See D.C. Switch (15)) and in the "B" position it short circuits the A.C. contacts of the "2/3" power tapping relay (240). A voltmeter (245) connected across the output side of the auto-transformer (246) is fitted in the control board.

Two main transformers (230)(231) are fitted, either of which can be used by setting the transformer C.O.S. (244) and H.T. transformer C.O.S. (232) to the appropriate positions.

The transformer C.O.S. (244) is fitted in No. 4 power board and the H.T. transformer C.O.S. (232) in the main rectifier panel. Care should be taken that both switches are set to the transformer in use.

The output from the main auto-transformer (246) is also used for supplying the low power H.T. transformer (218) when the L/T master controlled circuit is in use. (See figure h.)

Main H.T. Supply. The main transformers (230) or (231) and main rectifying valves (37)(38) supply H.T. to the main L/T transmitting valves (41)(42) or the main H/T transmitting valves (44)(45) as required. The transformers have a step up ratio of 1 to 35. One transformer is used for the main H.T. supply, its secondary windings being connected in series and the centre point earthed. The secondary is protected from stray oscillatory currents by four 1 jar condensers (233)(234) and safety horns (237)(238) connected across each half of the secondary windings of the transformer in use by the H.T. transformer C.O.S. (232). Horn fuses (235)(236) are connected in series with the supply from the H.T. transformer C.O.S. (232). The H.T.C.O.S. No.1 (239) connects the H.T. supply to the main rectifying valves (37)(38) or spark transmitter.

An equalising unit, consisting of two F/T by-pass condensers (240)(241) and a centre tapped resistance (242), is connected across the filament supply to the rectifying valves (37)(38). The centre tapping of the equalising resistance (242) is connected to the main C.W. - I.C.W. switch (393) and the main H.T. C.O.S. (78). Two 1 jar condensers (399), connected in series, protect the rectifying valves filament transformer (371) from stray oscillatory currents when using I.C.W. (see Admiralty Handbook of W/T (1931) paragraph 356(22)).

To obtain the greatest degree of frequency constancy, particularly on F/P, it is necessary to use a large smoothing unit of eight 1 mfd condensers. One condenser (397) is connected in circuit by the main C.W. - I.C.W. switch (393) and the other seven (398) are connected in parallel with the single condenser (397) by the 1 or 0 mfd condenser switch (395). The single condenser (397) only is used with primary signalling as the rise and fall of potential in the 8 mfd unit is such that sharp building up and shutting down of signals by the magnetic key (250) is not obtained.

A discharge resistance (514), consisting of nine 20,000 ohm units in series, is connected across the seven smoothing condensers (398) and a similar resistance (515) across the single 1 mfd condenser (397). These resistances (514)(515) provide a safety arrangement by discharging the smoothing condensers to earth if the cage door is opened and the rectifier switch (395) remains closed.

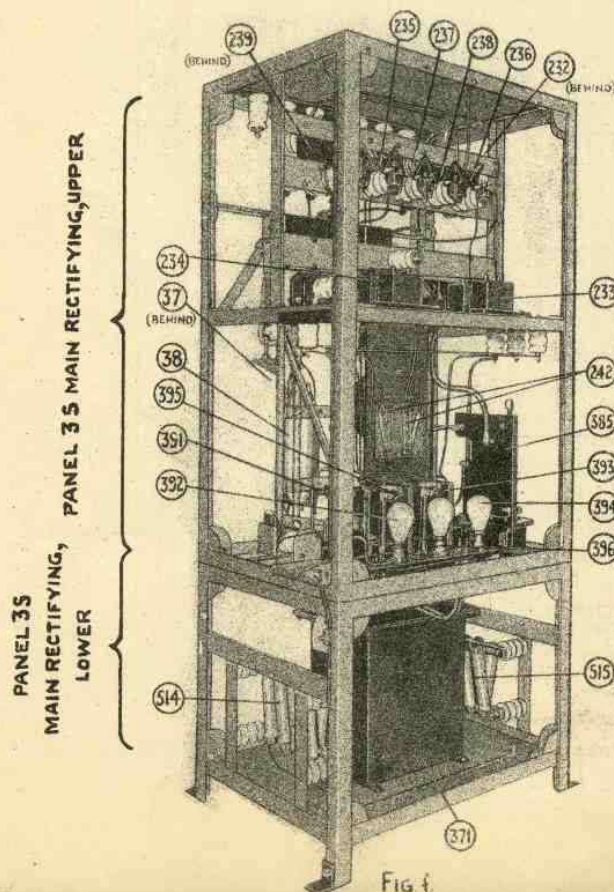


Fig. f.

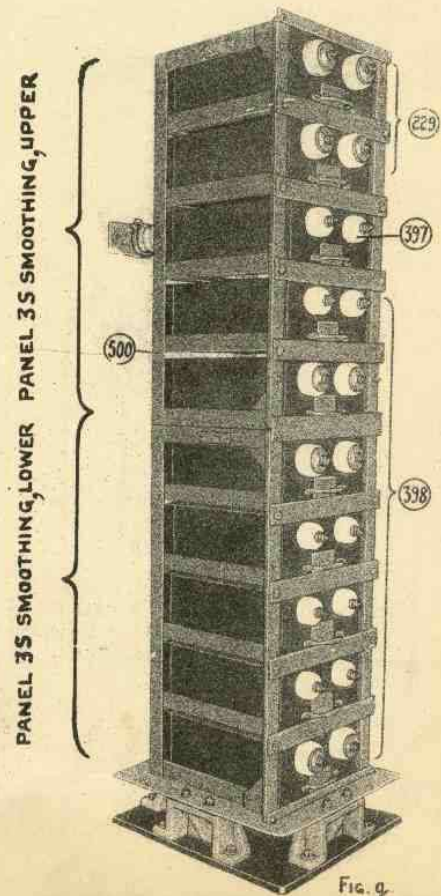


Fig. g.

11kW A.C. Supply. (See figure h.) The A.C. output from the 11kW alternators is connected to the filament supply C.O.S. (330) in No. 1 power board. Fuses (361) and an ammeter (332), in this board, connect the filament supply C.O.S. (330) to the filament switch (427) thence to the L.P. auto-transformer (289), filaments C.O.S. (363), filament transformers (364) to (371) (see figure j.) and the transformer (446) which supplies the rectifier (448) for the L.P. safety unit (see page RM24, figure s.).

The L.P. auto-transformer (289) supplies power to the low power H.T. transformer (218) when the L/F master circuit is used as a low power transmitter. Three relays (292)(293)(294) connect tapings on the auto-transformer (289) to one contact of the filaments C.O.S. (363). The relays are operated by contacts on the power tapping switch (297) fitted in Board 2S Controlling. The tapings on the auto transformer (289) are arranged to give adjustments of "1/3", "2/3" and "Full" power. The "1/3" power tapping can be reduced to 10 or 20 volts by means of a link (291) fitted in No. 1 power board. The L.P. auto-transformer (289) is connected to the low power H.T. transformer (218) via the filaments C.O.S. (363) (Set to "L.P.") and the L.P. rectifier supply C.O.S. (255) (set to "H/F Master, L/F L.P. "). The low power H.T. transformer (218) is also supplied from the 11 kW alternator when the filaments C.O.S. (363) is set to "H/F Master", the whole 180 volts being used independently of the auto-transformer (289). The low power magnetic key (422) forms a break in this circuit for signalling (L/F, L.P.). This break is short circuited by one contact of the signalling C.O.S. (122) when using grid signalling.

Low Power H.T. Supply. The low power transformer (218) and rectifying valves (39)(40) supply H.T. to the absorber valve (47) and the L/F or H/F master valves (43)(46). The transformer (218) has a step-up ratio of 1 to 40; the centre point of the secondary winding is earthed. Two 1 jar condensers (219)(220) and safety horns (221)(222) protect the secondary from stray oscillatory currents. Horn break fuses (221)(222) are connected in series with the supply from the transformer to the anodes of the rectifying valves (39)(40). An equalising unit (225)(226)(227) is connected across the filament supply to the valves (39)(40) and the centre point of the equalising resistance (227) is connected to the anode ammeter (76) and thence to the absorber valve anode resistance (130) and low power H.T. C.O.S. (114). This switch (114) is magnetically operated and connects the H.T. supply to the L/F or H/F master valves (43)(46).

A 1 jar condenser (217) protects the rectifying valves filament transformer (370) from stray oscillatory currents and two 1 mfd condensers (229) are connected across the H.T. supply by the low power C.W. - I.C.W. switch (417) when using C.W. A discharge resistance (416), consisting of nine 30,000 ohm units in series, is connected across the smoothing condensers (229) to provide a safety arrangement by discharging the condensers if the cage door is opened and the rectifier switch (388) remains closed.

For L/F master controlled transmissions the L.P. rectifier supply C.O.S. (255) is set to "Master L/F" which connects the low power H.T. transformer (218) to the 20 kW A.C. supply from the main auto-transformer (246). By this arrangement the H.T. supplies to the L/F master and main valves is maintained at a ratio of approximately 1 to 3 on any power tapping position.

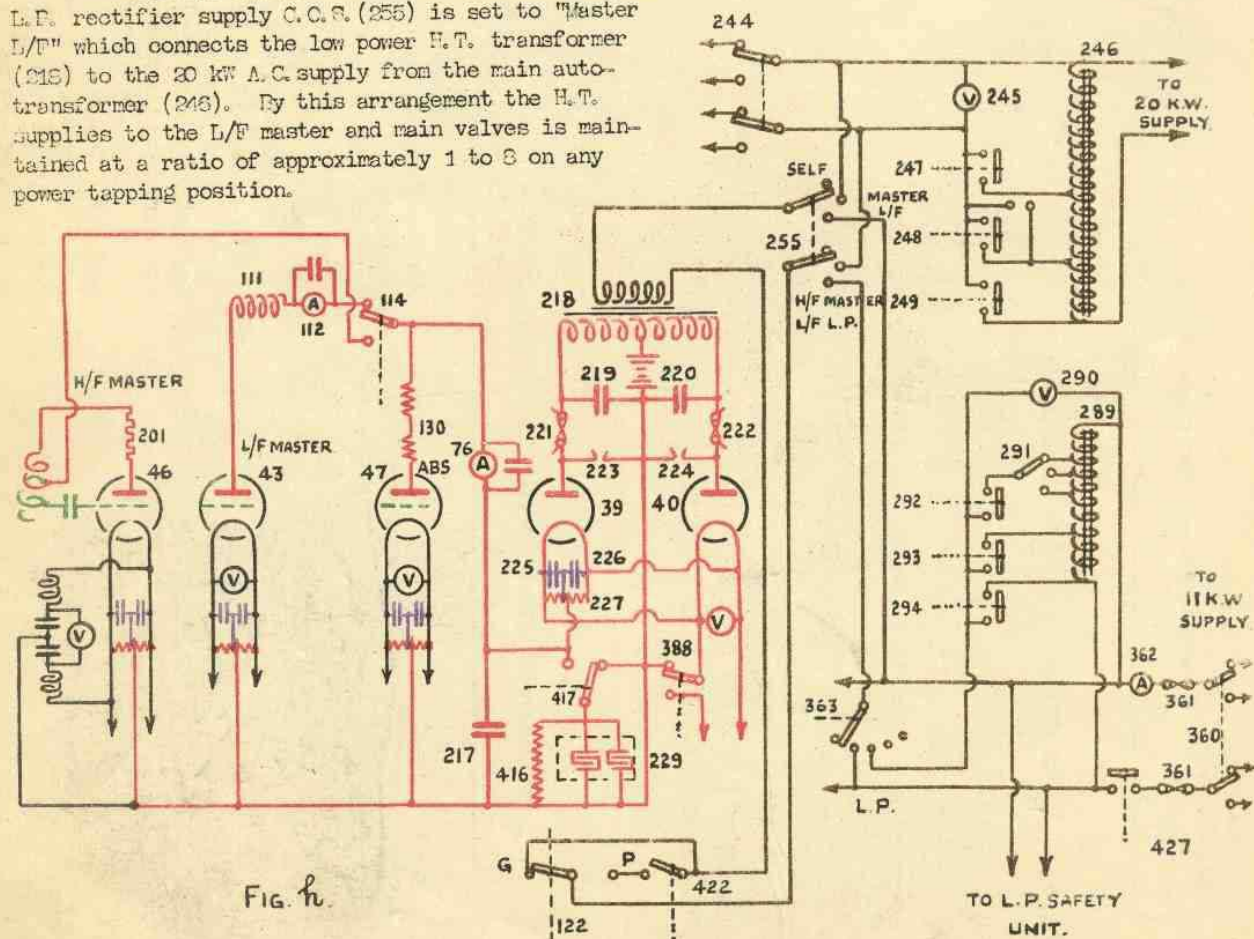


Fig. h.

TYPE 48 11 KW. SUPPLY (CONT.)

RM9

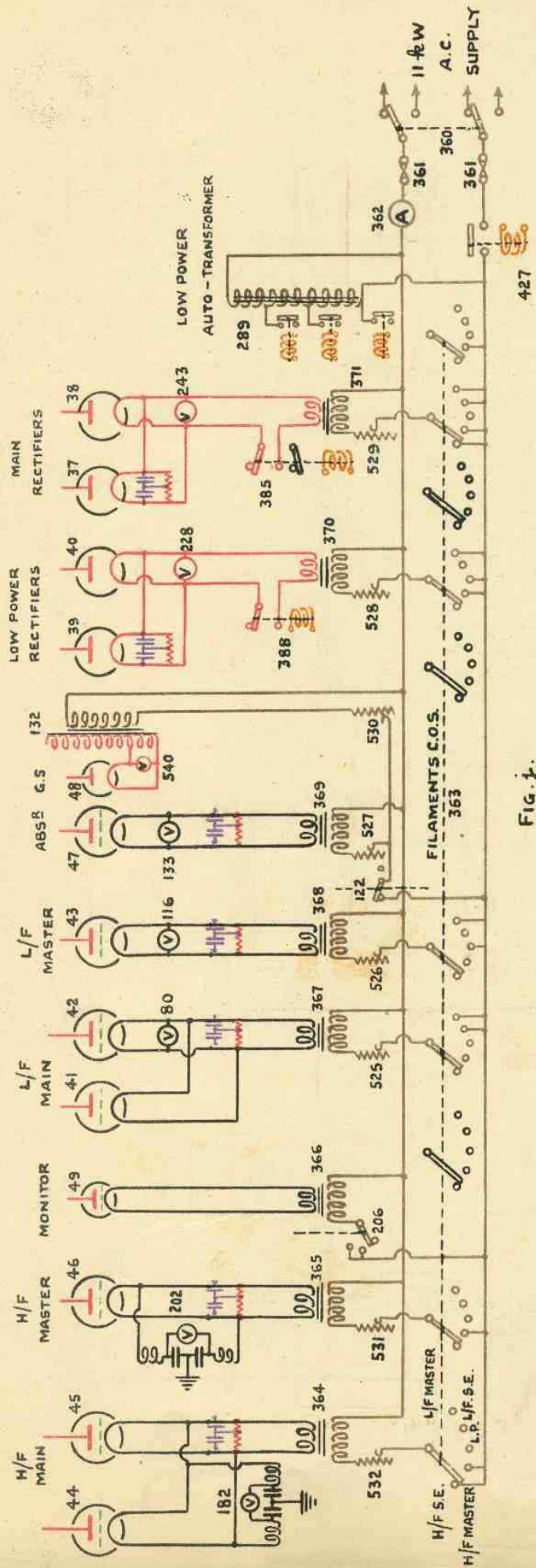


Fig. j.

PANEL 3 S LOW POWER RECTIFIER

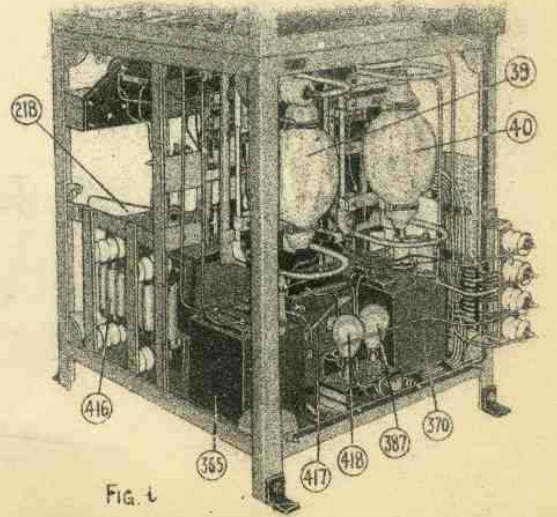


Fig. t

Filaments Supply. (See figure j.) All the valve filaments are fed from the 11 kW A.C. supply through voltage step-down transformers with filament rheostats in the supply to the primaries with the exception of that supplying the monitor valve (46). The grid signalling valve (48) obtains both H.F. and filament supplies from a single transformer (182) the primary of which is connected in parallel with the primary of the absorber valve filament transformer (369). The supply to both transformers (182) (369) is completed by one contact arm of the signalling C.O.S. (122) when the latter is set to "grid". Separate rheostats (530) (527) are fitted in the supply to each transformer (182) (369) for adjusting the filament voltages.

