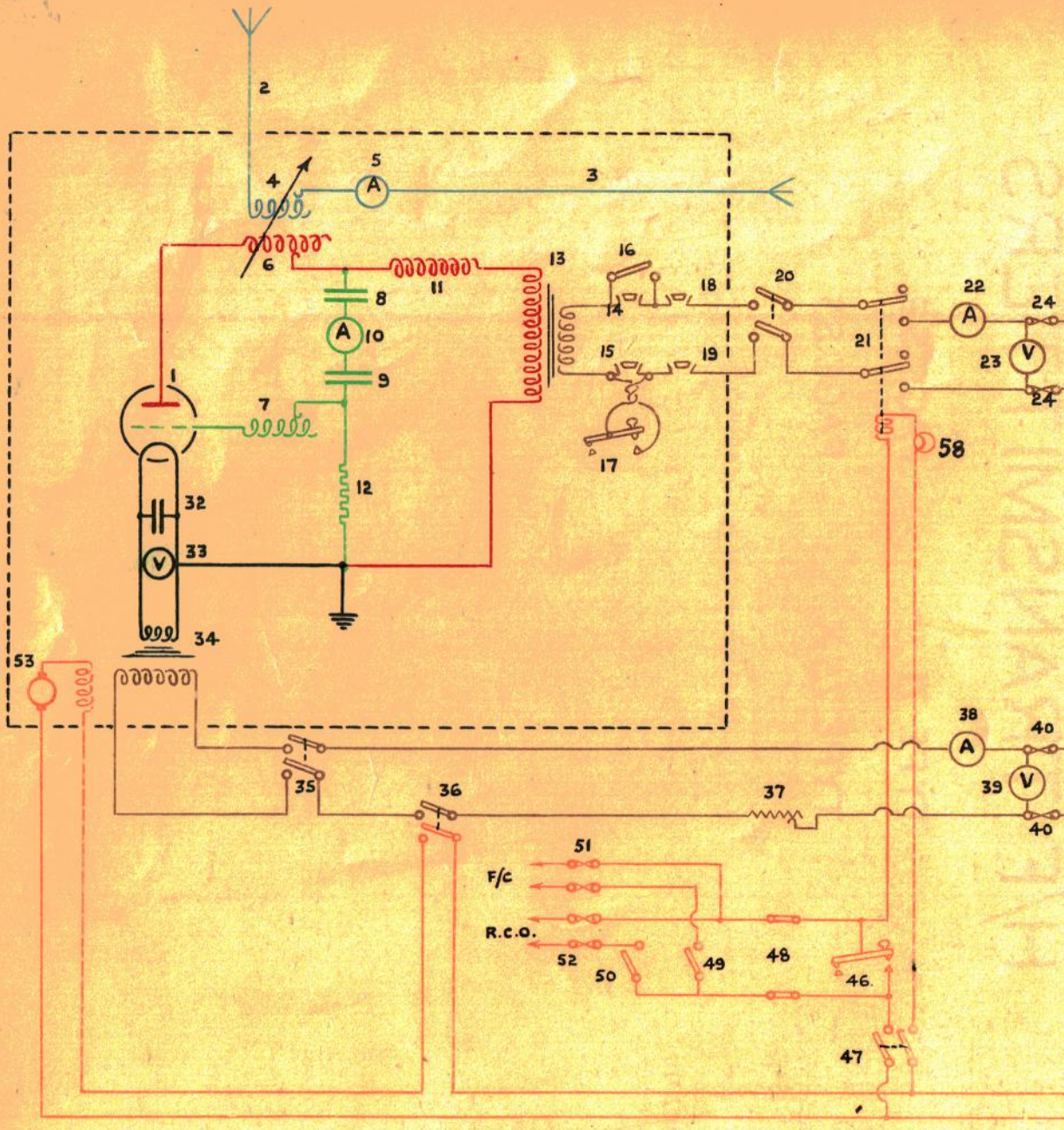
SECTION
S
H/F TRANSMITTERS


2
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V
9
24
1
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12
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F/C
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TYPE 71

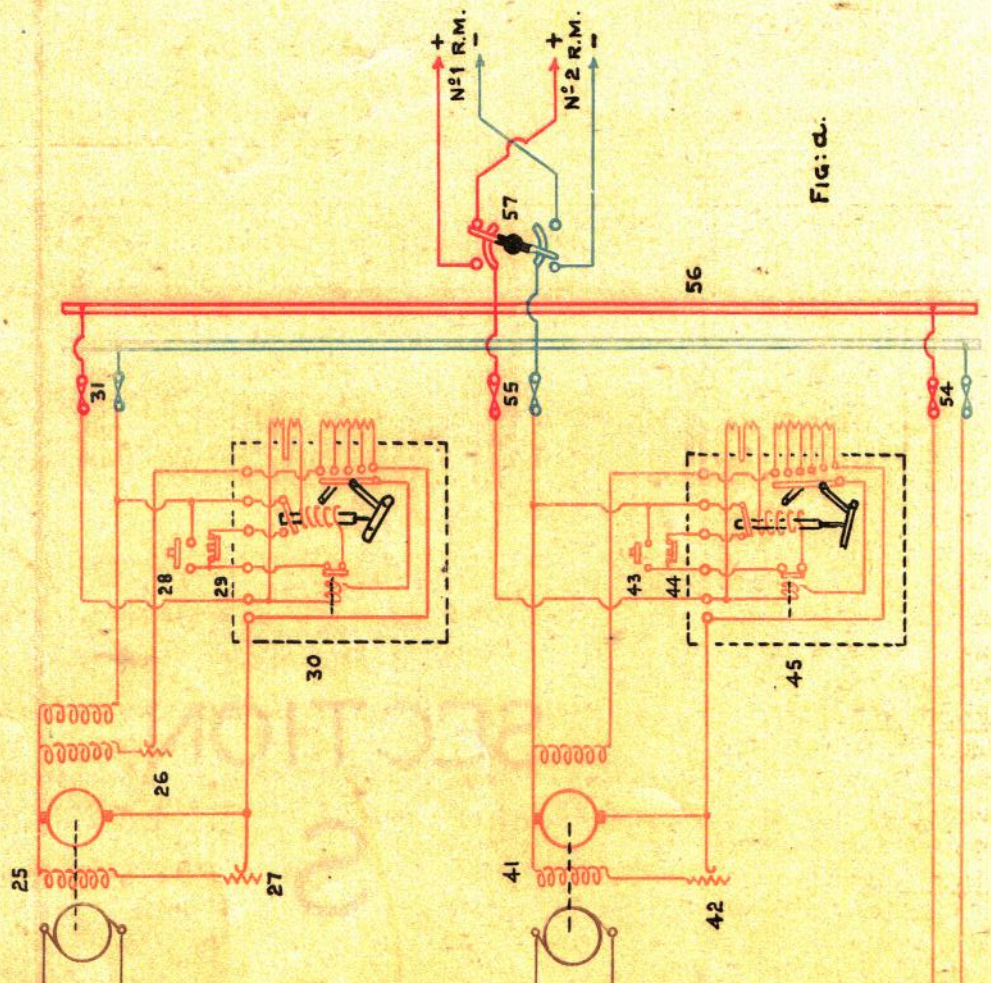


Fig: a.

TYPE 71

Date of design. — 1925.
Frequency range — 18,750 - 28, 570 kc/s.
Power supply — 5 kW. motor alternator.
Valves used — One MT26.
Approximate distance range — 50 miles (Transmitter fitted on deck).
25 miles (Transmitter fitted below).
Associated wavemeter — G6.

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

Type 71 is a single valve H/F transmitter. It may be fitted:-

(a) In the second office in conjunction with an M/F set.
(b) In the auxiliary office.
(c) In a separate office by itself.

The essential difference in each case lies in the power distribution inside the office.

The transmitter used in Type 71 is Transmitter 7H which is usually fitted above the upper deck in a position secure from gun blast and spray and also as far as possible from receiving aerials of other sets and from rigging and wire stays. In some cases the 7H is fitted below in one of the three offices mentioned above.

Power Supply. In the second office alternative supplies are taken from opposite sections of the ring main through separate branch breakers to a ring main C.O.S. (57) and thence on to the bus bars (56) on Board, Fuse, 6 way. These branch breakers and supply cables are capable of supplying all the W/T sets fitted in the office, but when the set is fitted in an auxiliary office the supply is obtained from the power boards of the other sets in that office.