The supply to the monitor valve filament transformer (366) is completed by one contact arm of the monitor C.O.S. (306) in the "L/F" or "H/F" position.

The supply to the main, master and rectifying valves filament transformers is completed by six contact arms of the 10 pole filament C.O.S. (353). This switch has five positions and connects the appropriate transformers to the supply for the type of transmission required.

All the filament rheostats (525) to (532) are grouped together in the lower part of the filament distributing panel. The filament C.O.S. (293) is fitted in the upper part of the same panel.

The filament voltmeters are fitted in their appropriate panels with the exception of those for the H/F main and L/F master valves (45) (302) which are fitted in the spark and L.F. rectifying panels respectively.

TYPE 48

TRANSMITTER 3S,L/F, MASTER CONTROLLED

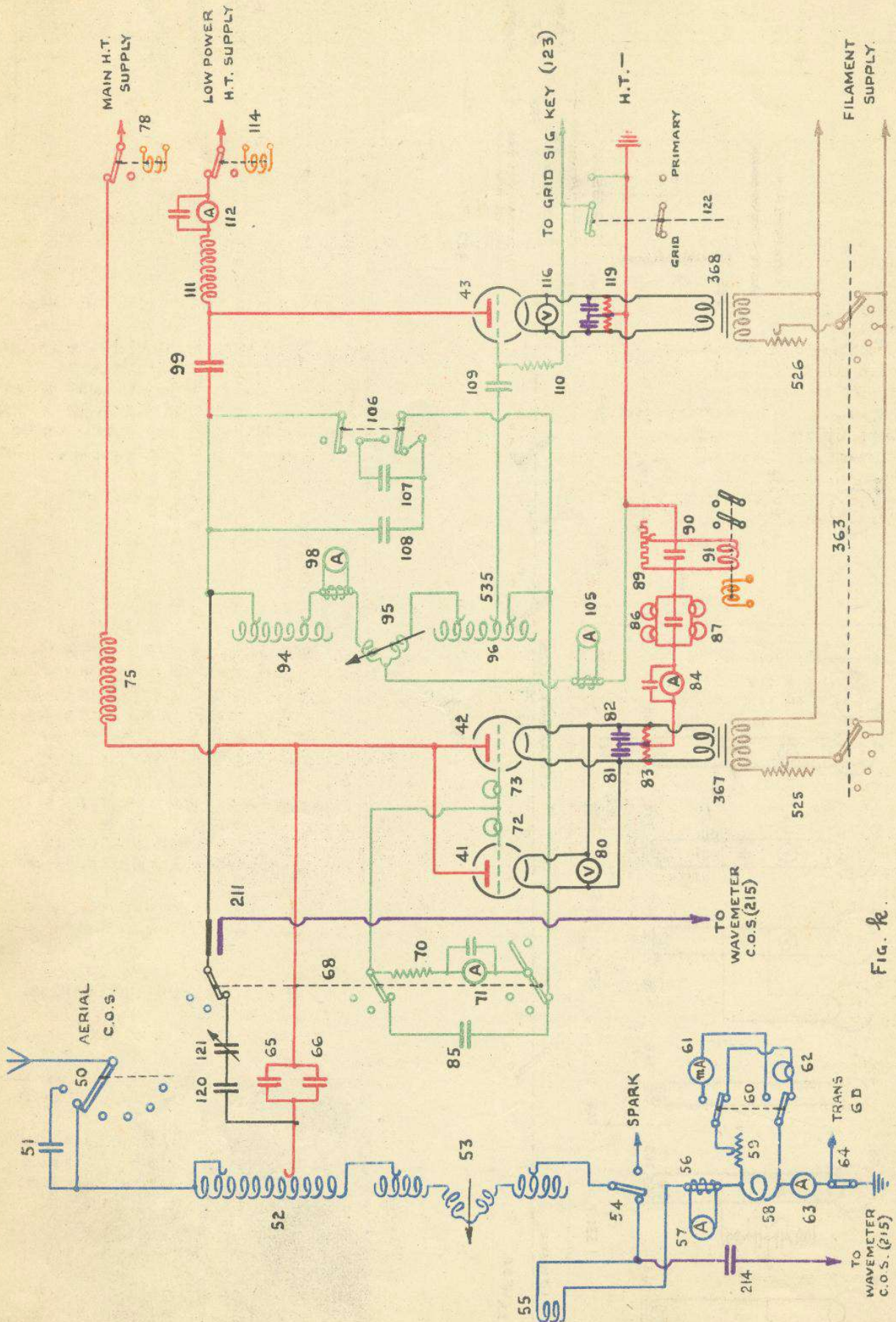


Fig. 48

TRANSMITTER 3S, L/F, MASTER CONTROLLED

Wave form	Method of producing oscillations.	Nature of circuit		Grid excitation		Feed		Aerial excitation.	High oscillating potential electrode
		Master	Main	Master	Main	Master	Main		
C.W. or J.C.W.	Master controlled	Tuned circuit between anode and grid	Tuned circuit between anode and filament	Direct inductive	Direct inductive from master circuit	Parallel	Parallel	Direct inductive.	Anode

Reference:- Admiralty Handbook of W/T (1938) Vol. II, Secy. K, Para. 35, Fig. 32. (1931), paragraph 600, figure 270.

The main L/F transmitting circuit fitted in Type 48 consists of a single valve master oscillator circuit coupled to two amplifying valves in the main transmitting circuit. The components of the master oscillator are housed in Panel, 3S, L/F Master Oscillator. Most of the components of the main transmitter are fitted in Panel 3S, L/F, Main Transmitting, but some are fitted in other panels or positions as shown in the photographs.

Figure k is a diagram of the complete L/F master controlled circuits.

Master Circuit. The master oscillator circuit consists of a coil (94)(95)(96) and two 3-jar condensers (107)(108). The coil has two main windings (94)(96) which are connected together by a variometer coil (95). Each of the main windings (94)(96) has rough and fine tapings which are controlled by two handles (533)(534) on the front of the panel. The switchgear attached to the handles is arranged to operate so that, for both rough and fine tuning, the inductance is varied an equal amount on each side of the earthed electrical centre of the variometer coil (95). Further adjustment of the tuning inductance is obtained by the L/F master fine tuning variometer (95) which has a wheel handle for rough adjustment and a slow motion dial for finer tuning. The connections to the tapping switches are shown in detail in figure m.

The tuning condensers (107)(108) are connected in circuit by the L/F master condenser switch (106) as follows:-

Position of switch (106)	Condensers (107)(108)	Total Capacity.
1	Two in parallel	6 jars
2	One condenser (108) only.	3 jars
3	Two in series	1.5 jars

The grid of the master valve (43) is connected, via the grid condenser (109), to the master coil (96) by a six position grid tapping switch (535) (see figure m.) The grid of the valve (43) is also connected via the grid leak resistance (110) to one contact of the signalling C.O.S. (122) and one side of the grid signalling key (123). The signalling C.O.S.(122) is fitted in the grid signalling and absorbing panel and when set to "Primary" connects the grid of the master valve (43) to its filament for primary signalling. When the signalling C.O.S.(122) is set to "Grid" the grid of the master valve (43) is disconnected from its filament until the grid signalling key (123) is operated for grid signalling. Details of the master circuit switching arrangements are shown in figure m.

The H.T. supply for the master circuit, is taken from the low power rectifier and is connected to the master valve (43) by the low power H.T. C.O.S.(114). The bobbin of this switch is connected in parallel with the bobbin of the main H.T. change over switch (78) for the main valves (41)(42).

Amplifying Circuit. The grids of the main valves (41)(42) are connected to the master oscillator circuit by the L/F circuits C.O.S.(68) which is hand operated from the front of the panel. When the switch (68) is set to "MASTER" the grids of the valves are connected through a *2,500 ohms grid re- *10.00 sistance (70) and grid ammeter (71), in parallel with a 0.08 jar grid condenser (65), to one end of the master circuit. The anodes are connected to the other end of the master circuit via the anode blocking condensers (65)(66) and two neutralising condensers (120)(121) in series. One condenser (120) is 0.2 jar fixed capacity; the other condenser (121) has a maximum capacity of 50 cms and is variable by a handle on the front of the L/F Master Oscillator Panel.

The neutralising condensers (120)(121) are connected to the anode tapping point of the main aerial coil (52) and are insulated from the H.T. supply potential to the main valves (41)(42) by the anode blocking condensers (65)(66).

The 20 kW H.T. supply is connected to the main valves (41)(42) by the anode choke coil(75) and main H.T. change over switch (78) which is magnetically operated and is controlled by a switch (400), marked "H.T. C.O.S. No.2", fitted on the front of the Filament Distributing Panel (see figure z)

Each valve has a 220 volts, 32 c.p. lamp (72)(73) connected to the grid to prevent parasitic oscillations.

When using grid signalling the main valves (41)(42) act as self-absorbers during the "spacing" periods of signalling.

The filaments of the valves are connected to earth through the anode ammeter (84), grid bias lamps (86)(87) and the overload relay (89)(90)(91). The action of the overload relay is explained in the notes on Type 36S, page RE9.

TRANSMITTER 3S, L/F, MASTER CONTROLLED (CONT.)

Four 110 volts, 32 c.p. lamps (96)(27) are connected in series with the earth return lead from the valve filaments to carry the anode current and act as an automatic grid bias unit.

The main aerial coil (52) is fitted behind the panels and is mounted on a wooden stand with a metal base plate which contains mechanical gearing coupled to the anode and aerial tapping switches. Both switches are operated simultaneously by a handle, marked "L/F Aerial Coil Tapping Switch", mounted on the front of the panel. The switch has six positions. Tappings from the coil (52) are connected to terminals mounted on two parallel terminal strips. The terminals are arranged to take switch blades which can be attached to any selected terminal and are engaged by contact arms of the aerial and anode tapping switches. The switch blades are secured to the appropriate terminals when the set is tuned. The fine tuning coil (53) is fitted in the panel and consists of a fixed outer coil with 7 tappings and a rotating inner coil. Tapping and variometer adjustments are made by two handles, (542)(543), fitted on a common base plate, on the panel front, marked "L/F Aerial Fine Tuning". (See figure z.)

The aerial circuit is connected to the L/F valve or spark circuit by the L/F Main Aerial Coupling C.O.S. (54). In the "valve" position this switch (54) connects the aerial circuit to the monitor valve coupling coil (55), aerial ammeter transformer (56), neutralising shunt (58), aerial ammeter (63) and emergency link (64). The aerial ammeter transformer (56) is connected to an ammeter (57) fitted in the C.R.R. and the direct reading ammeter (63) is fitted in the valve panel. When it is necessary to use the emergency set the aerial circuit is connected to Transmitter 6D by opening a link (64) on the back of the panel. As the L/F aerial circuit is not used for reception no operating switch is fitted.

The aerial is connected to the L/F aerial circuit by one contact arm of the aerial C.O.S. (50) which has two L/F positions, viz., "L/F IN" and "L/F OUT". In the former position a 1 jar condenser (51) is connected in series with the aerial for frequencies of 375 kc/s and above.

A wavemeter G57 is fitted in the Filament Distributing and Control Panel and is connected to the various circuits by the wavemeter C.O.S. (215) (see figure y.). Two brass strips, (211), one of which connects the L/F circuits C.O.S. (68) to the master circuit and the other connected to the wavemeter C.O.S. (215), form a coupling condenser to the wavemeter for tuning the master circuit.

Tuning. The aerial and master circuits are tuned for L/F master controlled transmissions by adjusting the aerial circuit with the set in the "L/F Self Excited" position and then tuning the master circuit with the transmitter set to "L/F Master". The method of tuning the self excited circuit is explained on page RM14. The master control circuits are tuned as follows:-

Set the wavemeter C.O.S. (215) and L/F circuits C.O.S. (68) to "Master".

Break the 20 kW transformer C.O.S. (244) in the power board.

Set the master circuit adjustments to the estimated positions for the frequency required by reference to the approximate adjustments given in the Book of Instructions.

Press the key and measure the frequency of the master circuit by means of the wavemeter G57. If incorrect readjust the master coil tuning switches until the approximate frequency is obtained. The grid tapping switch (535) (see figure m) should be adjusted to

the highest numbered position consistent with stable oscillations in the master circuit as indicated by the primary oscillatory current ammeter (98). The correct frequency can then be obtained by slow motion adjustment of the L/F master, fine tuning variometer (95).

Release the key.

Adjust the L/F neutralising condenser (121) to its position of maximum capacity, i.e., reading 0°.

Press the key. Press the L/F neutralising ammeter switch (60) and adjust the aerial fine tuning coil (53) until the neutralising ammeter (61) reads maximum current.

Adjust the L/F neutralising condenser (121) until the neutralising ammeter (61) reads minimum current, readjusting the aerial fine tuning coil (53) after each alteration of the neutralising condenser (121).

The L/F main circuits and neutralising condenser (121) are now correctly set.

Set the wavemeter G57 to the required frequency.

Make the transformer C.O.S. (244).

Press the key; aerial current should now be obtained on approximately the correct frequency. The frequency

should be checked by the wavemeter G57 and adjustment made on the master fine tuning coil (95), final correction being made to the aerial fine tuning coil (53).

When using the aerial series condenser (51) the maximum voltage tapping used should be that which gives aerial current not greater than 20 amps.

As the frequency range of wavemeter G57 does not cover the lower L/F frequency ranges it is necessary to use wavemeter G56 or pattern 1492B when tuning below 100 kc/s.

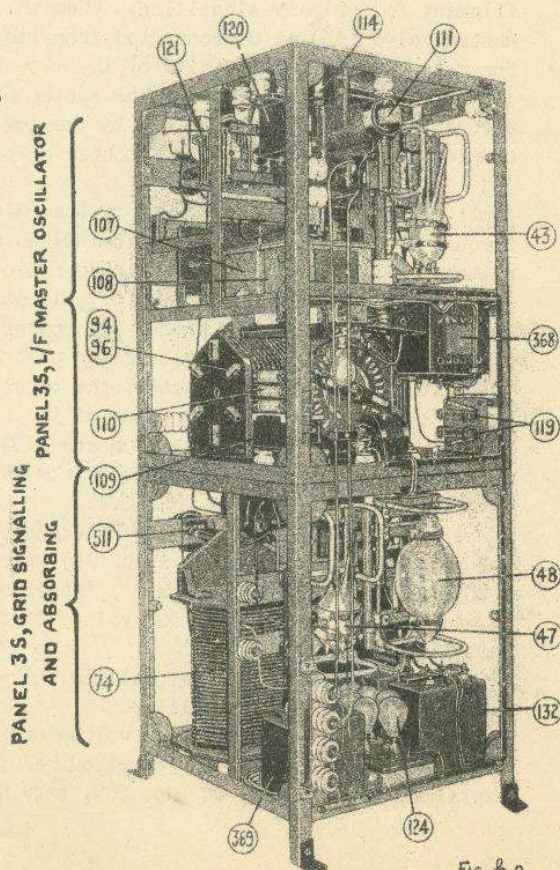


Fig. k a.

TRANSMITTER 3S,L/F,SELF EXCITED

Wave form	Method of producing oscillation	Nature of circuit	Grid excitation	Feed	Aerial excitation	High oscillating potential electrode.
C.W. or I.C.W.	Self	Tuned circuit between anode and filament.	Capacitive	Parallel	Direct inductive	Anode

The L/F self excited circuit is used in the event of failure of the master control circuits.

A diagram of the complete circuit is shown in figure 1.

The 20 kW H.T. supply is connected to the anodes of the valves (41)(42) by the H.T. C.O.S. (78) and anode choke coil (75). The centre point of the filament equalising resistance (83) is connected to earth and H.T. negative by an anode ammeter (84), four 110 volts, 32 c.p. grid bias lamps (86)(87) and the overload relay circuit.

The valves (41)(42) are self excited by setting the L/F circuits C.O.S. (68) to "Self". With the switch (68) in this position the grids of the valves are disconnected from the master circuit and connected to the anode lead by a 0.2 jar condenser (67) and to the filaments and earth by a 4-jars grid condenser (69), grid resistance (70) and a 4700 mic grid coil (74). The grid coil (74) has six tapping by means of which the current flowing in the circuit between anode and filament can be adjusted to produce the correct potential, in the right phase, at that point in the circuit to which the grids of the valves are connected.

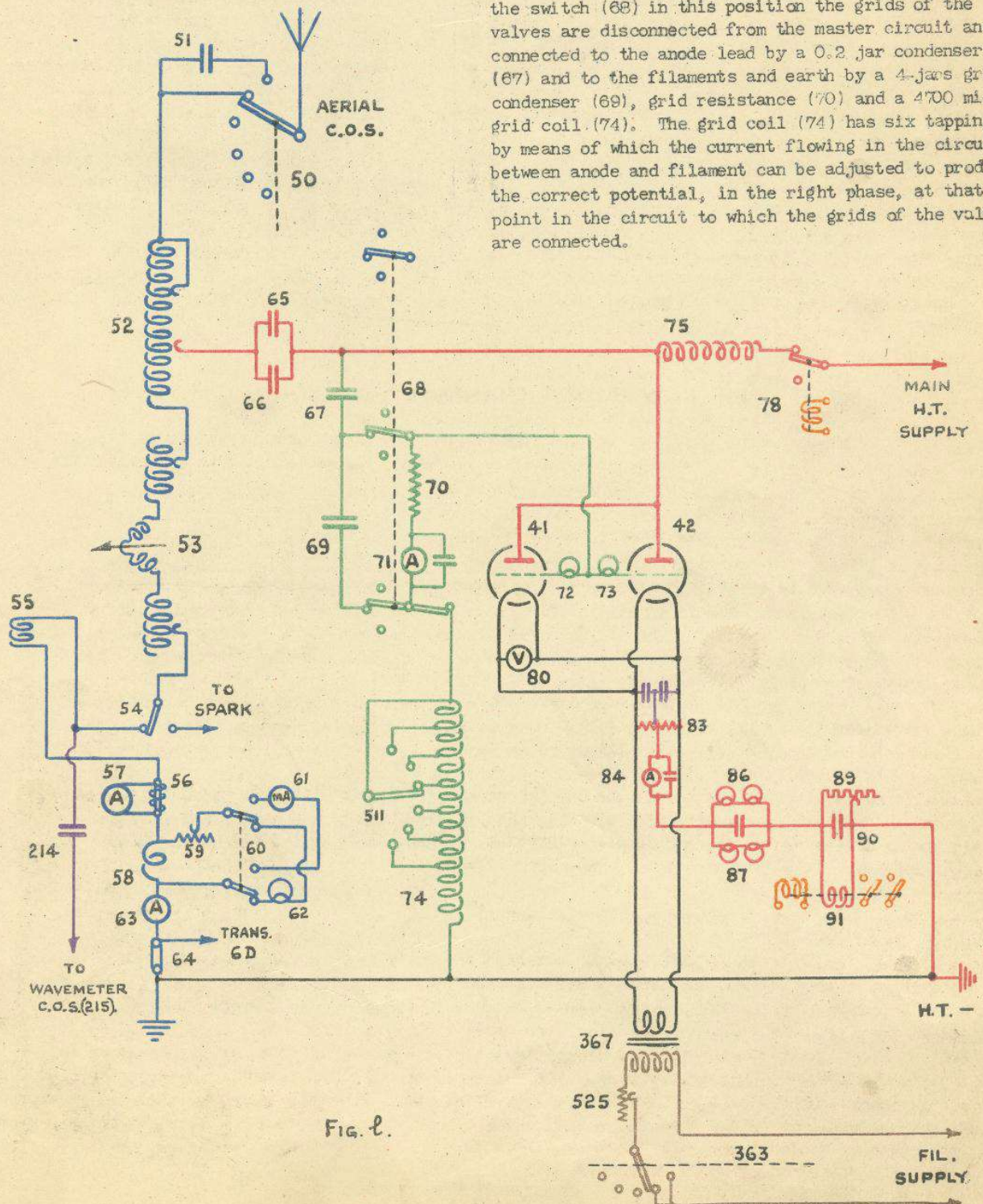


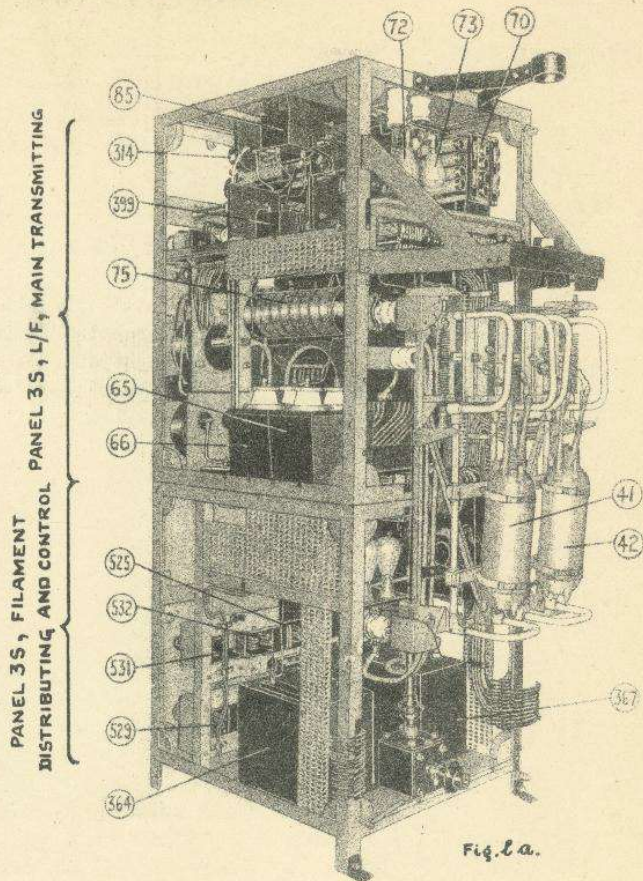
Fig. 1.

TYPE 48 TRANSMITTER 3S, L/F, SELF EXCITED (CONT.)

The aerial circuit is the same as that used for L/F master controlled transmissions and forms the tuned circuit to which the anodes of the valves (41)(42) are connected by the anode tap through two 5 jar blocking condensers (65) (66). The aerial circuit is coupled to the wavemeter G57 by a 75 cms fixed condenser (214) when the wavemeter C.O.S. (215) is set to "L/F Main".

Tuning. Set the wavemeter C.O.S. (215) to "L/F Main" and the L/F circuits C.O.S. (68) to "Self". Set the aerial circuit adjustments to the estimated positions for the frequency required by reference to the approximate adjustments given in the Book of Instructions.

Press the key.
Adjust the grid coil (74) until maximum aerial current is obtained.
Measure the transmitted frequency by means of the wavemeter G57. If incorrect readjust the aerial and anode tapplings on the main aerial coil (52) (if necessary) and the main fine tuning coil (53) until the correct frequency is obtained. The adjustment of the tapping on the grid coil (74) should be checked for maximum aerial current after every alteration of the aerial circuit.
When using the aerial series condenser (51) the maximum voltage tapping used should be that which gives aerial current not greater than 20 amps.



L/F LOW POWER TRANSMITTER

Wave form	Method of producing oscillation	Nature of circuit	Grid excitation	Feed	Aerial excitation	High oscillating potential electrode
C.W. or I.C.W.	Self	Tuned circuit between anode and grid.	Direct inductive	Parallel	Direct	Anode

Reference:- Admiralty Handbook of W/T (1931) paragraph 623, at sec. figure 980 (b). (1938) Vol. II Sect. K. Para. 24. Fig. 16 (c).

The L/F master circuit is used as the low power transmitter and is connected direct to the aerial by one contact arm of the L/F circuits C.O.S. (69).

Figure m. is a diagram of the complete low power circuit showing the rough and fine tuning and grid tapplings on the master coils (94)(96).

The H.T. supply is taken from the low power rectifier and is connected to the master valve (43) by the low power H.T. C.O.S. (114), anode ammeter (112) and anode choke coil (111).

The oscillatory circuit is described on page RM11, under Transmitter 3S, master controlled.

When the aerial C.O.S. (50) and the L/F circuits C.O.S. (68) are set to "L.P." the master circuit is disconnected from the main circuits and the aerial connected to one end of the master coil (94). A part of the master circuit inductance is then common to the aerial and master oscillatory circuits.

For the higher frequencies a 0.5 jar condenser (92) can be connected in series with the aerial by the L.P. aerial series condenser switch (93).

Tuning. Set the wavemeter C.O.S. (215) to "L/F Master" and the L/F circuits C.O.S. (68) to "L.P.". Set the master circuit adjustments to the estimated positions for the frequency required by reference to the approximate adjustments given in the Book of Instructions.

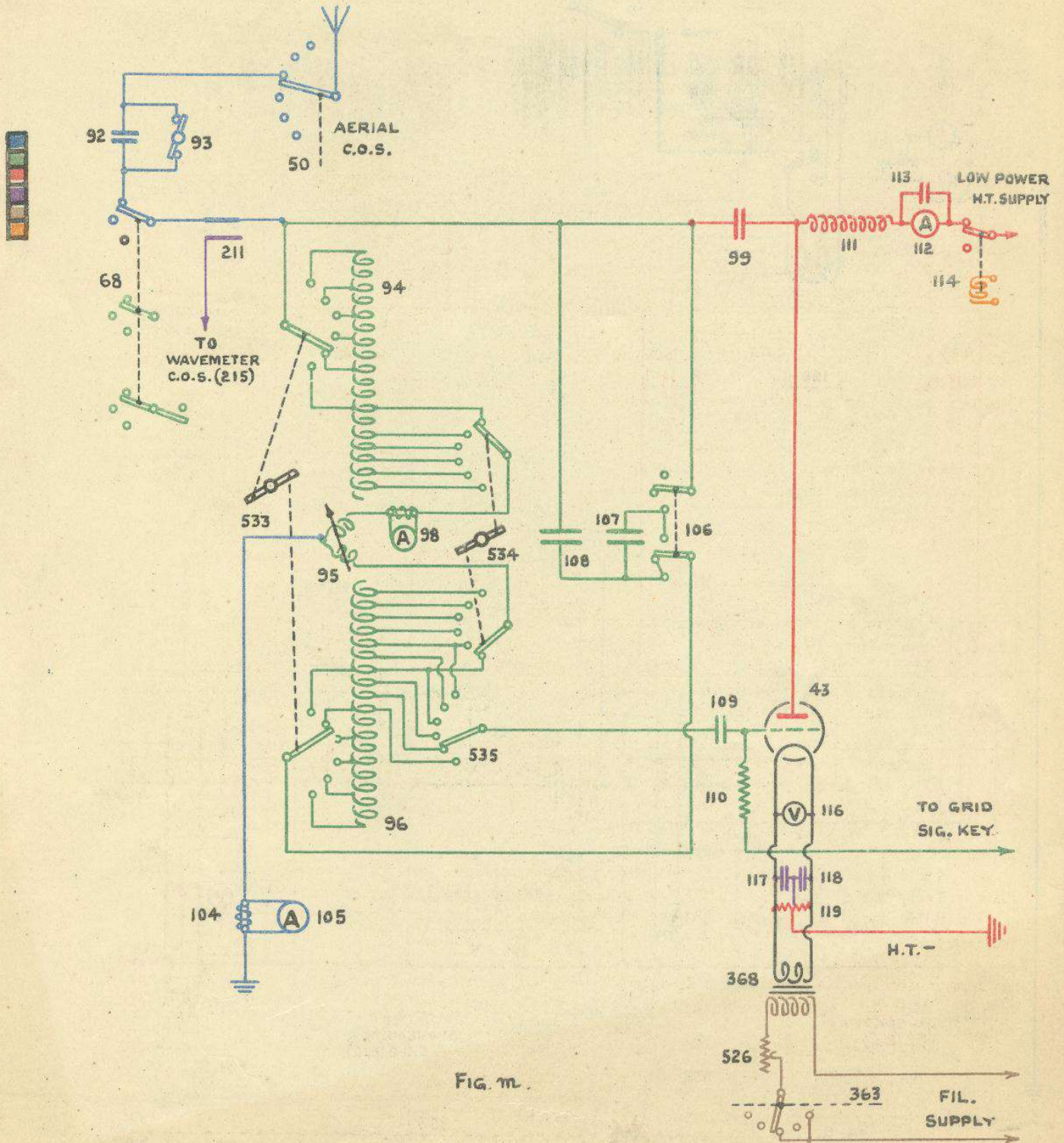
Press the key. The primary ammeter (98) and low power aerial ammeter (105) should now indicate oscillatory current.

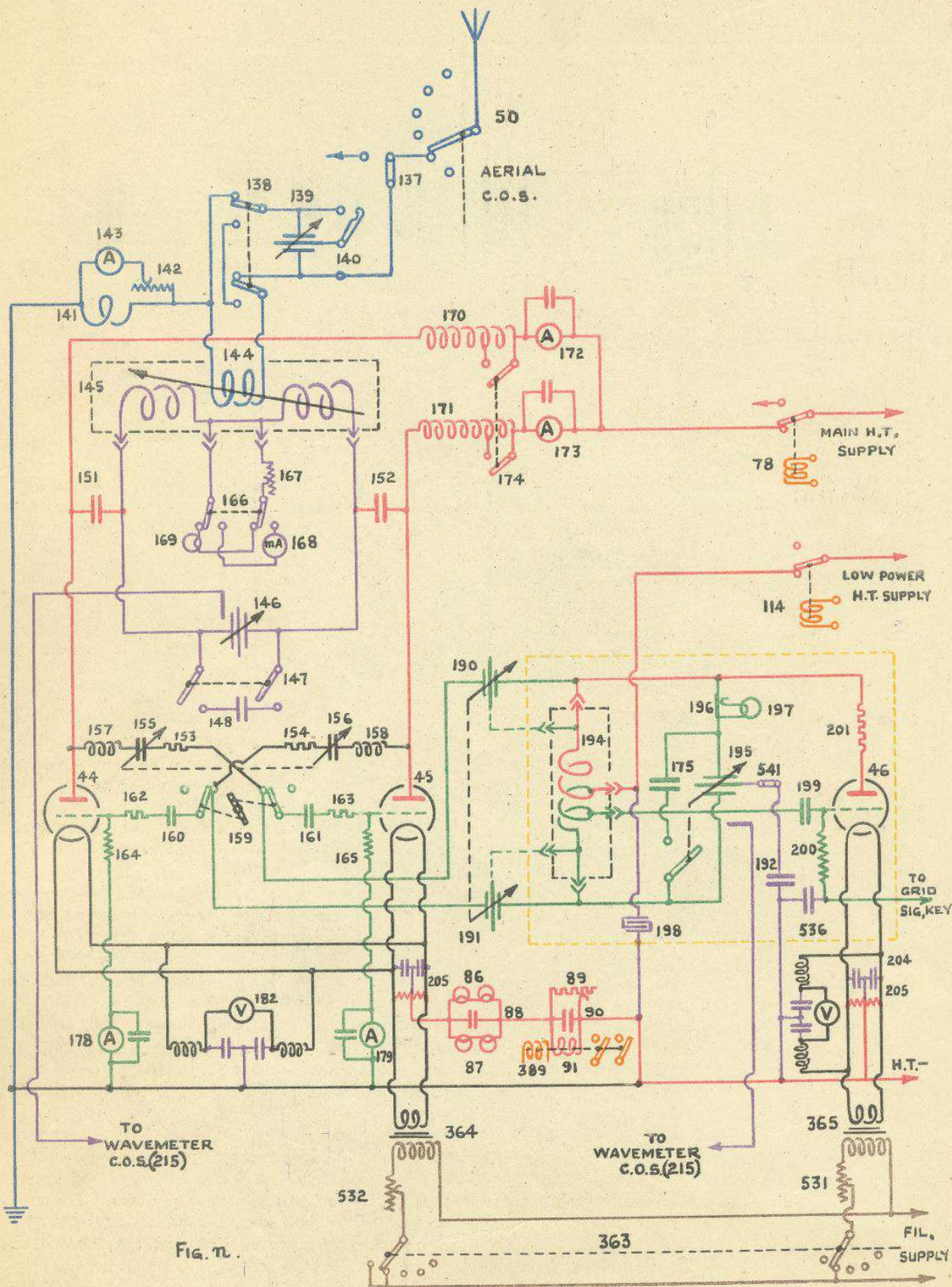
Measure the transmitted frequency by means of the wavemeter G57. If incorrect re-adjust the master coil tuning switches until the approximate frequency is obtained, re-setting the grid tapping switch (535) as necessary. The correct frequency can then be obtained by slow motion adjustment of the L/F master fine tuning variometer (95).