Main A.C. Supply, is provided by a 5 kW motor alternator (25) which is supplied from the bus bars (56) through fuses (31) and is controlled by a Y size automatic starter (30) (see page MA7), a motor speed regulator (26) and alternator field regulator (27). The alternator (25) supplies the primary of the main transformer (13) (step up 30 : 1) through fuses (24), an ammeter (22), the magnetic key (21), a D.P. switch (20) and door contacts (14) (15) (18) (19) on the transmitter box. The fuses (24) have a voltmeter (23) connected across them.

Filament A.C. supply is provided by a 1½kW motor alternator (41) which is supplied from the bus bars (56) through fuses (55) and is controlled by a Z size automatic starter (45) and an alternator field regulator (42). The alternator (41) supplies the primary of the filament transformer (34) (step down 5½ to 1) through fuses (40), an ammeter (38), a rheostat (37), one pole of a D.P. switch (36) the other pole of which makes the blower motor circuit, and a D.P. switch (35). A voltmeter (39) is connected across the fuses (40).

Transmitter 7H employs a divided circuit consisting of the coils (6) and (7) of the flat spiral type, two 1-jar condensers (8) and (9) and the anode grid capacity of the MT26 valve (1). (See Admiralty Handbook of W/T (1931) paragraph 829.) A 10,000 ohm grid leak (12) and an anode choke (11) are provided. The 1-jar condenser (32) is inserted to by-pass R/F current which might otherwise burn out the filament. A voltmeter (33) is connected across the filament leads but is actually situated below in the W/T office. An ammeter (10) is provided in the oscillatory circuit. When fitted above decks the aerial consists of a vertical aerial tube (2) and coupling coil (4), an ammeter (5) and a horizontal aerial tube (3). The aerial tubes (2) (3) are about 5' 3" long and have sliding extension tubes 4' 3" long for tuning purposes. When fitted below, the set is connected to the ordinary second office aerial which is energised at one of its harmonics.

The whole transmitter is housed in two splinter proof steel boxes, one mounted on the top of the other. The walls of the upper box are heavily copper plated, inside and out, to reduce high frequency resistance losses and the box contains the oscillatory circuit and the coil (4) and ammeter (5) of the aerial circuit. The lower box contains the transformers (13) (34) and blower (53).

Each box has a hinged door carrying a door contact controlling a D.P. break in the A.C. supply to the main transformer (13). Contact (14) has a catch plate (16) across it and contact (15) a morse key (17). Contacts (14) (15) are in the upper door and (18) and (19) in the lower door.

The D.C. Auxiliary Circuits which consist of the signalling circuit and the blower motor circuit are fed from fuses (54) and the bus bars (56). The signalling circuit consists of the bobbin of the magnetic key (21) lamp (58) and the morse key (46) and is connected to the supply by means of the D.P. switch (47). Remote Control leads are wired in parallel with the morse key (46).

The blower (53) is controlled by one pole of the D.P. switch (36). The other pole of this switch (36) makes the filament supply to the valve (1) so that the filament cannot be switched on without the blower (53) being switched on also. On the other hand the blower (53) can be left running when the valve is not lit by breaking switch (35) and leaving switch (36) made.

TYPE 71

Tuning. Open the door of the upper box and close and latch the catch plate (18) to short circuit the door switch (14). A morse key (17) is connected across the other door contact (15).

Disconnect the aerials and tune by G8 to the correct wave in the oscillatory circuit, adjusting proportion of inductance in grid and anode coils (7) (8) to give maximum current in ammeter (10). Usually the anode inductance (8) will be the larger. 180 volts (no load) should be used in the primary circuit as shown in voltmeter (23).

Connect up the aerials and, with the coupling set to the smallest value (80°), tune them for maximum aerial current. If this has altered the radiated frequency, readjust the inductance (4).

Increase the aerial coupling to 80° and vary the aerial tuning to see if the resonance curve has a single peak. If two maxima are obtained or maximum is very flat, coupling must be reduced until a single sharp peak is obtained. Coupling must then be left fixed and power adjusted by altering the A.C. voltage.

When Transmitter 7H is fitted below, the aerial is not tuned and the aerial coupling has a more critical effect on the aerial current.

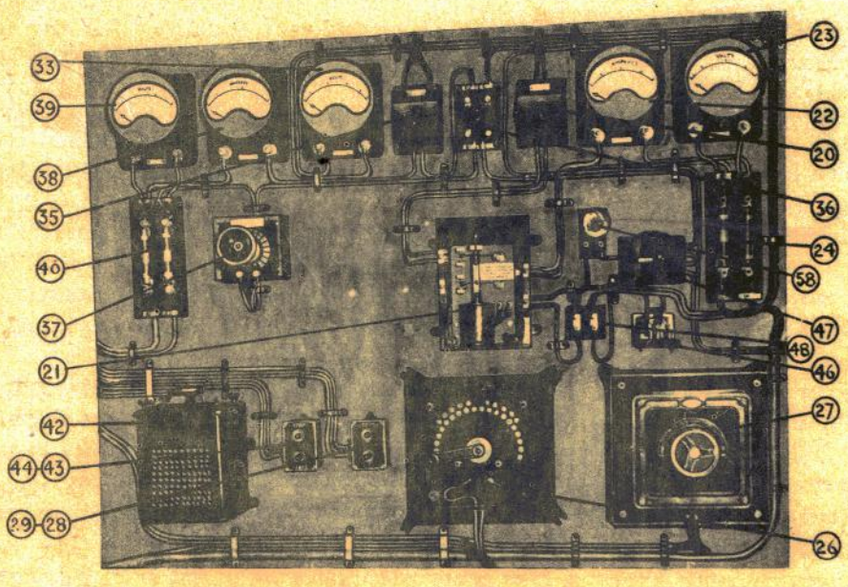


FIG. B.

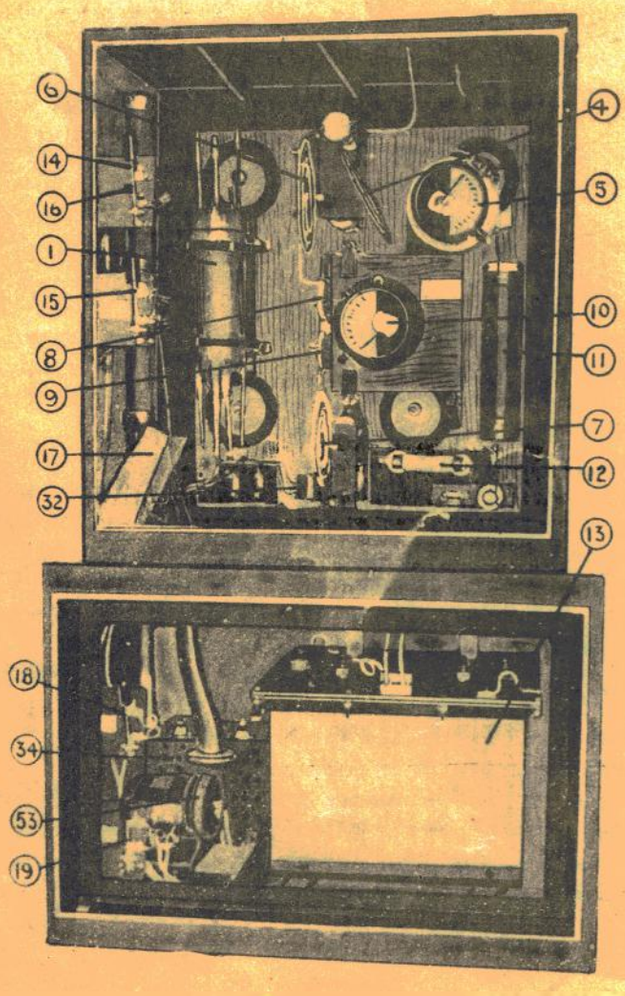


FIG. C.