TYPE 48

RM15

L/F LOW POWER TRANSMITTER





TRANSMITTER 3S, H/F, MASTER CONTROLLED

Wave form	Method of producing oscillation	Nature of circuit		Grid excitation		Feed		Aerial excitation	High oscillating potential electrode
		Master	Main	Master	Main	Master	Main		
C.W. or I.C.W.	Master controlled	Tuned circuit between anode and grid.	Tuned circuit between anodes of main valves connected in push-pull.	Direct inductive	Direct capacitive from master circuit.	Series	Parallel	Mutual inductive.	Anode

Reference: Admiralty Handbook of W/T (1938) Vol. II, SECT. R, Para. 41. (1931) paragraph 716, figures 425 and 426.

The H/F transmitting circuit consists of a screened master circuit and master valve (46) which control the grids of two main amplifying valves (44)(45) connected in push-pull.

The components of the H/F master circuit are enclosed in an earthed copper screening box supported by springs in Panel 3S H/F Master. A door at the back of the box provides access to the valve etc., and a plate on the front can be removed when changing the tuning coils.

Most of the components of the H/F main circuits are contained in Panel 3S H/F Main Transmitting. The neutralising condensers are in Panel 3S H/F Main Neutralising which is secured to the back of the H/F Main Transmitting Panel.

A diagram of the complete H/F master controlled circuit is shown in figure n. and a simplified version in figure na.

H/F Master Circuit. The H/F master oscillatory circuit consists of a plug-in coil (194) and a 115 cms variable tuning condenser (195) which can be connected in parallel with a 75 cms fixed condenser (175). The five plug-in coils supplied with each set are temperature compensated to prevent frequency drift. The approximate frequency ranges covered by the coils are as follows:-

Frequency range.	Coil.	No. of turns.
3000 - 4000	14 Y	14
4000 - 6000	10 Y	10
6000 - 8500	6 Y	6
8500 - 13000	4 Y	4
13000 - 17100	2 Y	2

The master condenser (195) has two ranges of capacity which are indicated by black or red scales, marked 0 - 50, on the dial. The black scale indicates the lower capacity range, i.e., 115 cms to minimum, when the variable condenser (195) only is in use. The red scale indicates the higher capacity range, i.e., 190 cms to 75 cms, when the fixed condenser (175) is connected in parallel with the variable condenser by the switch attached to the end of the condenser spindle.

The frequency ranges which can be obtained using the black or red scales with each tuning coil are shown on an engraved plate on the panel front. The red scale is not used on the higher frequencies with coils 2Y or 4Y.

The moving plates of the master condenser (195) are kept at an earthy potential by a 4 jars condenser (192) through which they are connected to earth. On certain frequencies the master circuit may fail to oscillate when the master condenser (195) is connected to the earth condenser (192). When this occurs the connection should be broken by opening the link (541) which is fitted inside the screening box. A 0.8 ohm non-inductive resistance (201) is connected in the anode lead of the valve to prevent parasitic oscillations through the anode/grid capacity and the master condenser (195). The grid of the master valve (46) is connected by a 15000 ohms grid resistance (200) to one contact of the signalling C.O.S. (122) and one side of the grid signalling key (122) (see figure p.) A 1 jar P/F by-pass condenser (536) prevents standing waves being set up in the lead connecting the grid leak resistance (200) to the signalling key (123). The master oscillatory current indicator consists of a 4 volt lamp (197) connected, by an adjustable tapping, to a shunt (196).

The master circuit is coupled to the grids of the main amplifying valves (44)(45) by two variable coupling condensers (190)(191) controlled by a handle on the front of the panel. Each condenser (190)(191) has two sets of fixed plates and the capacity between them is varied by a set of moving vanes. When using coils 2Y and 4Y the two sets of fixed plates and the moving vanes are connected in series, giving a variable capacity of 7 to 80 cms. When using coils 6Y, 10Y and 14Y studs on the coil holder depress contacts on the coil mounting which connect the moving vanes to one set of fixed plates; the resultant maximum capacity is then 60 cms. With this arrangement over coupling between the master and main circuits cannot occur on any frequency within the range of the set.

The low power H.T. supply is connected to the master valve (46) by the low power H.T. C.O.S. (114) which is magnetically operated and is controlled by a switch (400), marked "H.T.C O.S. No.2" fitted on the front of the Filament Distributing Panel (See figure z.).

The H.T. supply is fed to the master circuit at the centre point of the plug-in coil in use.

TRANSMITTER 3S, H/F, MASTER CONTROLLED (CONT.)

H/F Main Amplifying Circuit. The grids of the main valves (44)(45) are connected to the master oscillator circuit by setting the H/F circuits C.O.S.(159) to "Master".

The main valves (44)(45) are connected in push-pull and the main oscillatory circuit connected between their anodes by two 0.2 jar anode blocking condensers (151)(152).

The main oscillatory circuit consists of a plug-in coil (145) and a 60 cms variable tuning condenser (146). A 40 cms fixed condenser (148) can be connected in parallel with the variable condenser (146) by main fixed condenser switch (147).

Seven plug-in coils are supplied with each set and cover the approximate frequency ranges shown below:-

Frequency range.	Coil.	No. of turns.
3000 - 4000	12 Z	12
4000 - 5400	10 Z	10
5400 - 7400	8 Z	8
7400 - 9700	6 Z	6
9700 - 13000	4 Z	4
13000 - 15800	2 Z	2
15800 - 17100	1 Z	1

A portion of the connecting strip between the two halves of the primary coil (145) is used as a shunt for the 4 volt primary current lamp (169) or the neutralising milliammeter (168). The lamp (169) or milliammeter (168) are connected to the shunt by the neutralising ammeter switch (166). This switch is held in position to connect the lamp (169) in circuit by the action of a spring and must be kept pressed to connect the milliammeter (168) in circuit for neutralising purposes.

Current in the lamp (169) or milliammeter (168) is controlled by a rheostat (167) which is adjusted by a handle, marked "H/F neut. am. and primary current regulator" (167).

Owing to the inductance of the connecting leads to the grids of the valves (44)(45) an 80 cms condenser (160)(161) is connected in each grid lead to reduce the L.C. value of the leads and so balance in the bridge system on the higher frequencies (See Admiralty Handbook of W/T (1938) ^{VOL II SECT IV} ~~PARA 41~~ ^{PARA 41}).

The 20 kW H.T. supply is connected to the anodes of the valves (44)(45) by the main H.T. change over switch (78), anode ammeters (172)(173) and anode choke coils (170)(171). A section of each choke coil can be short circuited by the H/F choke tapping switch (174) to prevent resonant frequencies in the coils. The centre point of the filament equalising resistances (205) is connected to earth and H.T. negative by the four grid bias lamps (83)(87) and overload relay circuit.

The aerial circuit consists of a 50 cms variable condenser (139), aerial coupling coil (144), series parallel switch (138), aerial ammeter (143), ammeter shunt (141) and the ammeter current regulator (142). The aerial condenser (139) and coupling coil (144) are connected in series or parallel by the series parallel C.O. Switch (138). A link (140), which swivels on a centre terminal, short circuits half the aerial condenser when the link is secured to either of the outer terminals. The aerial condenser (139) and link (140) are fitted in the Spark Transmitter Panel. Coupling between the aerial and primary circuits is varied by a worm drive on the aerial coupling coil holder operated by the H/F aerial coupling handle on the panel front. Current in the aerial ammeter (143) is adjusted by the aerial ammeter current regulator (142).

A link (137) on the back of the H/F main transmitting panel is used to connect the aerial to the aerial exchange board when it is desired to use the main aerial for reception on H/F.

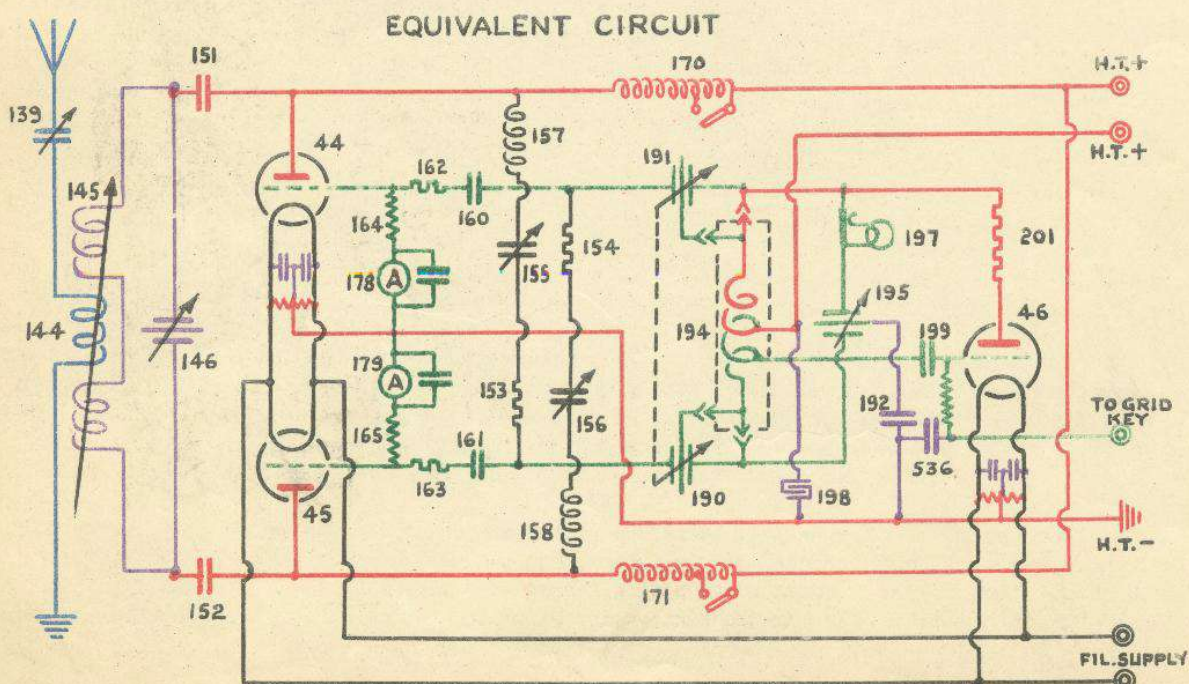


Fig. n. d.

TRANSMITTER 3S,H/F, MASTER CONTROLLED (CONT.)

For coupling to the wavemeter short lengths of copper tubing, connected to the wavemeter C.O.S. (215), are fitted near the fixed plates of the master condenser (195) and of the main tuning condenser (146).

Tuning. Set the wavemeter C.O.S. (215) to "H/F Master" and the H/F circuits C.O.S. (159) to "Master". Break the 20 kW transformer switch (244) in the power board.

Plug in the appropriate coils for the master and main circuits by reference to the tables on the front of the panels.

Set the master condenser (195) to its mid position using the red or black scale according to the table.

Press the key. The master oscillatory current lamp (197) should now indicate current in the master circuit.

Measure the frequency of the master circuit by means of the wavemeter G57. If incorrect readjust the master condenser (195) until the correct frequency is obtained.

Release the key.

Set the wavemeter C.O.S. (215) to "H/F Main".

Set the H/F coupling condenser (190)(191) to a value depending on the frequency (0° approximating to 2000 kc/s and 90° to 17000 kc/s.) This adjustment is not critical but, once having been set and recorded, it must be reset accurately whenever adjusting the transmitter to the same frequency.

Set the main tuning condenser (146) to its mid position and the neutralising condensers (155)(156) to their maximum (i.e., reading 0°).

Press the key.

Press the neutralising ammeter switch (166) and adjust the main tuning condenser (146) (switching in the fixed condenser (146) if necessary) until the reading in the neutralising ammeter (166) is a maximum.

Adjust the neutralising condensers (155)(156) until the reading in the neutralising ammeter (166) is a minimum.

Readjust the main tuning condenser (146) and the neutralising condensers (155)(156) until the lowest reading possible is obtained in the neutralising ammeter (166).

Release the key and neutralising ammeter switch (166).

Make the 20 kW transformer switch (244).

Set the choke tapping switch (174) to No.1 position.

Press the key. The indicator lamp (169) in the main primary circuit should now indicate current in the main oscillatory circuit. If no primary current is shown or if sparking occurs in the choke coils, change to No.2 position of the choke tapping switch (174).

Check the frequency of the main circuit by the wavemeter G57 and make final adjustment to the master tuning condenser (195).

Set the aerial coupling coil (144) to its mid position and the aerial series-parallel switch (138) to "Series".

Adjust the aerial tuning condenser (139) until aerial current is a maximum. If no aerial current is obtained in "series" position set the aerial series-parallel switch (138) to "parallel" and repeat the operation.

The lower frequencies usually require the "series" position of the series-parallel switch (138) but the higher frequencies may require either "series" or "parallel" position according to whether the aerial is electrically equivalent to an even or odd multiple of a quarter wavelength.

Adjust the aerial coupling until the aerial current is slightly less than maximum.

PANEL 3S LOW POWER RECTIFIER PANEL 3S,H/F, MASTER OSCILLATOR

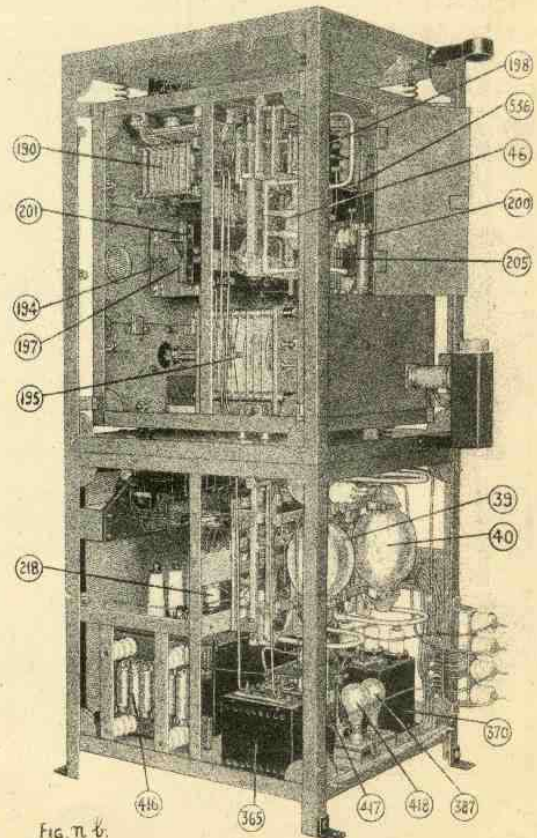


FIG. 76.

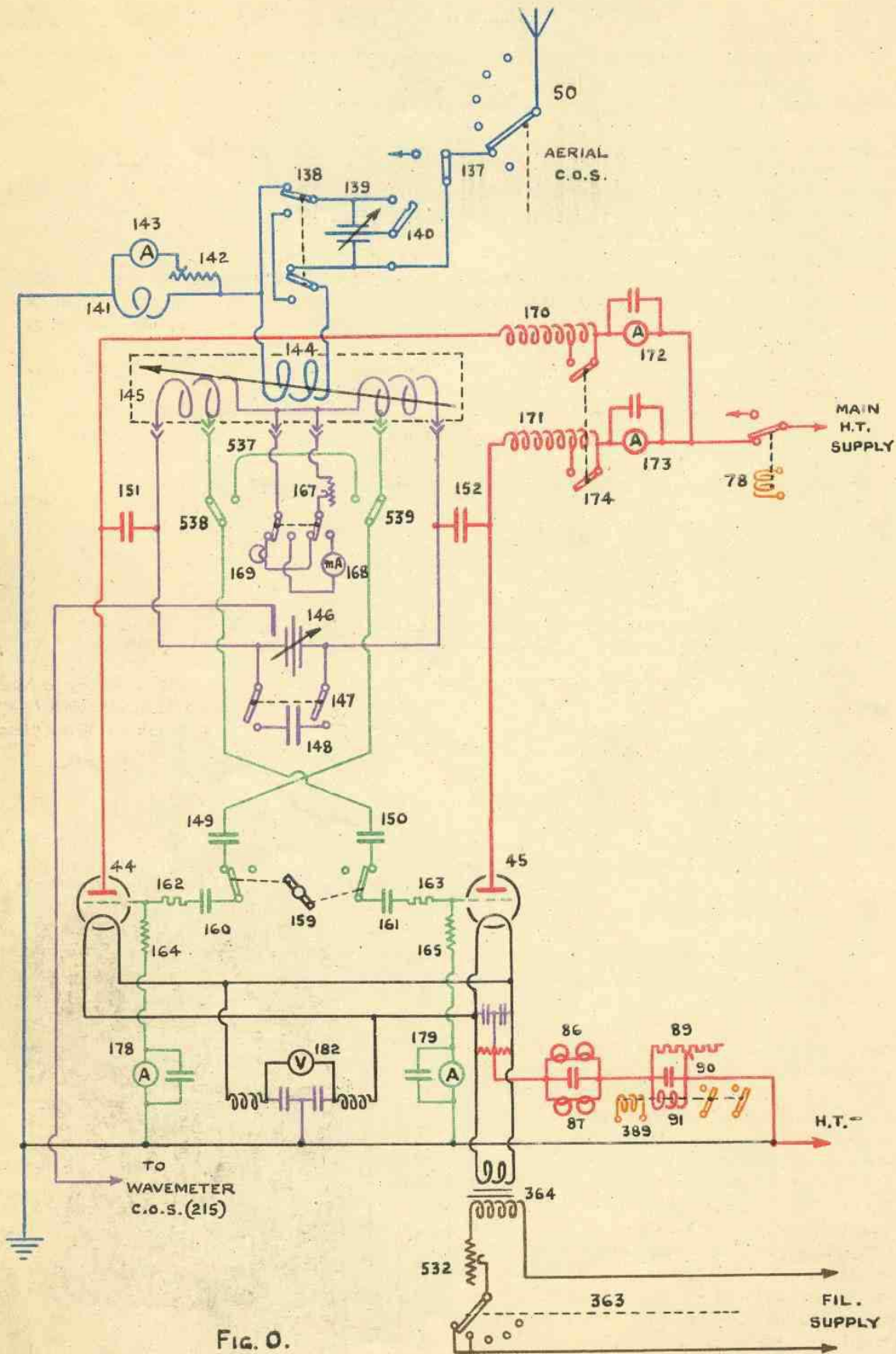


FIG. 0.

TYPE 48

RM21

TRANSMITTER 3S, H/F SELF EXCITED.

Wave form	Method of producing oscillation	Nature of circuit	Grid excitation	Feed	Aerial excitation	High oscillating potential electrode.
C.W. or I.C.W.	Self	Valves in push-pull tuned circuit between anodes and grids.	Direct inductive.	Parallel	Mutual inductive.	Anode

Reference:- Admiralty Handbook of W/T (1935) Vol. II. SECT. K. PARA. 34. FIG. 26

The H/F self-excited circuit is used in the event of failure of the master control circuits. A diagram of the complete circuit is shown in figure 0.

The H.T. and filament supplies to the main valves (44)(45), using the self excited circuit, are the same as those used for H/F master controlled transmissions.

The valves (44)(45) are self-excited by setting the H/F circuits C.O.S.(159) to "Self". With the switch (159) in this position the grids of the valves are disconnected from the master circuit and connected to tapings on the tuning coil (145) by the 0.08 jar coupling condensers (149)(150) and links (538)(539).

The frequency ranges which can be obtained with the seven tuning coils are as follows:-

Frequency range.	Coil.	No. of turns.
3000 - 3800	12 Z	12
3800 - 5000	10 Z	10
5000 - 6800	8 Z	8
6800 - 8700	6 Z	6
8700 - 11500	4 Z	4
11500 - 13800	2 Z	2
13800 - 15500	1 Z	1
15500 - 18500 *	1 Z	1

* To obtain this range the grids of the valves must be coupled to the tuning coil (145) by means of the coupling bar (537). The links (538)(539) are provided for this purpose.

With the exception of the grid connections described above the main oscillatory circuit is the same as that used in the main amplifying circuit for master controlled transmissions (see page RM10). The aerial circuit is the same as that used for H/F master controlled transmission.

Tuning. Set the wavemeter C.O.S.(215) to "H/F Main" and the H/F circuits C.O.S.(159) to "Self".

Plug in the appropriate coil for the frequency required.

Set the main tuning condenser (146) to its mid position using the red or black scale according to the table.

Set the choke tapping switch (174) to No.1 position.

Set the aerial coupling coil (144) to its mid position and the aerial series-parallel switch (138) to "series".

Press the key. The indicator lamp (169) should now indicate current in the main oscillatory circuit. If no oscillatory current indication is obtained, or if sparking occurs in the choke coil, change to No.2 position of the choke tapping switch (174).

Measure the frequency of the main circuit by means of wavemeter G57. If incorrect, readjust the main tuning condenser (146) until the correct frequency is obtained.

Adjust the aerial tuning condenser (139) until aerial current is a maximum. If no aerial current is obtained in "series" position, set the aerial series-parallel switch (138) to "parallel" and repeat the operation. Adjust the aerial coupling until the aerial current is slightly less than maximum.

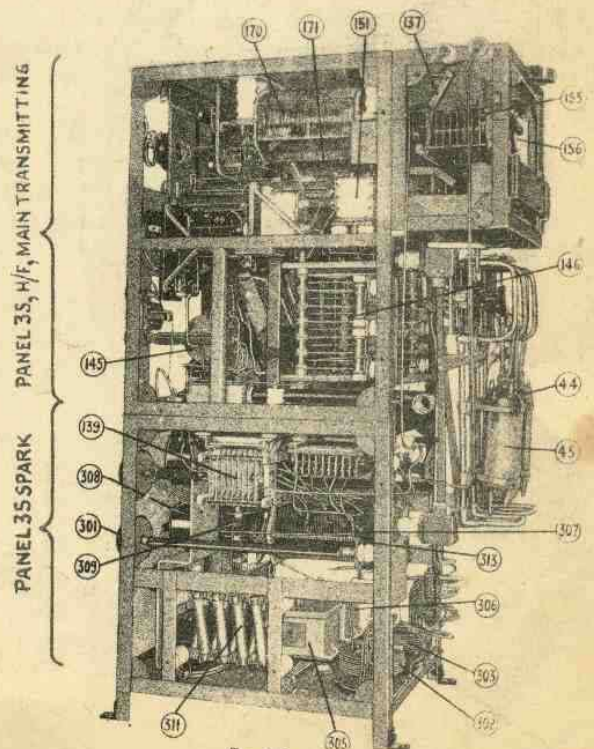


FIG. 0A.

GRID SIGNALLING AND ABSORBING CIRCUITS

Grid signalling and absorbing circuits (see figure p.) The grid signalling and absorbing circuits are fitted in the grid signalling and absorbing panel.

The method of grid signalling used for L/F and H/F master controlled transmissions necessitates the H.T. supply to the main amplifying and master valves being made continuously.

The main valves (41)(42) and (44)(45) have been designed to act as self-absorbers when the main circuits are not oscillating during the "spacing" periods of signalling.

REFERENCE
ADMIRALTY
HANDBOOK
OF W/T (1936)
VOL II SEC X
PARA. 59 FIG 57.

The H.T. supply to the master valves (43)(46) is connected to a ^{45A} ~~NT~~ absorber valve (47) and the circuit is arranged so that, when the master circuit is not oscillating the H.T. load is dissipated in the 20,000 ohms anode resistance (130) of the absorber valve (47). The anode resistance (130) consists of two units each of eight 5000 ohms resistances, connected in series ^{PARALLEL} and is fitted in the Low Power Rectifying Panel.

Power absorption during space is necessary with high speed keying to avoid the possibility of power line surges either from electrical resonance of the supply circuit or mechanical resonance of the generators. It also reduces key clicks, particularly where hot cathode rectifying valves are used.

The 800 volts negative potential required for controlling the grids of the master control and absorber valves is obtained from the small rectifying unit comprising the transformer (132), the rectifying valve (48) and the smoothing condenser (131). The rectifying valve (48) is connected to the transformer (132) in series with the condenser (131), and the anode terminal of the transformer (132) is earthed. At the moment of first exciting the rectifier unit, the anode of the rectifying valve is at earth potential. During the first half cycle of the transformer voltage when, say, the filament terminal connection of the transformer is positive to the earthed terminal, no current can flow in the rectifying valve because its filament is positive to the anode. During the negative half cycle, the filament is below earth potential and therefore negative to the anode so that electrons will travel from the valve filament to anode and build up a negative charge on the condenser plate connected to the valve anode. This condenser plate therefore builds up a negative potential, the limiting value of which is equal to the peak potential difference across the transformer winding. Actually it does not reach this limit because of the action of the grid signalling key which operates as follows:-

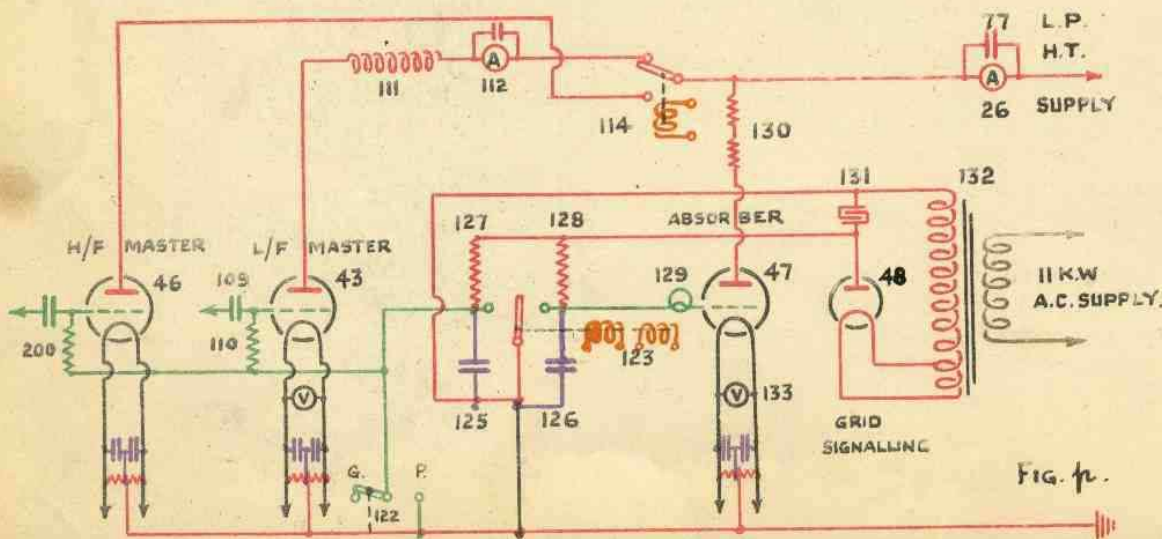
Spacing Position. In the spacing position, the moving contact of the key connects the grid of the absorbing valve direct to its filament. Current then flows through this valve and through the absorbing resistance (130) thus causing power absorption. At the same time the connection between the grids of the master valves and their filaments is broken thus leaving them connected to the negative potential supply on the smoothing condenser (131). This negative potential prevents the master valve in use from oscillating and from taking any anode current. It will be noticed that the 30000ohm resistance (128) prevents short circuit of the smoothing condenser (131). If a short circuit occurred there would be no negative potential available for shutting down the master valves and the rectifying valve anode would become very hot.

Marking Position. On the marking position of the key the opposite action occurs, the grids of the master valves being connected, in series with their grid leaks, to their filaments and the grid of the absorbing valve is isolated from its filament and left connected to the negative supply on the smoothing condenser. The master valve in use can now oscillate and drive the power amplifying valve whilst the absorber valve is prevented from taking any anode current. The 30000ohm resistance (127) carries out the same function as did resistance (128) in the spacing condition.

The two 4 jar condensers (125) and (126) are connected across the key contacts to prevent arcing.

It will be noticed that the negative keying potential is not applied to the grids of the power amplifying valves. If the circuit is correctly balanced these cannot self oscillate but they do pass anode current and therefore assist in power absorption during the spacing periods.

A photograph of the grid signalling and absorbing panel is shown in figure ka.



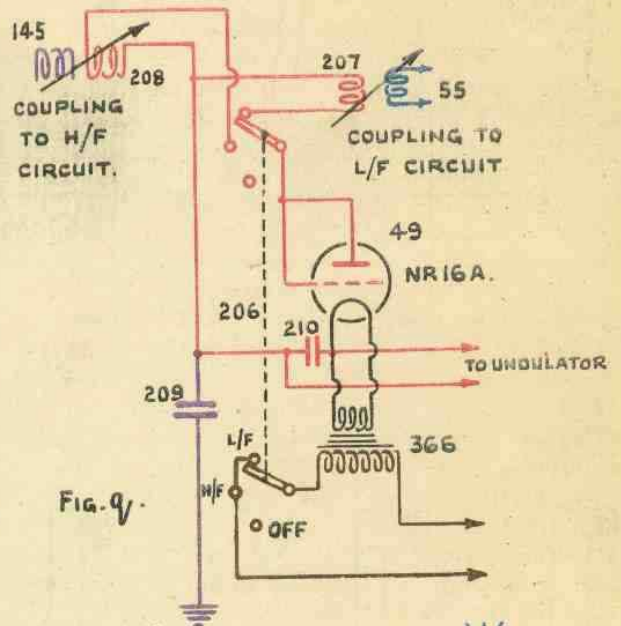
MONITOR VALVE CIRCUITS

In order to provide a means of checking the accuracy of transmissions at high speed an NR16A monitor valve (49) is fitted which can be coupled to the L/F or H/F transmitter (see figure q.)

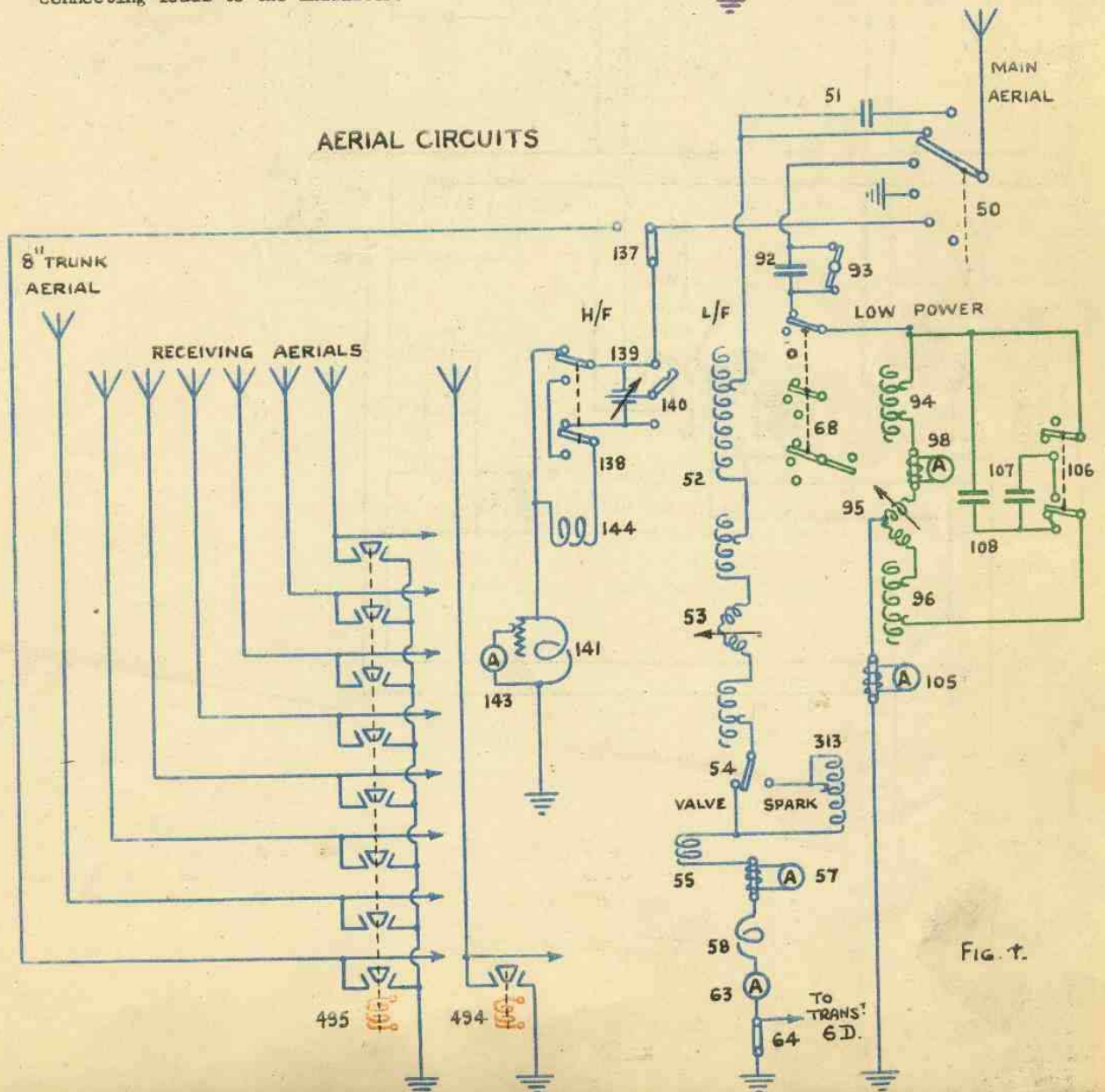
The valve (49), filament transformer (366) and condensers (209)(210) are fitted on a shelf in the H/F main transmitting panel.