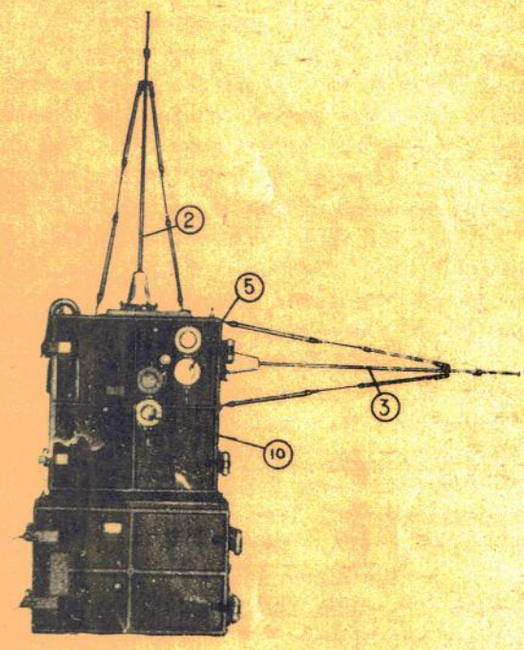


FIG. d.

TYPE 75 X

Date of design :-	1929
Frequency range :-	42,400 kc/s to 75,000 kc/s.
Power supply :-	220 volt mains.
Valves used :-	Transmitter. 2NT16 for each Transmitter-Receiver box fitted. Master Modulator. 2 NT16 (1 in use, 1 alternative) Main Modulator. 2 NT16 for each Transmitter-Receiver box fitted.
Associated Wavemeter :-	G2.
Approximate range in miles :-	2 - 5
Reference :-	Admiralty Handbook of W/T (1931) paragraph 715.

Type 75X is a combined transmitter and receiver designed for very high frequencies(V.H/F). The receiver Q2X is described on page K3 of this book. Equivalent circuits of the transmitter and receiver are shown in figures l. and m.

Type 75X is fitted in certain battleships. Each set comprises a control box and two or three transmitter-receiver boxes and these notes describe the arrangement for two transmitter-receiver boxes.

The control box contains the master modulator and main modulator for the transmitter, the note selector and quench unit for the receiver, the various fuses and switches for controlling the transmitter and receiver, and a main 12 pole 1 way switch(42)(see figures k. and n.) which controls the whole of the H.T., filament and grid bias supplies. The control box is fitted in the auxiliary W/T office.

The transmitter-receiver boxes each contain a transmitter and receiver complete, and a buzzer and key for internal communication. They are fitted in positions aloft. The transmitter and receiver are screened from each other by a metal screen.

POWER SUPPLY.

The power supplies for Type 75X are shown in figure k. The supplies for the transmitting portion are as follows:-

Transmitter. Master Modulator, and Main Modulator valves. H.T.	220 volts.	Ship's mains.
Transmitter. Master Modulator, and Main Modulator valves. Filament.	8 volts.	Patt. 6038A cells.
Main Modulator valves. Grid bias.	About 15 volts.	Patt. 4976 cells inert.

H.T. supply is taken from any convenient 220 volt terminals provided fuses are inserted in the supply leads. These terminals are connected, through a pair of fuses (199), to the appropriate terminals on the control box, which are connected to two contacts of the main switch(42)(see figures k. and n.)

The 8 volt batteries(187)(188)are duplicated and housed in a special battery cupboard with the receiving batteries. Either battery can be connected to the control box by their respective switches(157)(158). The 8 volt terminals of the control box are connected to two contacts of the main switch(42).

The 220 volt and the 8 volt negative leads are made common inside the control box.

The main modulator grid bias battery(186) is connected direct to two contacts of the main switch(42). This battery is housed in a position near the control box.

TRANSMITTER 7RX.

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

As the circuits of each transmitter are identical, and the H.T. and filament supplies for each are paralleled from certain switches, the circuit and switches for transmitter No.1 only will be described.

H.T. Supply. The H.T. supply is taken from the 220 volt contacts of the main switch (42). A smoothing condenser (193) is connected across the supply (see figure a.).

The switch (42) connects the H.T. supply to the morse key (123) and condenser (124). A key condenser (194) is connected across the morse key (123).

When the morse key (123) is pressed the H.T. positive supply is completed, through one half of a 1/1 transformer (122), to the switch (137). The switch (137) connects it through a fuse (179) to the centre of the anode inductance (116).

The morse key (115) forms a break in the circuit, but is only used for tuning purposes, (see under "Tuning" Page 39) and is normally clamped down.

TYPE 75 X
TRANSMITTER 7RX (CONTD.)

Filament Supply. The filament supply is from the two 8 volt contacts of the main switch (42) which connect the supply to the switches (173) (176). As these switches are mechanically linked to the H.T. switch (137) the operation of making them connects the H.T. and filament supplies to the transmitter. The switch (27) (see figure h) is also linked to the switches (137) (173) (176) and the filament supply to the main modulator valves (104) (105) is therefore completed at the same time. For transmitter No. 2, the switches (138) (174) (177) and (28) are linked together, and the H.T. and filament supplies of that transmitter and the filament supply to the main modulator valves (106) (107) are therefore made simultaneously. A 1.75 ohm rheostat (120) is connected in the filament supply to adjust the filament current of both valves (100) (101).

A switch (197) and ammeter (198) are connected in the positive filament supply. The switch (197) has four positions "short", 1, 2, and "total" and, if moved to any position, when released, is returned to the "short" position by a spring, which is therefore its normal position. By switching it to positions 1 or 2 the ammeter (198) is connected in the filament supply of No 1 or No. 2 transmitter. As the valves (100) (101) each take 0.6 amp, the ammeter reading in the 1 or 2 position should be 1.2 amps. It will be noted therefore that the operator at the control box can discover if any transmitter valve is burnt out, without having to go to the aloft position. In the "total" position the total filament current taken by all transmitters is indicated.

Oscillatory circuit. A "Push-Pull" circuit is employed. (See Admiralty Handbook of W/T (1931) paragraph 638 and figure 389). It consists of two NT16 valves (100) (101) an inductance (116) with a variable condenser (117) connected across it. The valves (100) (101) are connected in push-pull, the H.T. supply being taken to the centre of the coil (116). The coil (116) is connected between the anodes, and the condenser (117) is used for tuning, and is adjusted by a slow moving dial fitted on the front of the panel. An inductance (118) is connected between the grids of the valves (100) (101) with a 5000 ohm grid leak (119) connected between the centre point of the coil (118) and the negative filament supply. The coils (116) and (118) are of the plug-in type. Two pairs of coils are supplied. One pair cover a frequency range of approximately 56,800 kc/s to 75,000 kc/s and are marked AA for the anode coil (116) and AG for the grid coil (118). The other pair cover a frequency range of 48,400 kc/s. to 57,700 kc/s. and are marked BA and BG for anode and grid respectively.

Aerial circuit. The aerial circuit consists of a 4 ft. rod aerial (110), condenser (111), two coils (112) (113) and ammeter (114), connected in series. The coils (112) (113) consist of one turn each, and move across each end of the coil (116) coupling the oscillatory circuit to the aerial circuit. The amount of coupling is adjusted by a handle fitted on the front of the panel of the transmitter. One end of the coil (113) is connected through a shunted thermal ammeter (114) to earth, and one end of the coil (112) through the variable condenser (111) to the aerial. The condenser (111) is used to tune the aerial circuit to any required frequency and is adjusted by a slow moving dial on the front of the panel.

Signalling. There are no separate signalling circuits. The morse key (123) is connected direct in one lead of the H.T. supply to the transmitter and main and master modulators. The set can be operated from the transmitter box position by the morse key (115) as explained under "Tuning", or remote controlled by the morse keys (164) (165) and telephones (see figure n). The switches (160) (161) connect either of the remote control telephones in parallel with the operator's, and switches (162) (163) connect the respective morse keys (164) (165) in parallel with the morse key (123). The telephone and key switches controlling each remote control position, are mechanically linked.

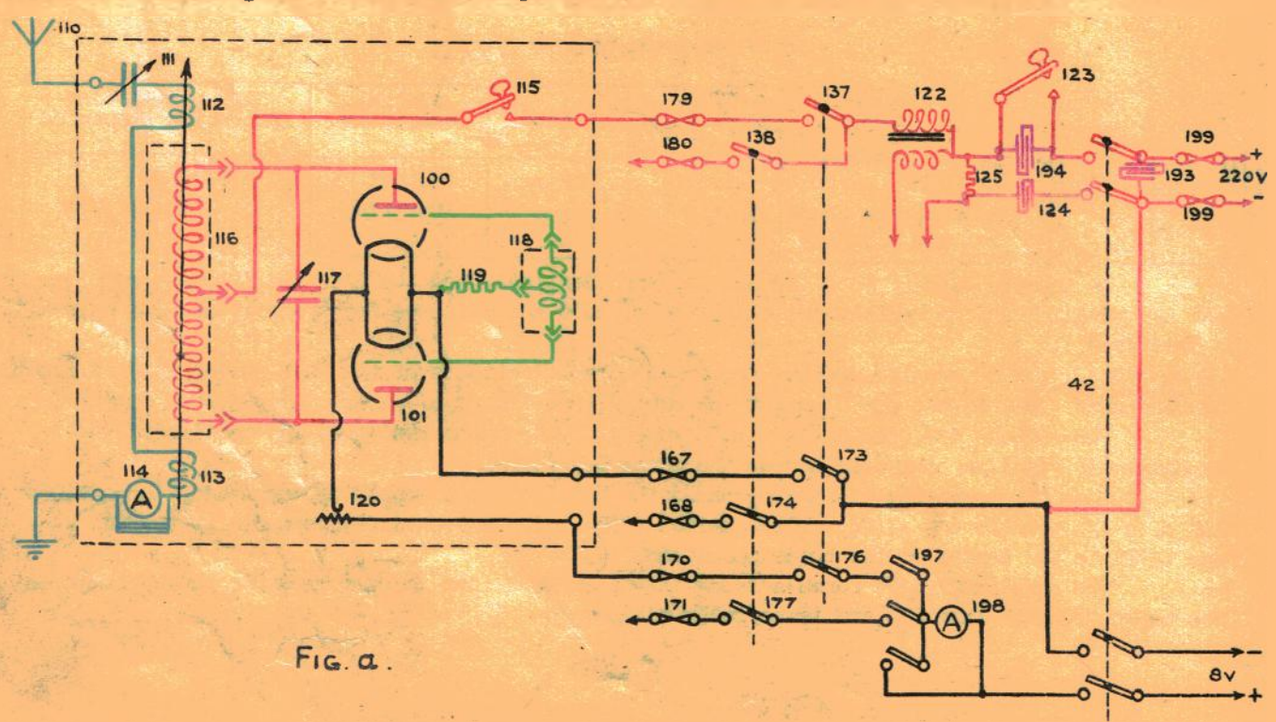


FIG. a.

TRANSMITTER 7RX. (CONTD.)

Tuning. As the tuning operation for each transmitter is the same, it will be assumed in these notes that transmitter No 1 is being tuned. Unlock the morse key (115) in th transmitter box, and connect a pair of telephones to the transformer (20) (see figure n) first removing the link. Lock the morse key (123) in the control box and make the main switch (42). Make the H T switch (137). This switch is linked to switches (173) (173) and (27), and the filament supplies to the main modulator and transmitter are therefore made at the same time. Adjust the filament current of the transmitting valves (100) (101) by the rheostat (120), a portable ammeter should be used for this. Adjust the megostat (33) (see figure n) to the "0" position, and make the switch (30), which connects the H.T. to the receiver. The switches (30) and (55) are mechanically linked, so that as the switch (30) is made for the receiver H T the switch (55) completes the receiver filament supply. Insert the pair of coils (116) (118) covering the frequency range required, close the doors and lightly couple the G2 wavemeter to the aerial (110). Press the key (115) and adjust the oscillatory circuit to the required frequency with the condenser (117) Adjust the aerial tuning condenser (111) to give a maximum current reading in the aerial ammeter (114) The aerial coupling between the coils (112) (113) and (116) should be as loose as possible consistent with good radiation. Tune the receiver for maximum signals. The condensers (111) (117), aerial coupling controls and morse key (115) should now be locked, the telephones removed and the transformer (20) again shorted by the link. To operate the set on any future occasion it is now only necessary to make the appropriate transmitter and receiver H.T. and filament supply switches, and the main switch (42) in the control box, and use the morse key (123). A buzzer (195) and key (196) are fitted in a special box underneath each transmitter-receiver box and are used for communication between the operator at the transmitter-receiver box and the operator at the control box in the Auxiliary W/T office. The telephone transformer (20) is also fitted in this box.

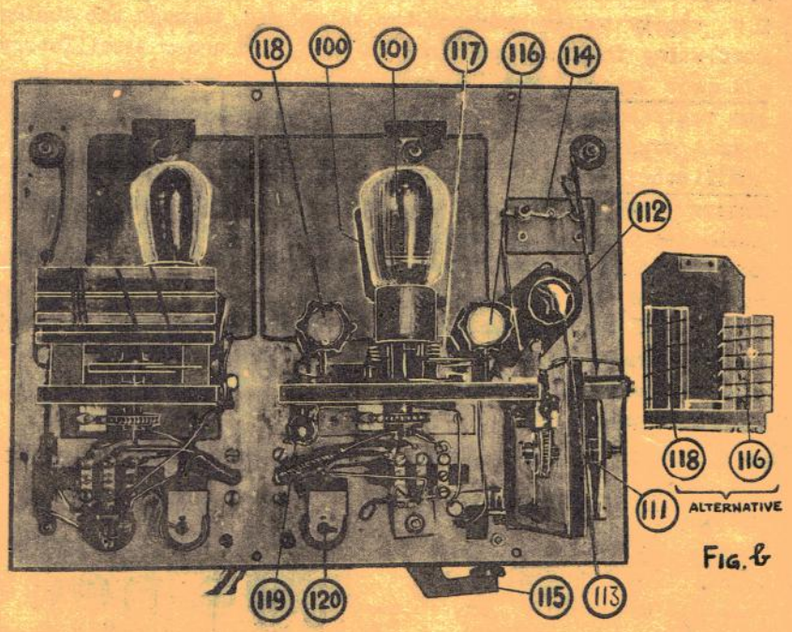


Fig. b

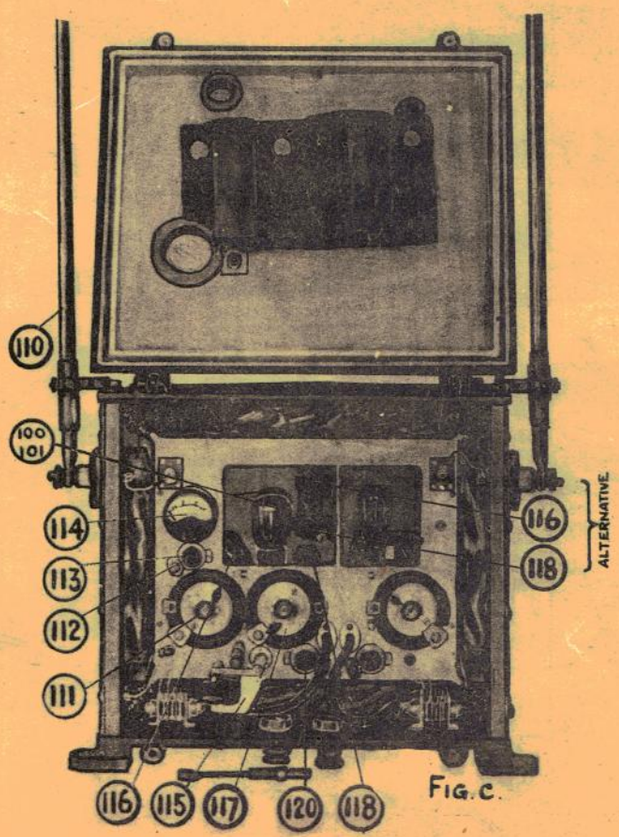


Fig. c.

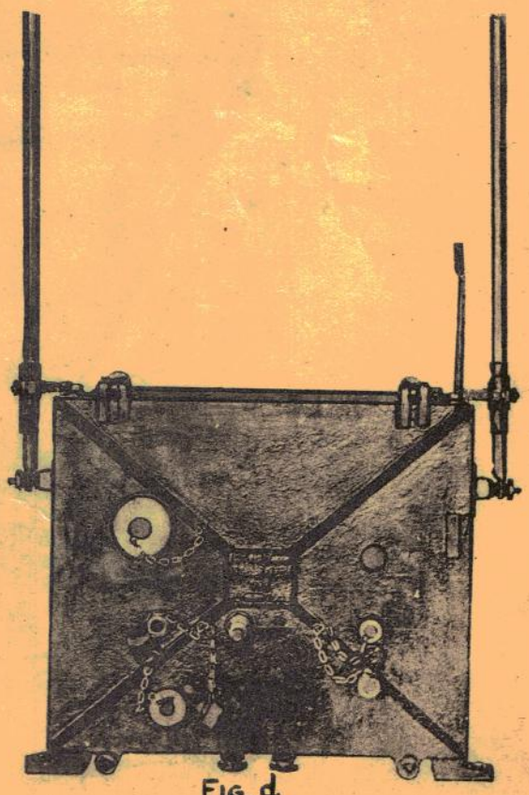


Fig. d

TYPE 75 X

MASTER MODULATOR.