The anode and grid of the valve (49) are connected together and the L/F or H/F monitor coupling coils (207) or (208) are connected in circuit by one contact arm of the monitor C.O.S. (206). An additional contact arm on this switch (206) completes the 11 kW A.C. supply to the primary of the valve filament transformer (366) when the monitor C.O.S.(206) is set to "L/F" or "H/F".

During the marking periods of signalling R/F currents induced in the coupling coil (207) or (208) are rectified by the valve (49) and applied to a 0.1 mfd smoothing condenser (210). This condenser (210) is connected to the undulator which is used for high speed reception in the high speed bay. Transmissions can thereby be checked and recorded by the automatic high speed tape recording apparatus. A 0.1 mfd R/F by-pass condenser (209) is connected between the coupling coils (207)(208) and earth to prevent R/F currents being set up in the connecting leads to the undulator.



AERIAL CIRCUITS



KEY SAFETY UNIT AND 21 VOLT WARNING CIRCUITS

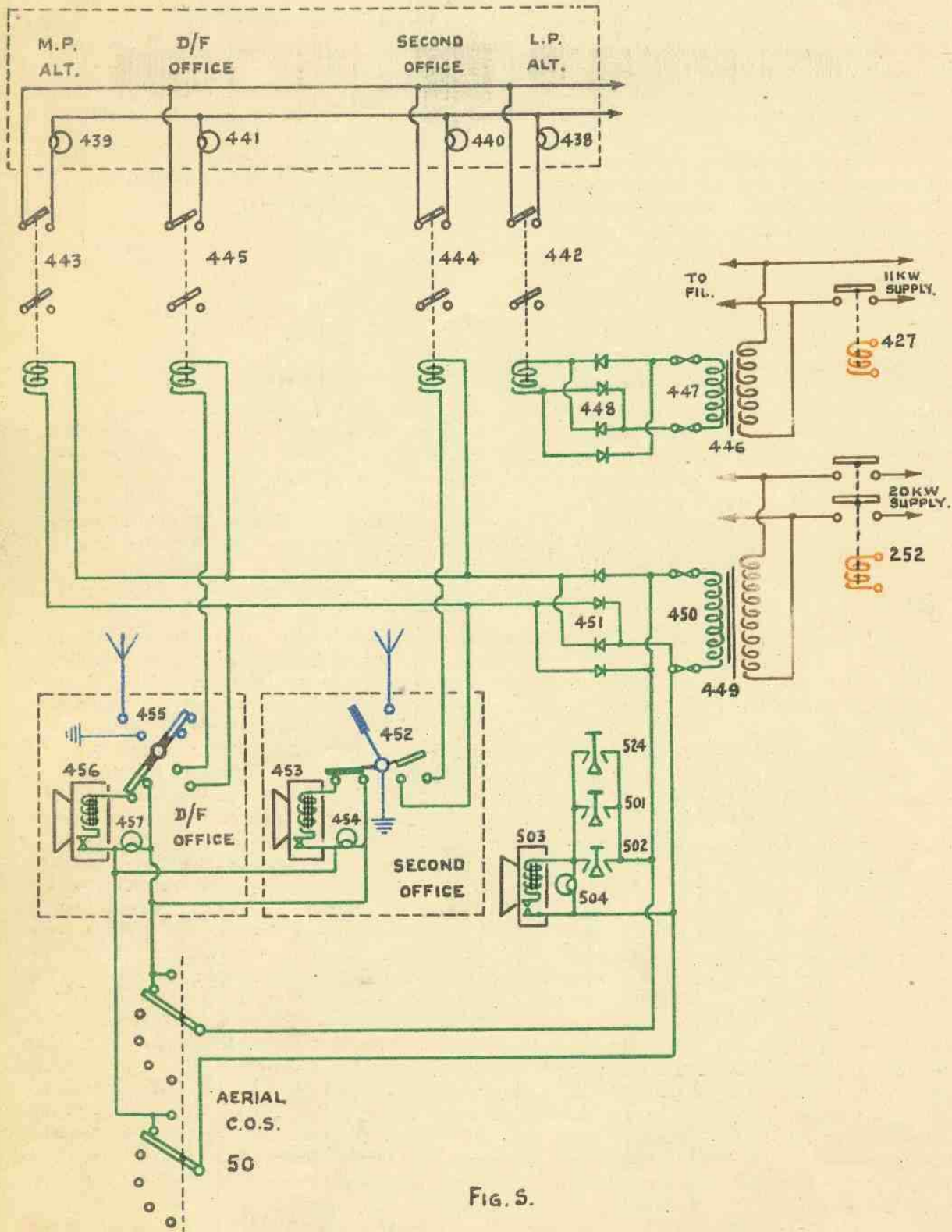


FIG. 5.

AERIAL CIRCUITS

The aerial circuits and methods of connecting the transmitters to the aerial are shown in figure r. The main aerial is connected to the L/F, H/F or Low Power sets by the aerial C.O.S. (50) and the aerial can be isolated, when taking D/F bearings, or earthed, by setting the switch (50) to the appropriate position. The handle controlling the aerial C.O.S. (50) is fitted in a convenient position over the valve panels.

To prevent the set being used on H/T when ammunitioning ship, etc., a removable plate is fitted to the mounting for the handle of the switch (50). When the plate is removed a spring loaded plunger prevents the handle being moved to the "H/F" position and a notice is exposed which warns the operator that it is "Dangerous to Transmit on H/F". The removable plate is retained by the Officer of the Watch during the time it is dangerous to use the H/F transmitter.

The main aerial can be connected to the 8 pole cabinet switch (495) for H/F reception by means of a link (137).

One of the single wire receiving aerials is connected to the double pole cabinet switch (494). This switch (494) operates for all types of transmission (See D.C. Switch (14)) and the aerial connected to it is used by the operator controlling the low power set.

All the remaining single wire aerials and the 8 inch trunk aerial are connected to the 8 pole cabinet switch (495).

KEY SAFETY UNIT AND 21 VOLT WARNING CIRCUITS

Key Safety Unit and 21 Volt Warning Circuits. (See figure s.)

In order to protect the receiving gear in the D/F and second offices when the main L/F set is transmitting a key safety unit and warning circuits are fitted.

The key safety unit is fitted in No.3 power board and consists of four magnetic switches (442)(443)(444)(445), two transformers (446)(449), fuses (447)(450) and two metal rectifiers (448)(451). The magnetic switches are connected in the key and indicating lamps circuits as described in the notes on D.C. Switches (13) and (15).

The low power magnetic switch (442) is operated by the 15 volts supply from a transformer (446) and metal rectifier (448). The primary of the transformer (446) is connected to the 11 kW A.C. supply and the magnetic switch (442) will close when the filament alternator is running and the filament switch (427) is made. One contact arm on the magnetic switch (442) completes the supply to an indicating lamp (438) in the C.R.P. marked "L.P. Alt."

The main power, second and D/F office magnetic switches (443)(444)(445) are operated by the 21 volts supply from a transformer (449) and metal rectifier (451). The primary of the transformer (449) is connected to the 20 kW A.C. supply. The main power magnetic switch (443) will close when the main alternator is running and the relay switch (252) is made. One contact arm on the magnetic switch (443) completes the supply to an indicating lamp (439) in the C.R.P. marked "M.P. Alt."

The warning circuit consists of loud sounding buzzers (453)(456)(503) and lamps (454)(457)(504) operated by the 21 volts A.C. supply from the transformer (449). The second and D/F offices are fitted with aerial safety switches (452) and (455) for earthing the aerials when the main L/F set is transmitting or the office is not in use. In the "receive" position the switches (452)(455) are connected as shown in figure s. and complete the 21 volt supply to the loud sounding buzzers (453)(456). When the main alternator is running and the relay switch (252) is made the second and D/F office operators are warned that transmission on the main L/F set is about to take place by the buzzers (453)(456) and lamps (454)(457). The warning lamps will burn as long as the relay switch (252) is made and the main alternator is running but the circuit to the buzzers (453)(456) is broken by the respective aerial switches (452)(455) when the operators earth their aerials.

In addition to breaking the circuit to the buzzers (453)(456) the aerial safety switches (452)(455) complete the supply to the bobbins of the second and D/F offices magnetic switches (444)(445). These switches (444)(445) light indicating lamps (440)(441) marked "Second Office" and "D/F Office" respectively in the C.R.P. The lamps (440)(441) indicate to the operator in the C.R.P. that the second and D/F office aerials are earthed and it is safe to transmit.

The supply to the warning circuit buzzers (453)(456) and lamps (454)(457) is completed when the main aerial C.O.S. (50) is set to L/F. It should be noted that the magnetic switches (444)(445) will operate and the indicating lamps (440)(441) will light when the aerials in the second and D/F offices are earthed by the aerial safety switches (452)(455) irrespective of the position of the main aerial C.O.S. (50), thus affording a permanent indication whenever the second and D/F office aerials are earthed.

A loud sounding buzzer (503) and lamp (504), fitted in the main W/T office, are operated by the supply from the transformer (449). Each of the removable covers on the H/F main and master panels and the safety cage gate is fitted with a safety gate switch (501)(502) or (524) which closes when the gate is open and completes the supply to the buzzer (503) and lamp (504). The operator is, therefore, warned if the relay switch (252) sticks "ON" when the gate is opened or the covers are not in place.

D.C. AUXILIARY CIRCUITS

The auxiliary circuits for Type 48 are all controlled by switches, numbered 1 to 12, fitted on No. 3 power board.

The duties of the switches are as follows:-

- D.C. Switch (1). Radiator W/T Office.
- D.C. Switch (2). Radiator Coding Office.
- D.C. Switch (3). 12-1/2 inch fan.
- D.C. Switch (4). 7-1/2 inch fan.
- D.C. Switch (5). Pneumatic tube motor No.1.
- D.C. Switch (6). Charging board.
- D.C. Switch (7). Warning Telephones.
- D.C. Switch (8). Pneumatic tube motor No.2.
- D.C. Switch (9). Spare.
- D.C. Switch (10). Lights, coding office.
- D.C. Switch (11). Lights, C.R.R.
- D.C. Switch (12). Blower and safety circuit (see figure t.).

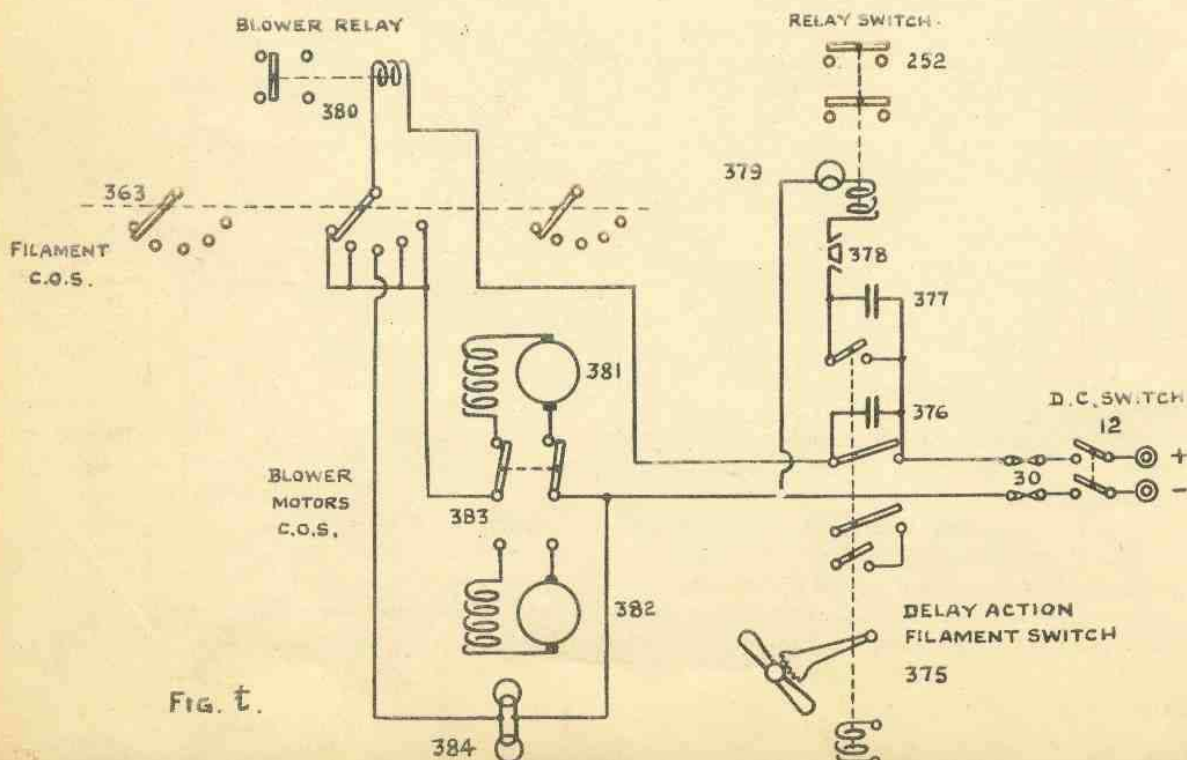
D.C. Switch (12) and fuses (30) supply the blower motors (381) or (382), the blower relay (380) and the bobbin of the main relay switch (252).

The delay action filament switch (375) has two long and two short contact arms and is arranged so that the former make contact before the latter. A detailed explanation of the action of the switch (375) is given in the notes on D.C. Switch (15). One of the long contact arms completes the supply to the bobbin of the blower relay (380) and a short contact arm completes the circuit to the bobbin of the main relay (252). By this arrangement the blower circuit is made before the main A.C. supply is completed by the main relay switch (252). The second short contact arm completes the supply to the filament switch (427) (see D.C. Switch (15)) and the blower will, therefore, be switched on before the filaments of the valves are burning. In the "Off" position the blower relay (380) short circuits the bobbin of the filament switch (427) (see D.C. Switch (15)).

When the filament C.O.S. (363) is set to any of the main power positions the bobbin of the blower relay (380) is connected in series with the blower motors C.O.S. (383). The blower relay (380) will only operate, therefore, when one of the blower motors is switched on. By this arrangement the filament switch (427) can only be operated when the short circuit of the blower relay (380) is removed by one of the blower motors being switched on. This prevents the valves lighting without the blower running.

The blowers are not used for the L/F master valve (43) and when the filament C.O.S. (363) is set to "L.F." the bobbin circuit of the blower relay (380) is completed by two 50 c.p. lamps (384) connected in parallel.

To prevent the set being used when men are working aloft in the vicinity of the aerials or feeders, etc., a locking device is fitted to the cover of D.C. Switch (12). By sliding a locking bar into position the switch (12) is secured in the "Off" position and a plate marked "Safe to transmit on M/F" can then be removed. The removal of the plate exposes a "Man Aloft" warning notice and releases a spring plunger which holds the locking bar in place to prevent the switch (12) being made to "ON".



D.C. AUXILIARY CIRCUITS (CONT.)

D.C. Switch (13), Morse Key R.C. (See figure u).

D.C. switch (13) and fuses (31) supply the bobtins of the master keys (469) and (470) which are operated by the remote control morse keys fitted in the receiving bays of the C.R.R. Two contacts of the master key C.O.S. (465) fitted on Board 2S Controlling, connect the bobtins of the master keys (469)(470) in circuit as required.

The morse key selector switch (429) connects the morse keys in the receiving bays to the master key in use as required.

The Remote Control Office morse key (431) is independent of the selector switch (429) and is connected in circuit by one contact arm of the remote control switch (432) on Board 2S Controlling. Each morse key in the C.R.R. and the R.C.C. morse key (431) has a neon lamp connected across the contacts to indicate when the key is connected in circuit.

The bobtin circuit of the master keys (469)(470) is connected to contacts on the magnetic switches (442)(443)(444)(445) and aerial C.O.S. (50). The L.P. and main alternator magnetic switches (442)(443) are made when the filament and main alternators are supplying power to the set and the second and D/F office magnetic switches (444)(445) close when the second and D/F office aerial switches are earthed. (See figure s).

When the low power transmitter is in use the main alternator is not required and it is not necessary to earth the second and D/F office aerials. For this reason the key circuit contacts on the main alternator, second office and D/F office magnetic switches (443)(444)(445) are short circuited by an auxiliary contact on the aerial C.O.S. (50) when the latter is set to "L.P."