Method of producing oscillation	Nature of circuit	Grid excitation	Feed	High oscillating potential electrode
Self	Tuned circuit between anode and grid.	Direct inductive	Series.	Anode.

The master modulator circuit is of the divided type (see Admiralty Handbook of W/T (1931) paragraph 829). "Choke control" modulation is employed (see Admiralty Handbook of W/T (1931) paragraphs 715 and 872).

The master modulator is fitted with two NT16 valves (108) (109), one being an alternative to the other. If the valve in use becomes defective the other can immediately be switched into the circuit by a 3 pole C.O.S. (134). This switch changes over the anode, grid and filament circuits. In these notes it will be assumed that the valve (108) is in use, and the change note switch (43) made to "subdivisional". The circuit is then as shown in figure f.

H.T. Supply. The H.T. supply is from the 220 volt contacts of the main switch (42) to one contact of the change note switch (43). A 5,000 ohm resistance (125) is connected in the positive supply to reduce the 220 volts to approximately 100 volts. The morse key (123) is connected in the supply to make and break the circuit for signalling purposes. The change note switch (43) connects the H.T. supply to the anode of the valve (108) through the tuning coils (127) or (128) depending on the modulating frequency required as described under "Oscillatory circuit."

Filament Supply. The filament supply is from the 8 volt contacts of the main switch (42). A 3.3 ohm resistance (135) is connected in the supply between the switches (42) and (134), to reduce the 8 volt supply to the 6 volts required by the NT16 valve (108).

Oscillatory circuit. The oscillatory circuit consists of the coils (127) (130), two microfarad condenser (132) and a 40 jar condenser (152) connected between the anode and grid of the valve (108). Audio frequency oscillations are generated in this circuit. The coils (127) (130) (149) are coupled, and fitted in one container as a transformer. The coil (149) which is connected between grid and filament of the main modulator valves (104) (105) (106) (107) (see figure h) is coupled to the coil (130), and has induced across it, potential variations at the frequency of the master modulator oscillatory circuit. These potential variations are therefore imposed between grid and filament of the main modulator valves (104) to (107) and cause the anode current of these valves to vary at the same frequency.

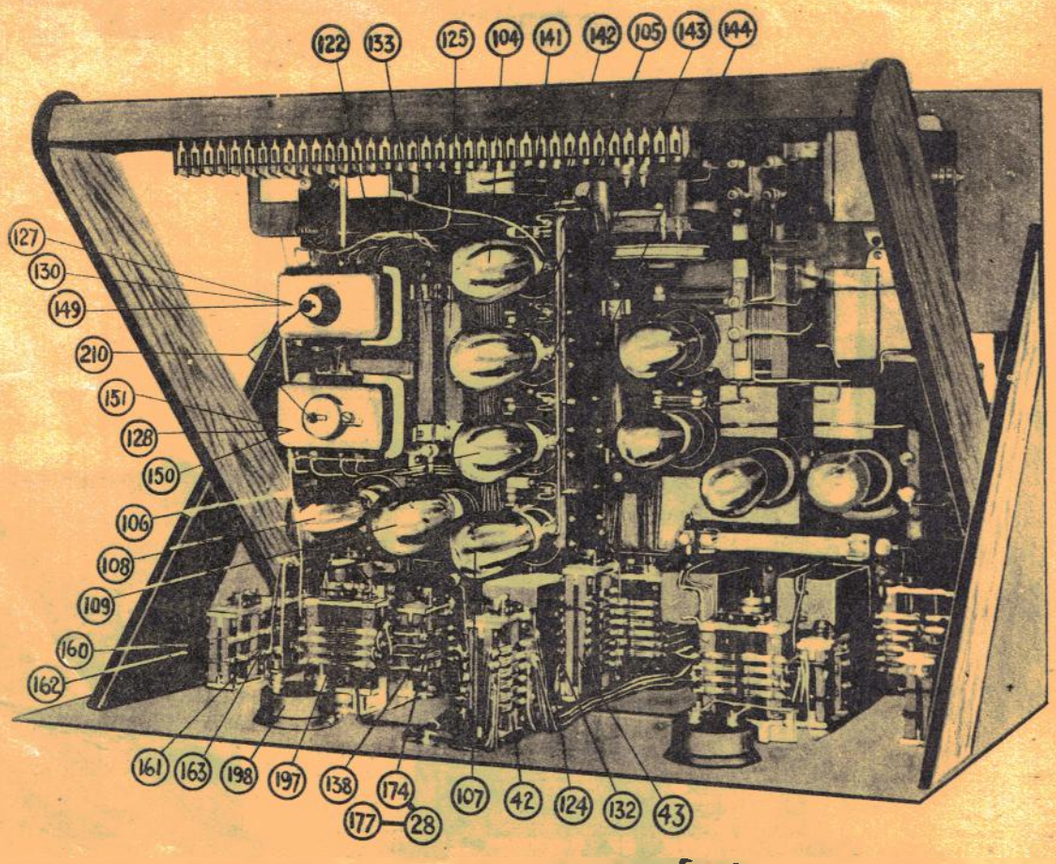


Fig e

MASTER MODULATOR (CONTD.)

As explained on page K3, two modulation frequencies (1000 and 1400 cycles) are used. The change-note switch (43) connects either the transformer (127) (130) (149) or the transformer (128) (150) (151) in the tuned circuit of the master modulator and also changes over condensers (44) (46) and (45) (47) in the grid circuit of the note selector (see figure n.)

The transformer (127) (130) (149) and the 40 jar condenser (152) tune to 1000 cycles, and the other transformer (128) (150) (151) and the same condenser to 1400 cycles.

It will be noted that as the transmitter modulating frequency is altered, so the receiving instruments are adjusted to correspond.

Tuning The iron cores of the transformers have an adjustable air gap which can be adjusted by the knurled head (210) on the tops of the transformers. They are accurately tuned and adjusted and the adjustments locked before leaving Signal School.

Tuning forks of the correct frequencies required, (1000 and 1400 cycles) are supplied, and if it is necessary to retune, the following method is employed.

Unlock the adjustments, put the change note switch (43) to the position for the transformer (127) (130) (149) or (128) (150) (151) according to the frequency required, and connect one lead only of a pair of telephones to the terminal marked "Modulator Anodes" on this transformer.

Make the main switch (42) for the H.T. and filament supplies and complete the H.T. supply by pressing the key (123). A note will now be heard in the telephones. Strike the appropriate tuning fork and hold near the telephones. Beats will be set up at a frequency corresponding to the difference between the oscillation frequency of the tuning fork and the oscillatory circuit. Adjust the knurled head (210) on the transformer until the frequency beats entirely disappear. The circuit is then in tune with the tuning fork. The adjustment should then be locked again.

EQUIVALENT CIRCUIT.

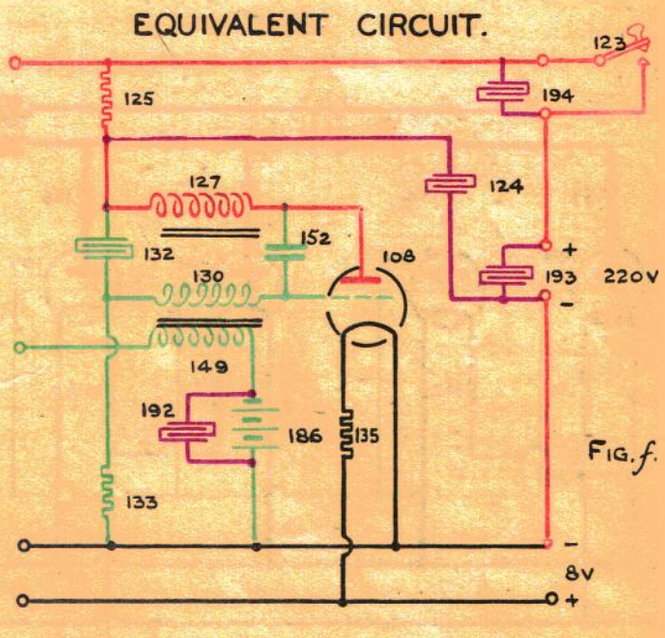


FIG. f.

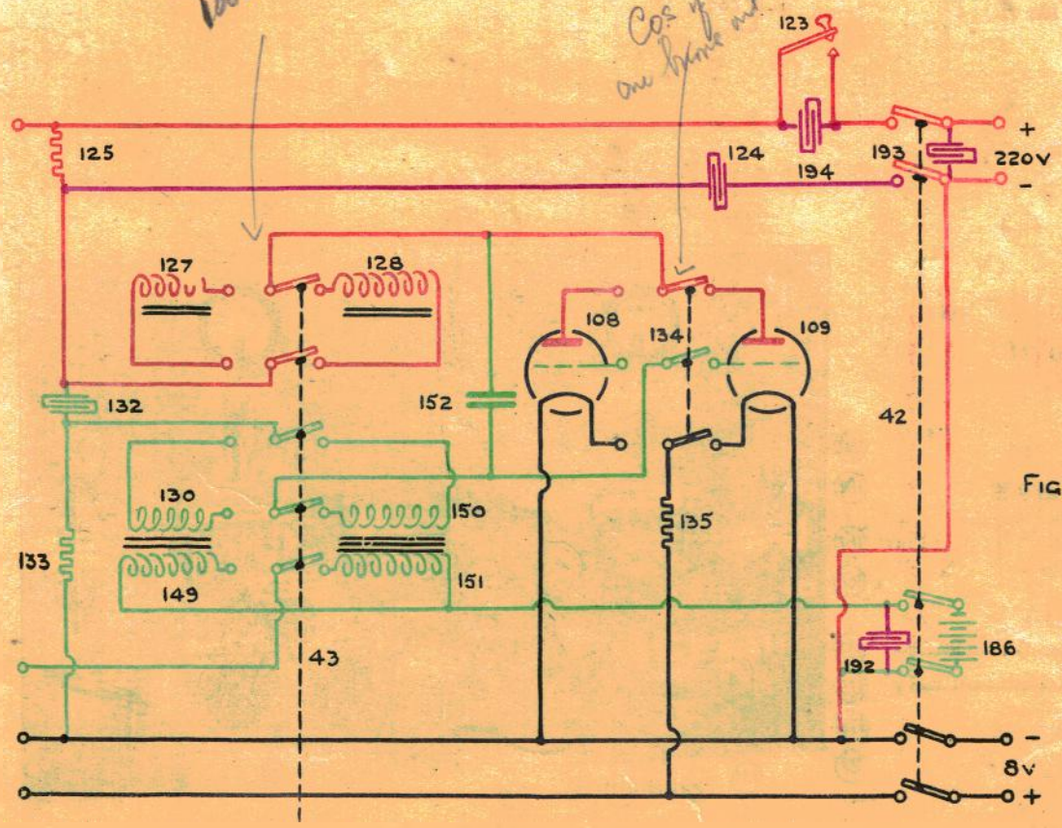


FIG. g.

MAIN MODULATOR.

The main modulator consists of two pairs of NT16 valves (104) (105) (106) (107) connected in parallel. One pair is for use with each transmitter-receiver box. A tuned coil (149) or (151) (depending on the position of the change note switch (43)) is connected between grid and filament of the valves and coupled to the tuned circuit of the master modulator. A grid bias battery (186) is included in the circuit.

H.T. Supply. The H.T. supply is taken from the 220 volt contacts of the main switch (42) through one half of the transformer (122) to the anodes of the valves (104) (105) (106) (107). A 1.5 amp fuse (153) (154) (155) (156) is connected in the H.T. supply to each valve.

Filament Supply. The filament supply is from the 8 volt contacts of the main switch (42) with 3.3 ohm resistances (141) (142) (143) (144) connected in each valve supply, to reduce the voltage to the 6 volts required for NT16 valves.

The filament supply is so arranged that either pair of valves (104) (105) or (106) (107) can be switched into use by their respective switches (27) and (28).

As mentioned before and shown in figure h, the switches (27) and (28) are linked to the H.T. and filament supply switches of the transmitters. The switch (27) to No.1 transmitter and the switch (28) to No.2 transmitter. Thus the operator is able to bring into use at once either or both the transmitters with their modulating valves.