Similarly for H/F transmissions the second and D/F office magnetic switches (444)(445) are short circuited when the aerial C.O.S. (50) is set to "H/F".

When testing the bobtin circuits the key circuit contacts on the magnetic switches (442) to (445) and aerial C.O.S. (50) can be short circuited by a tumbler switch (463) fitted in the lamp indicating box in the C.R.R. This switch (463) should always be broken after testing.

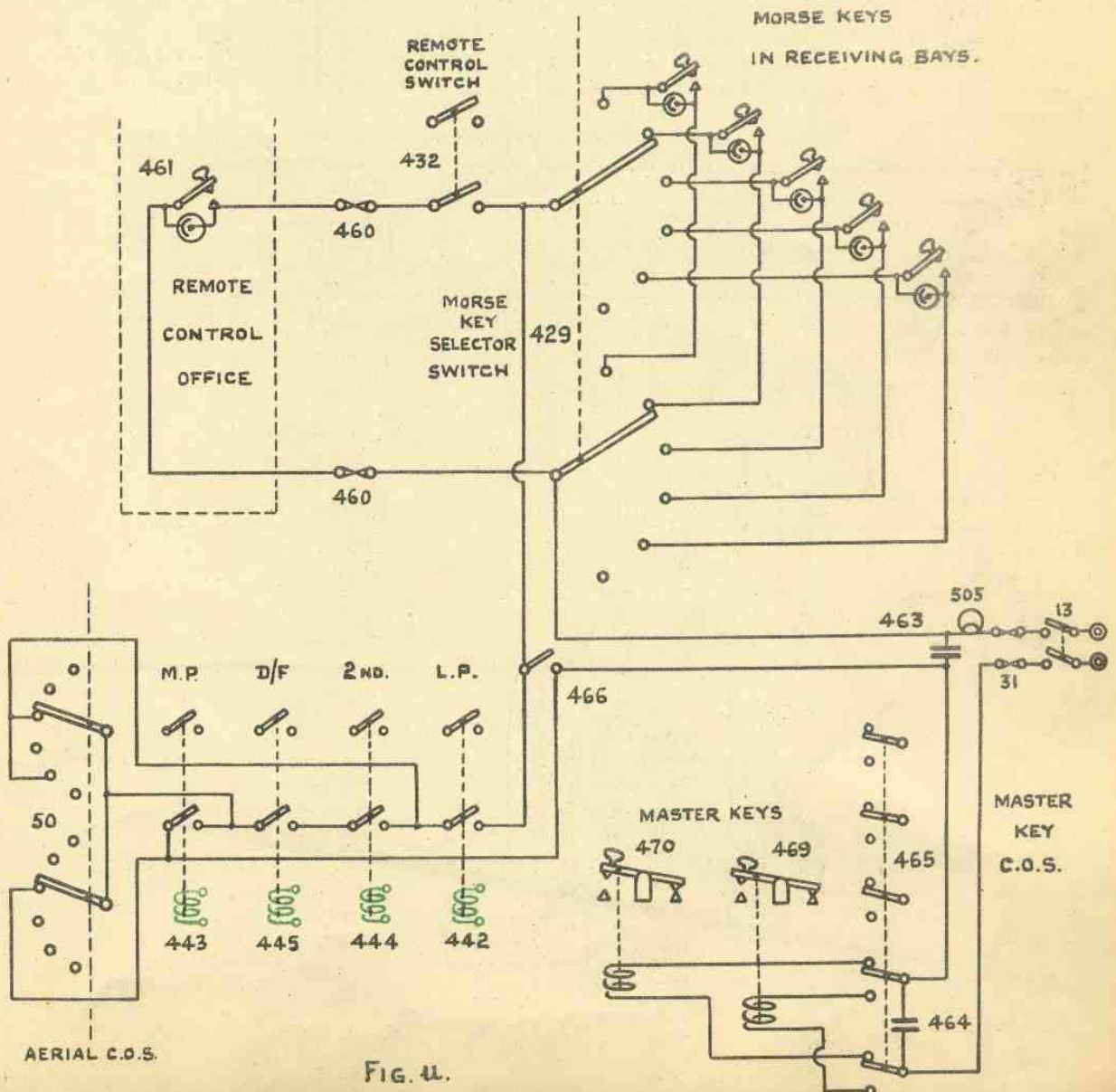


FIG. 4.

TYPE 48
D.C. AUXILIARY CIRCUITS (CONT.)

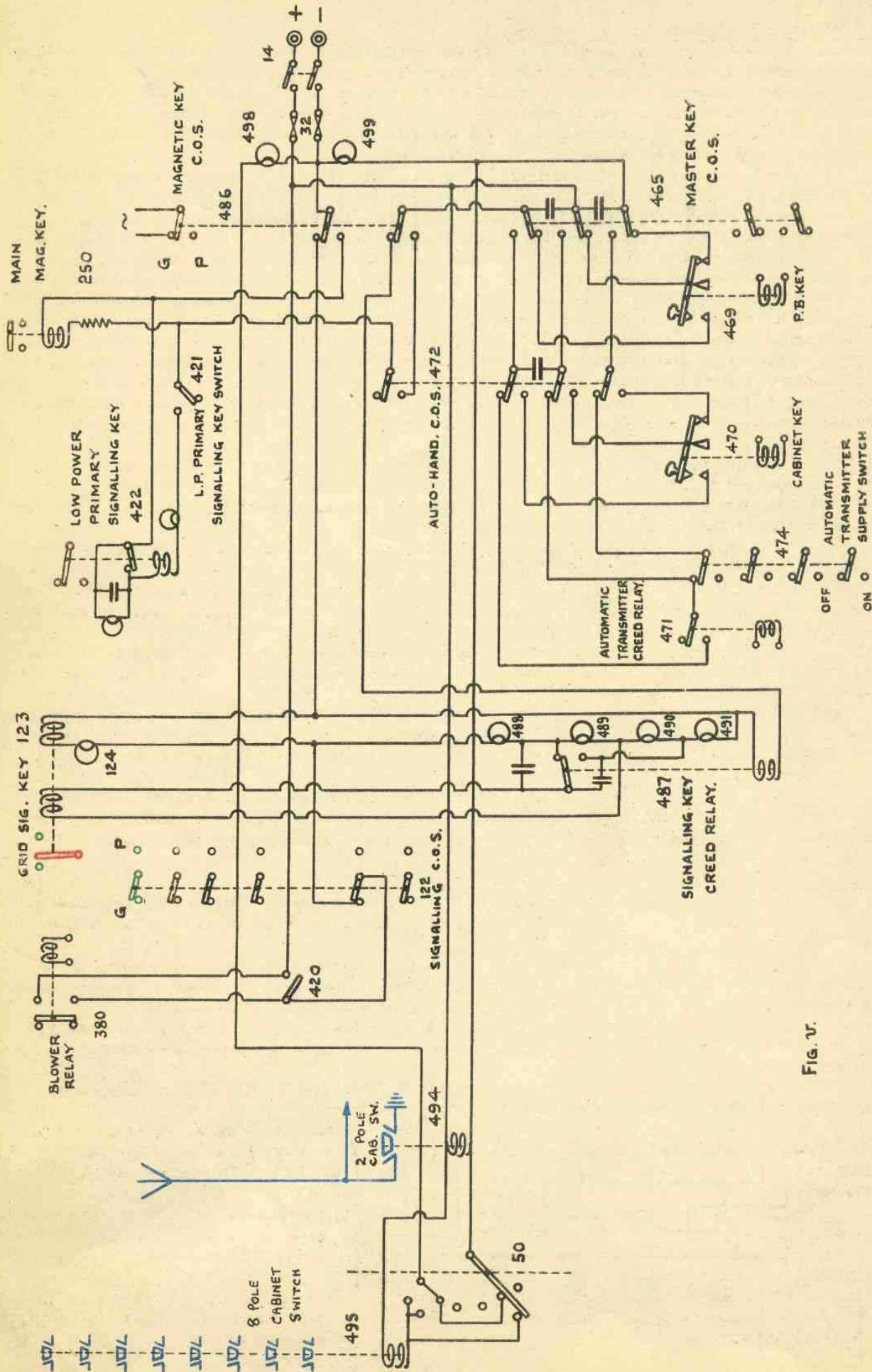


Fig. 17.

TYPE 48
D.C. AUXILIARY CIRCUITS (CONT.)

RM29

D.C. Switch (14) Key Circuit (See figure v).

D.C. Switch (14) and fuses (32) supply the master key circuits for operating the main magnetic key (250), low power primary signalling key (422), the signalling key creed relay (437), the eight pole cabinet switch (495) and the double pole cabinet switch (494). The bobbins of the grid signalling key (123) are also connected to the supply from D.C. switch (14). Three contacts of the master key C.O.S. (435) connect the operating circuits to the power board master key (439) or to the auto-hand C.O.S. (472) in the high speed transmitting bay.

The auto-hand C.O.S. (472) connects the operating circuits to the cabinet master key (470) or to the automatic transmitter creed relay (471).

Two methods of signalling can be used, viz., "Grid" or "Primary".

Grid Signalling. For grid signalling the magnetic key C.O.S. (435) is set to "Grid" and the signalling key creed relay (437) can then be operated by either of the master keys (439) (470) or by the automatic transmitter creed relay (471). The signalling key creed relay (437) controls the grid signalling key (123) which has a field and a moving coil to operate the contact arm.

The moving coil is suspended in the field produced by the current in the field coil. The contact arm of the grid signalling key (123) is attached to the moving coil. The direction of the current in the moving coil determines the direction in which the coil, and consequently the contact arm, will move for spacing and marking.

One side of the moving coil is connected to the centre point of a resistance consisting of four 32 c.p. lamps (433)(439)(490)(491) which are connected in series between the positive and negative supply.

The other side of the moving coil is connected to the positive or negative side of the centre of the resistance lamps by the contact arm of the signalling key creed relay (437).

The direction of the current through the moving coil will therefore depend on the position of the contact arm of the signalling key creed relay (437).

The signalling key creed relay (437) is magnetically biased and can be adjusted, so that the contact arm will connect to either side when the operating bobbin is not energised. The biasing adjustment is made by means of a milled handle on the side of the relay (437) marked "M - S". The bias should be set so that the grid signalling key (123) remains in the "spacing" position when the bobbin of the signalling key creed relay (437) is not energised.

When the bobbin circuit of the signalling key creed relay (437) is completed by the master key the current in the moving coil is reversed and moves the contact arm of the grid signalling key (123) to the "Marking" position.

For high speed working the signalling key creed relay (437) is controlled by the automatic transmitter creed relay (471) which is operated by the creed sender (see D.C. Switch (13)). Two of the 220-volt, 32 c.p. lamps (433) and (491) are replaced by 100-volt, 50 c.p. lamps when the high speed apparatus is in use.

The supply to the field coil and the resistance lamps (439) to (491) is completed when the blower relay (330) is made and the signalling C.O.S. (122) is set to "Grid". For testing purposes the contacts of the blower relay (330) can be short circuited by the grid key testing switch (420) fitted on the H/F main transmitting panel.

Primary Signalling.

For primary signalling the magnetic key C.O.S. (435) is set to "Primary" and the auto-hand C.O.S. (472) to "Hand". The main magnetic key (250) can then be operated by either of the master keys (439) or (470).

The bobbin of the low power primary key (422) is connected in circuit by setting the L.P. primary signalling key switch (421) to "Master or L.P." This connects the bobbins of the main magnetic key (250) and the low power primary key (422) in parallel.

Both keys (250)(422) will then operate when the master key (439) or (470) is pressed but as the main A.C. supply is not used for low power transmissions the movement of the main magnetic key (250) can be disregarded.

When the L.P. Primary signalling key switch (421) is set to "Self or Spark" the bobbin circuit of the low power primary key (422) is broken.

The supply to the bobbins of the magnetic keys (250)(422) is broken by a contact on the auto-hand C.O.S. (472) when the latter is set to "auto". This prevents the automatic transmitter creed relay (471) being used for operating the magnetic keys (250)(422). The cabinet switches (494) (495) are operated by the back contacts of the master keys (439)(470).

The two pole cabinet switch (494) is connected to the receiving aerial used by the operator controlling the low power transmitter, and operates for all types of transmission.

The bobbin of the eight pole cabinet switch (495) is connected in parallel with the bobbin of the two pole cabinet switch (494) by an auxiliary contact on the aerial C.O.S. (50) when the latter is set to any of the L/F or H/F main power positions. An additional 32 c.p. lamp (496) is connected in parallel with the 32 c.p. operating circuits lamp (499) when both operating switches (494)(495) are working.

TYPE 48
D.C. AUXILIARY CIRCUITS (CONT.)

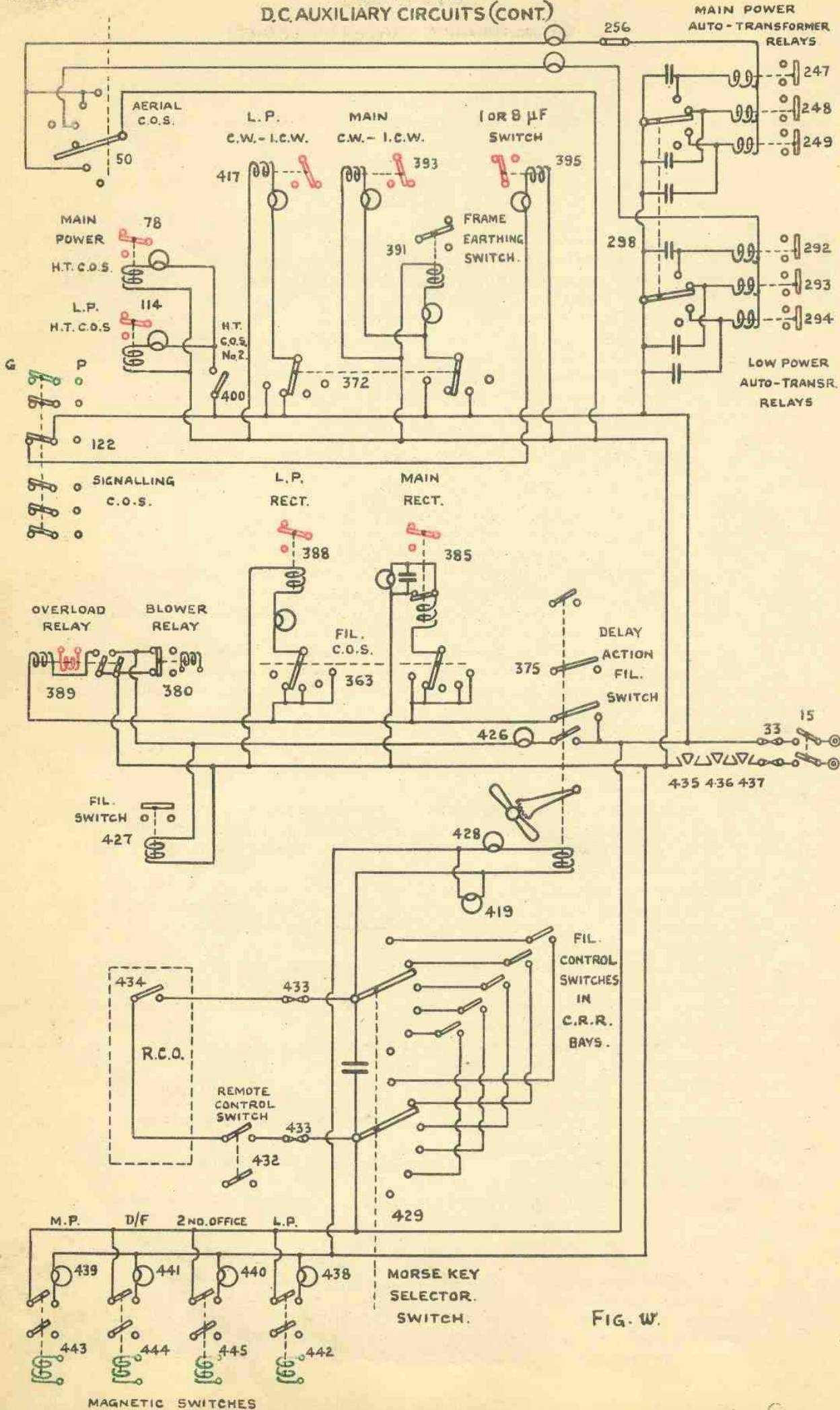


FIG. W.

TYPE 48

D.C. AUXILIARY CIRCUITS (CONT.)

RM31

D.C. Switch (15). Control Board (see figure w.)