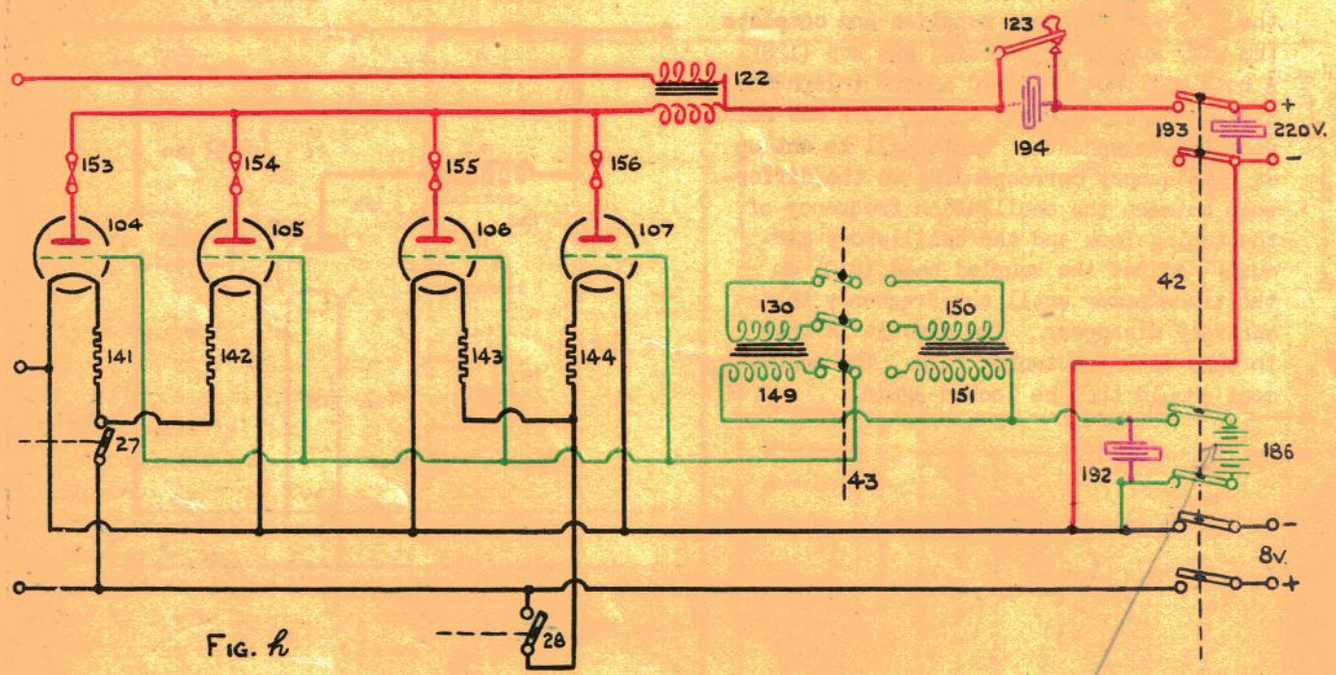


FIG. h

Grid Bias Battery

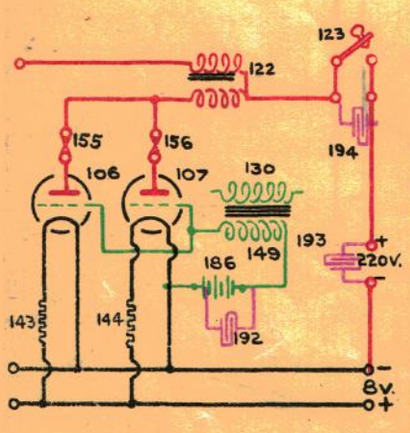


FIG. i

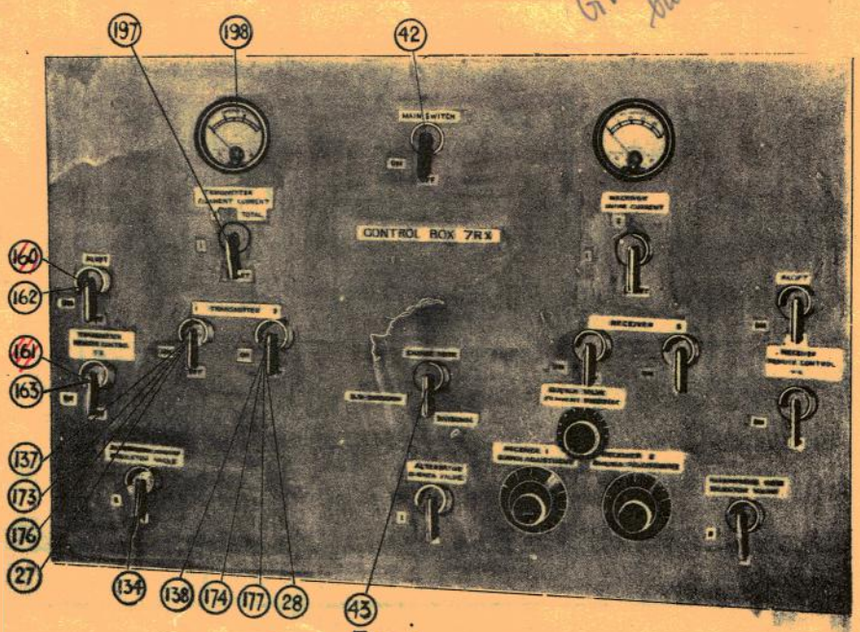


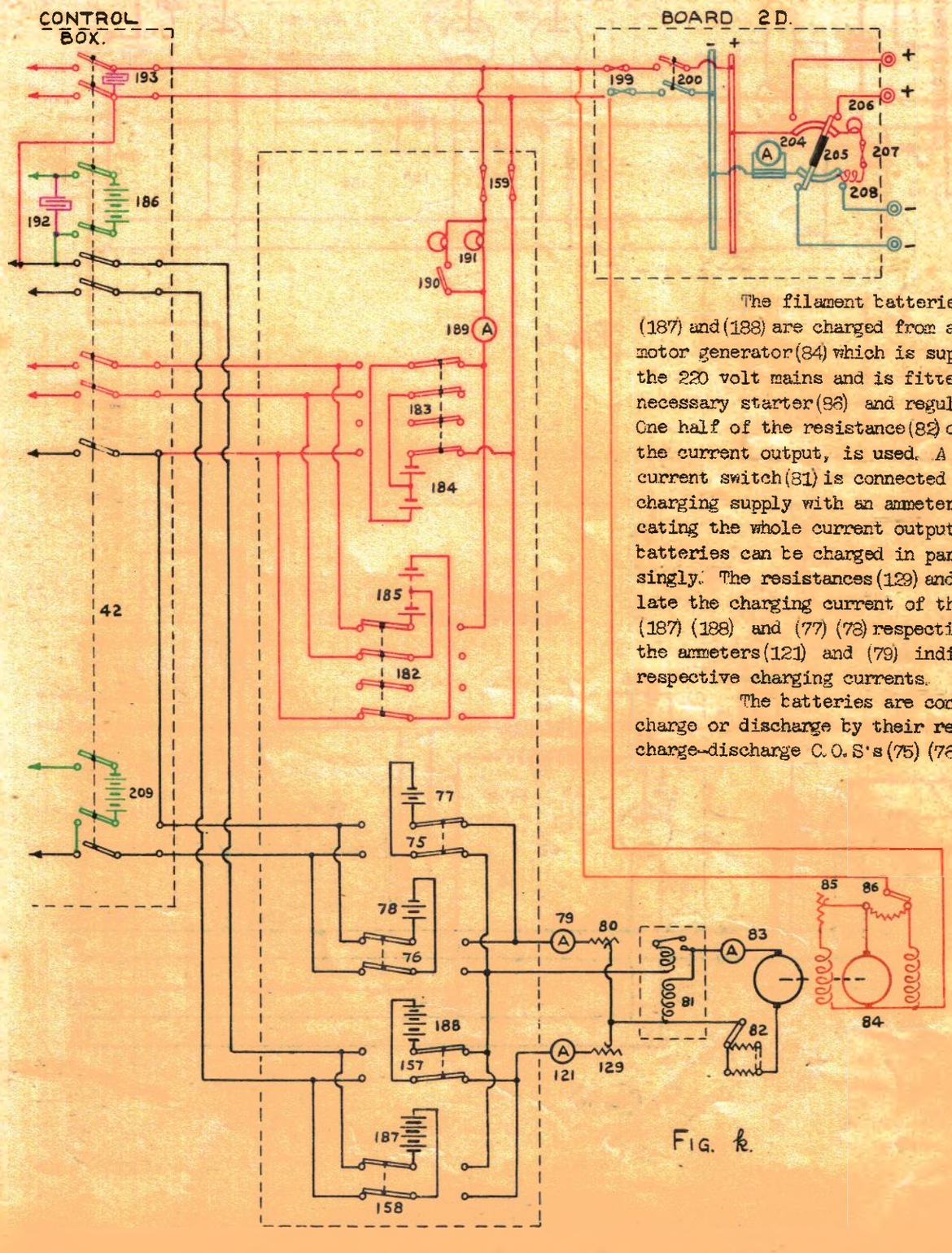
FIG. j

BATTERY AND CHARGING ARRANGEMENTS.

Duplicate 96 volt H.T. batteries (184) (185), 8 volt batteries (187) (188) and 4 volt batteries (77) (78) are supplied and housed in a special battery cupboard.

The 96 volt battery supplies the H.T. for the note selector and the 72 volts H.T. for the receiver valves. The 8 volt battery supplies all the valve filaments of the transmitting units and the receiver quench unit. The 4 volt battery supplies the valve filaments of the note selector and receiver. The grid bias batteries, (186) for the master modulator and (209) for the note selector, are inert cells and are placed in a convenient position near the control box. The 96, 8 and 4 volt batteries are connected to a special charge-discharge board and are charged as follows.

The 96 volt batteries (184) (185) are charged from the 220 volt mains, the supply being controlled by the D.P. switch (200). A pair of 3 amp fuses (159) fitted on the charge-discharge board, are connected in the supply. A 2½ c.p. resistance lamp (191) is connected in the circuit to give the necessary charging current. An additional lamp can be connected in parallel by the switch (190). The ammeter (189) indicates the charging current. The charge-discharge switches (182) (183) are four pole, two way switches, two poles only are used to connect the battery to charge and three to discharge. The batteries may be charged together or singly



The filament batteries (77) (78) (187) and (188) are charged from a 300 watt motor generator (84) which is supplied from the 220 volt mains and is fitted with the necessary starter (86) and regulator (85). One half of the resistance (82) controlling the current output, is used. A reverse current switch (81) is connected in the charging supply with an ammeter (83) indicating the whole current output. All the batteries can be charged in parallel or singly. The resistances (129) and (80) regulate the charging current of the batteries (187) (188) and (77) (78) respectively, and the ammeters (121) and (79) indicate the respective charging currents.

The batteries are connected to charge or discharge by their respective charge-discharge C.O.S's (75) (76) (157) (158).

FIG. 4.

TYPE 75 X

EQUIVALENT CIRCUITS

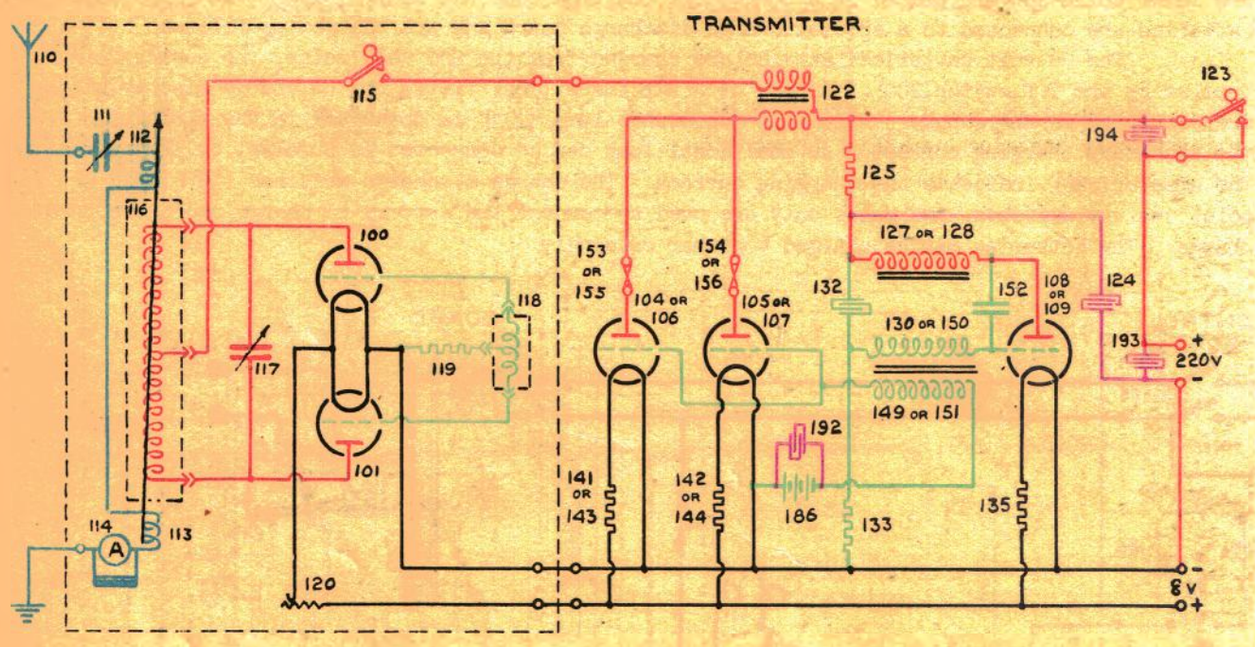


Fig. l.