D.C. Switch (15) and fuses (33) supply three groups of control and indicating circuits as follows:-

- (a) Power tapping switch (208), main and low power C.W. - I.C.W. switches (393)(417), frame earthing switch (391), main and low power H.T. change over switches (78)(114) and the 1 or 8 mfd. condenser switch (395).
- (b) Main and low power rectifier switches (385)(388), hold on coil of overload relay (389) and the filament switch (427).
- (c) Delay action filament switch (375) and the indicating lamps (438)(439)(440)(441).

The power tapping switch (208) is fitted on Board 2S Controlling and operates the bobbins of the relays (247)(248)(249)(292)(293)(294) for controlling the power taken from the main and low power auto-transformers. A link (258) in the bobbin circuit to the main relays can be used to complete the A.C. supply from the 2/3 power tapping on the main auto-transformer in the event of failure of the bobbin circuits (See figure e.)

An auxiliary contact on the aerial C.O.S. (50) completes the bobbin circuit to the main auto-transformer relays (247)(248)(249) for I/F and H/F main power transmissions and to the L.P. auto-transformer relays (292)(293)(294) when using low power.

The main and low power C.W. - I.C.W. switches (393)(417) and the frame earthing switch (391) are controlled by the C.W. - I.C.W. C.O.S. (372) which is fitted on the front of the filament distributing panel. This switch (372) has four positions and connects the bobbins of the main and low power C.W. - I.C.W. switches (393)(417) in circuit for the various types of transmission as follows:-

Position 1.	C.W. Master.
" 2.	I.C.W. Master or C.W. L.P.
" 3.	C.W. Self.
" 4.	I.C.W. Self or I.C.W. L.P.

The bobbin circuit of the 1 or 8 mfd condensers switch (395) is completed by one contact arm of the signalling C.O.S. (122) when the latter is set to "Grid". This ensures that the eight 1-mfd condensers are used as the smoothing unit for all grid signalling master controlled transmissions.

The bobbins of the main C.W. - I.C.W. switch (393) and frame earthing switch (391) are connected in parallel. When the main C.W. - I.C.W. switch (393) is broken the frame earthing switch (391) falls to the "OFF" position and connects the insulated metal framework, in which the smoothing condensers are fitted, to earth. This prevents danger from shock to anyone touching the framework, due to an induced floating potential, after using C.W.

The bobbins of the main and low power H.T. change over switches (78)(114) are connected in parallel and are controlled by H.T. C.O.S. No.2(400) which is fitted on the front of the filament distributing panel.

The main and low power rectifier switches (385)(388) are connected in circuit by two contact arms on the filaments C.O.S. (363). The main rectifier switch (385) operates when the filament C.O.S. (363) is set to either of the self-excited or master positions. The low power rectifier switch (388) operates when the filament C.O.S. (363) is set to low power or either of the master positions. The supply to the bobbins of the rectifier switch, or switches, in use is completed by one of the long contact arms of the delay action filament switch (375). The delay action filament switch (375) is fitted with a braking device which ~~consists~~ ^{consists} of a fan, enclosed in a box, and revolved by a ratchet attached to the spindle of the switch. When the bobbin of the switch (375) is energised the switch moves to the "ON" position in, approximately 3 seconds. The long contact arms are flexible and, after making contact, will bend until the switch moves to the full "ON" position and the short arms make contact. A short contact arm on this switch (375) completes the supply to the bobbin of the filament switch (427). As the long contact arm makes contact a short time before the short contact arm the rectifier switches (385)(388) operate before the filament switch (427) is closed and break in the reverse order. By this arrangement the A.C. supply to the primaries of the voltage step down filament transformers is broken by the filament switch (427), before the secondary circuit of the rectifying valves filament transformers (370)(371) is broken by the rectifying switches (385)(388). Arcing at the contacts of the rectifying switches, due to the large filament current, is therefore prevented.

A 32 c.p. lamp (426) fitted in the filament distributing panel, is connected in series with the supply to the bobbin of the filament switch (427). The lamp (426) burns at half brilliancy when the filament switch (427) is "ON" and at full brilliancy when the resistance of the bobbin of the filament switch is short circuited by the overload relay (389) or the blower relay (390).

The delay action filament switch (375) is controlled by tumbler switches fitted in the bays of the C.R.R. Two additional contacts on the morse key selector switch (429) connect the bobbin circuit to the tumbler switch in the required bay. The morse key selector switch (429), therefore, connects the morse key (see D.C. Switch (13)) and the filament control tumbler switch to any desired bay.

Each of the removable covers on the H/F main and master panels and the safety cage gate is fitted with a safety gate switch (435)(436) or (437). These switches are connected in series and break the supply from D.C. Switch (15) when either of the covers is removed or the safety gate is open.

D.C. AUXILIARY CIRCUITS (CONT.)

A separate filament control tumbler switch (434) is fitted in the remote control office and is independent of the morse key selector switch (429). The R.C.O. tumbler switch (434) is connected in circuit by one contact arm of the remote control switch (432).

A 2-1/2 c.p. indicating lamp (419), fitted on the rack in the main receiving bay, is connected in parallel with the resistance lamp (423) and bobbin of the delay action filament switch (375).

The indicating lamps (438)(439)(440)(441) are fitted in the lamp indicating box which is mounted in a convenient position in the C.R.R. Each lamp will light when the appropriate magnetic switch operates as described on page RM31.

D.C. Switch (16) High Speed Sender. (see figure x.)

D.C. switch (16) and fuses (34) supply the creed keyboard perforator motor (475), the creed sender (482) and the automatic transmitter creed relay (471).

The keyboard perforator is used to prepare the perforated paper tape necessary for operating the signalling mechanism of the creed sender (482). In appearance the perforator resembles a typewriter with a bank of keys representing the alphabet, numerals etc. The depression of any single key causes the required punches to be selected and driven through the paper tape in accordance with the corresponding code combination.

After punching, the paper tape is inserted in the creed sender (482) and is pulled through the operating mechanism when the transmitter motor is switched on.

The creed sender (482) operates the automatic transmitter creed relay (471) by an arrangement of levers and bell cranks protruding through the holes in the paper tape. One side of the bobbin of the automatic transmitter creed relay (471) is connected to the positive or negative side of the D.C. supply through resistance lamps (477) or (478). The other side of the bobbin is connected in series with a condenser (481) and lamp (483) to the centre point of two lamps (479)(480) which are connected in series across the D.C. supply.

The current through the bobbin of the relay (471) charges the condenser (481) and the direction of the charging current will change as the "marking" or "spacing" levers in the sender protrude through the paper tape.

The relay (471) is polarised and will stop at the position in which it was left by the last charging current to the condenser (481).

As explained in the notes on D.C. Switch (14) the automatic transmitter creed relay (471) operates the signalling key creed relay (487) which, in turn, operates the grid signalling key (123).

D.C. Switch (17) lights W/T office.

D.C. Switch (18) Spare.

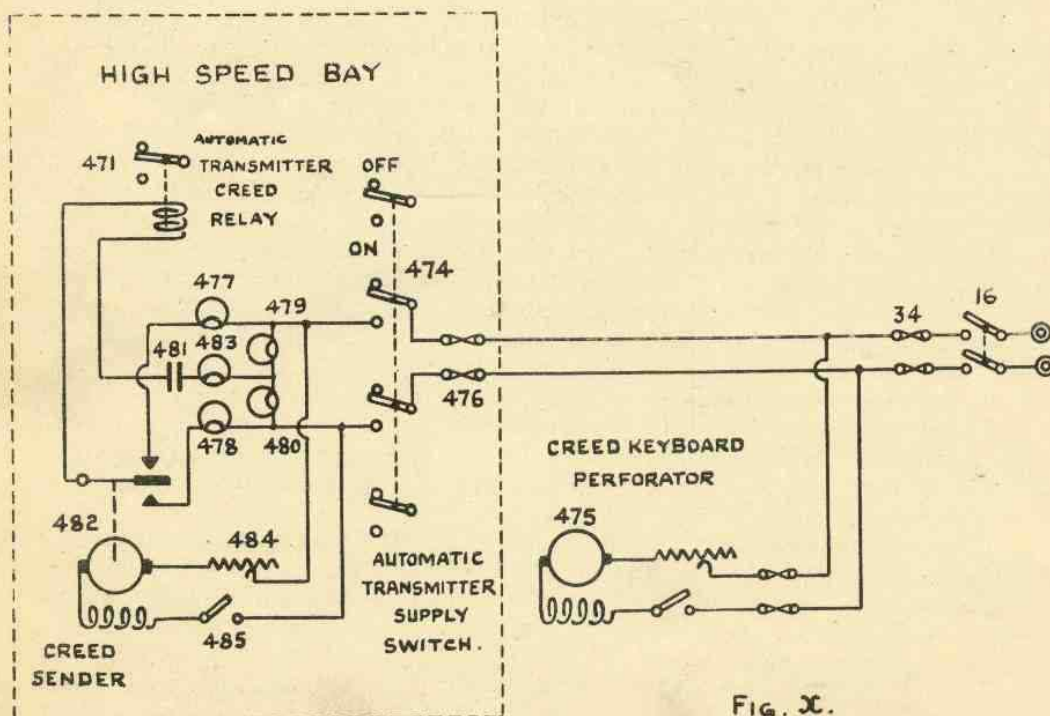


FIG. X.

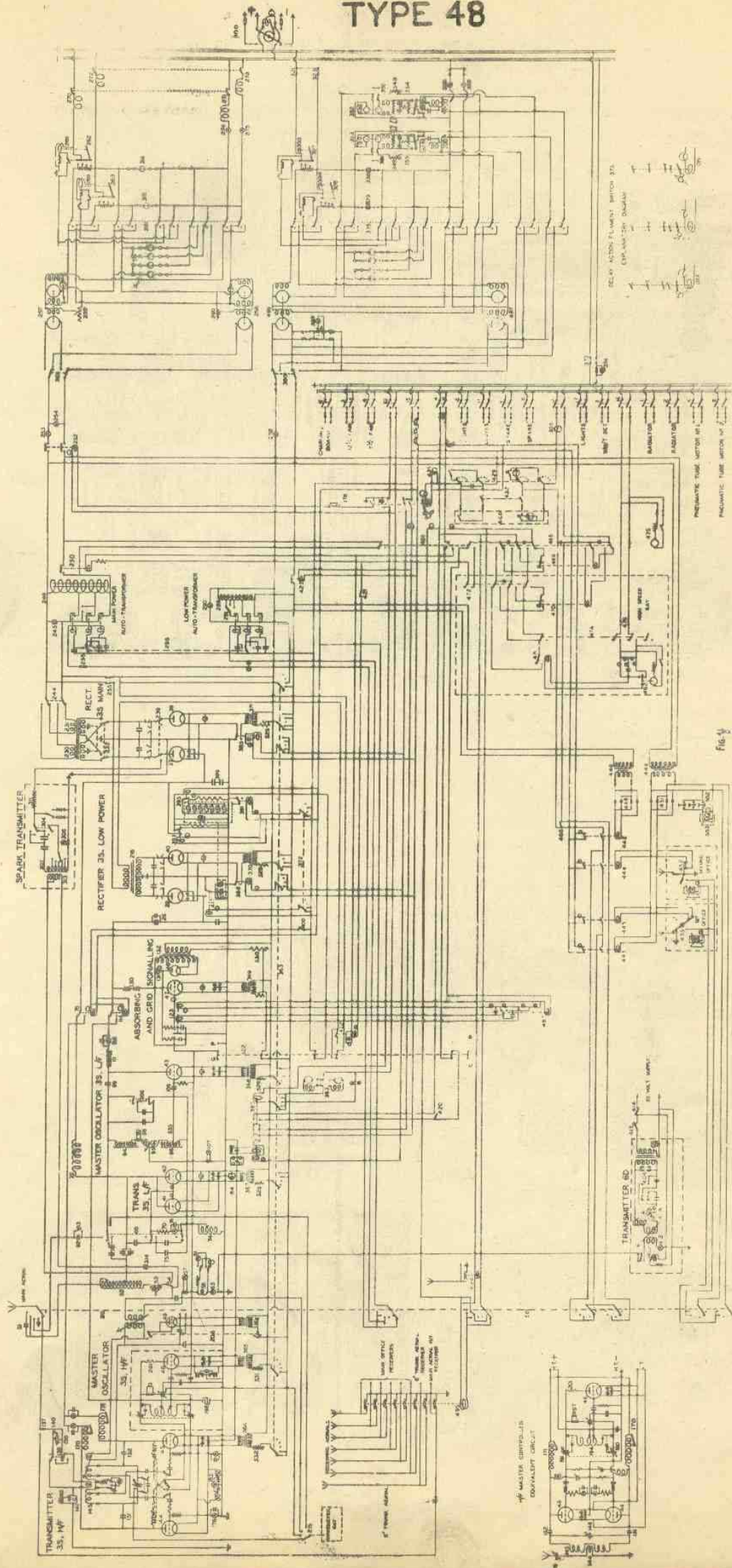


FIG. 4

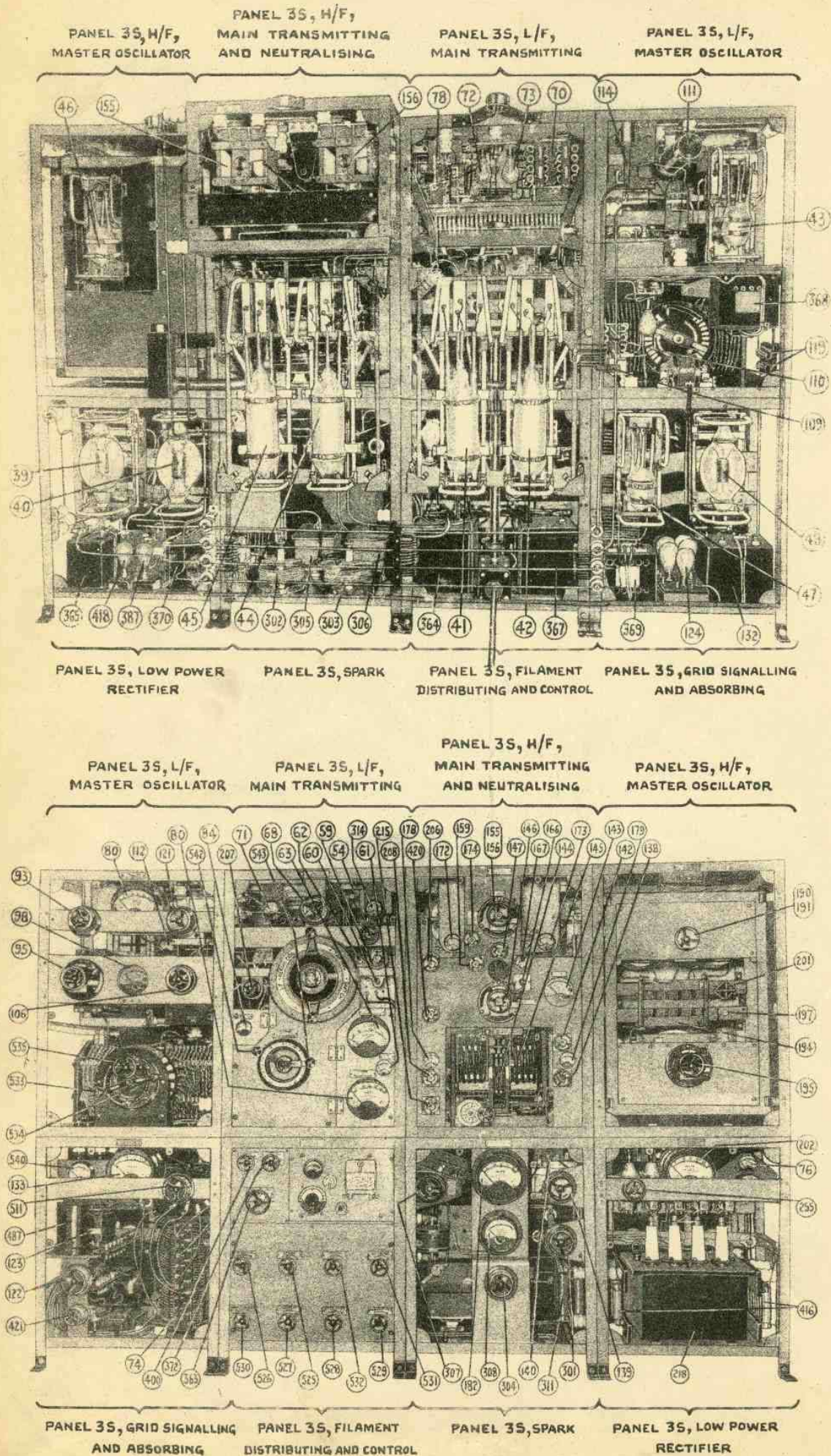


Fig. 7