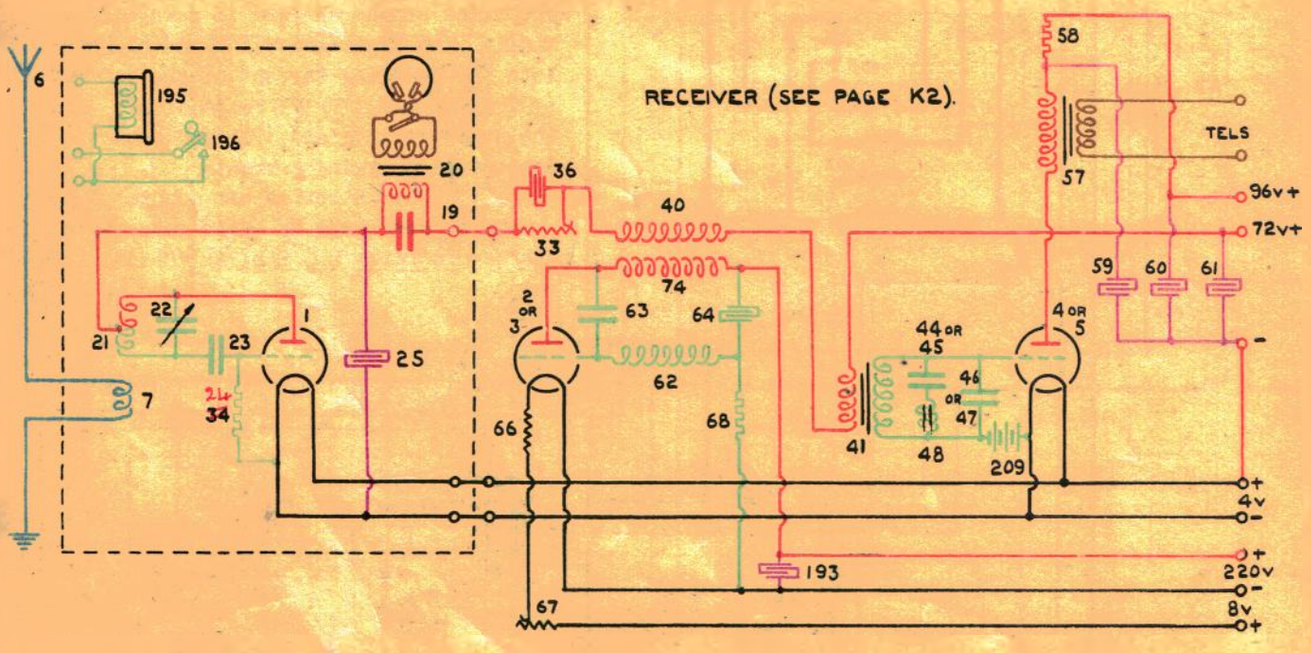
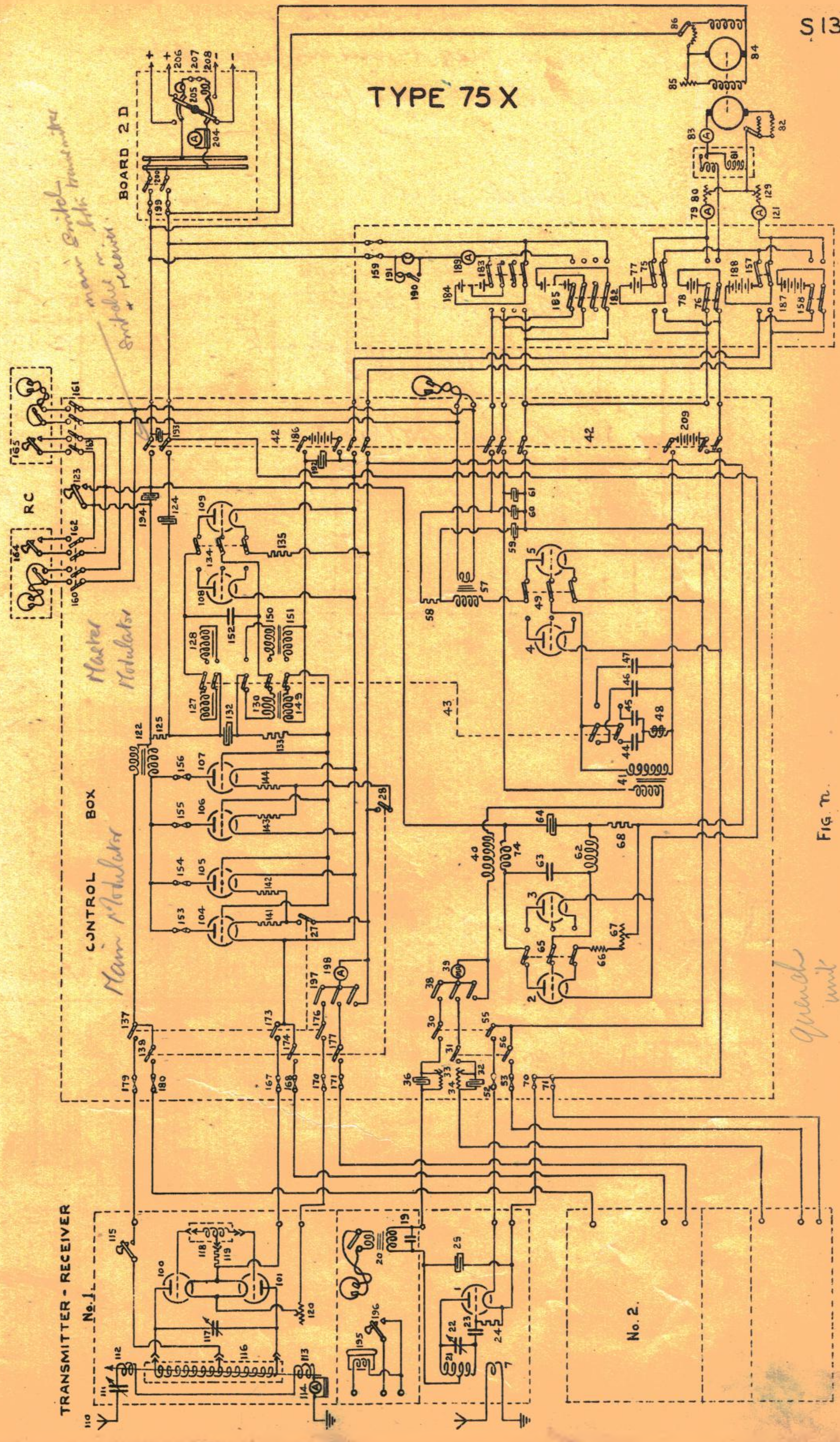


Fig. m.

TYPE 75 X


BOARD 2D
RC
CONTROL BOX
TRANSMITTER - RECEIVER
No. 1
No. 2
Master Modulator
Main Modulator
Quench unit
main switch transmitter
switched on both transmitter + receiver
FIG. n

Type 75.

Chief Difference - uses supersonic modulation so that transmitter - receiver may be used with experimental arrangement

Master modulator valves in push pull.

Main " " " " "

Transmitter on " switch 3 pole

Receiver " " "

Modulator CO2 { 3 poles for modulation
2 for appropriate Quench unit in the receiver.

Single Remote Control switch for key