10KW BROADCAST TRANSMITTER BTM-10K

TYPE 5J60090

VOL. 2 OF TWO VOLUMES

TECHNICAL DESCRIPTION AND MAINTENANCE

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Handbook 2-60090R

Amalgamated Wireless (Australasia) Limited,

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1. TECHNICAL DESCRIPTION

1.1 General

The AWA Broadcast Transmitter BTM-10K, type 5J60090 is a crystal controlled a.m. transmitter capable of an output of 10kW (carrier). The output of a crystal oscillator unit is amplified in two Class C stages before being applied to a high-efficiency Class C power output stage which is modulated by a push-pull Class AB1 modulator.

The output from the transmitter is connected to the transmission line via a directional coupler which provides for the metering of forward and reflected power, protection against aerial faults and indication of carrier failure.

The programme input is amplified by two stages of push-pull Class A amplifiers, followed by the Class AB1 modulator. Partial modulation of the r.f. driver stage is employed to improve the linearity of modulation in the power output stage.

Four rectifier circuits provide outputs as follows:

(a) main and minor h.t. supplies
(b) auxiliary h.t. supply
(c) bias voltages
(d) control supply

1.2 Circuit Reference Numbers

Numerical prefixes to the normal circuit reference numbers of components are used in the simplified circuit diagram and in the technical description. These prefixes indicate the unit in which a particular component is located and will further assist in the identification and physical location of components. A numerical prefix is not allocated to external components.

The allocation of the numerical prefixes to the various units in the transmitter is shown in the following table.

Prefix	Unit (or Cabinet)	Type
1	R.F. Drive and Modulator	5J60092
2	Control Panel	6P60095
3	R.F. Unit and H.T. Rectifier	4J60093
4	Crystal Oscillator	1J60099
5	Modulation Monitor Accessory Item	6A51921
6	Contactor Panel	3P60096
7	Mains Low Alarm Unit Accessory Item	1F56745
10	Directional Coupler	1F60098

1.3 Radio Frequency Circuits (Drg. 60090H8)

1.3.1 Crystal Oscillator

The crystal oscillator unit comprises a crystal oscillator and an aperiodic amplifier.

The oscillator is a modified Pierce circuit in which the crystal is connected between the screen and grid of 4V1. Two crystals are used, crystal selection being made by the crystal selector switch which operates relay 4XTL, the contacts of which switch both sides of the crystals. Trimmer capacitors 4C1 and 4C2 provide fine adjustment of the frequency of the crystal oscillator over a range of approximately 30 Hz.

Output from the oscillator valve is capacitively coupled to the aperiodic amplifier 4V2 which drives the second r.f. amplifier stage RFA2 (1V7).

High tension for the crystal oscillator unit is derived from the 600V auxiliary h.t. supply. Cathode currents in 4V1 and 4V2 are metered by 1M12 and 1M13 respectively, the meters being mounted on the dividing panel in the modulator cabinet.

The crystals are contained in individual thermostatically controlled ovens which are assembled as sealed plug-in units. The oven heaters are supplied from the ancillary mains circuit allowing the ovens to be maintained at operating temperature when the transmitter is shut down.

1.3.2 R.F. Amplifiers

The output from the aperiodic amplifier in the crystal oscillator unit is capacitively coupled to the second r.f. amplifier stage RFA2 in which a pentode is used. The valve is biased to Class C by a combination of cathode and self-bias and is shunt-fed via 1L5, h.t. being derived from the 600V auxiliary h.t. supply. The output is tuned by a parallel circuit 1C55, 1C56/1L6, the input to the succeeding stage being tapped down 1L6. Metering is provided by 1M9 (RFA2 GRID) and 1M10 (RFA2 [illegible].) both of which are located on the control panel of the modulator cabinet.

A tetrode (1V8) is used in the third r.f. amplifier stage RFA3. A combination of cathode and self-bias is used to bias the valve to Class C, grid drive being obtained from a tapping on 1L6. The anode is shunt-fed via 1L7 and is coupled to the power amplifier stage by a π-circuit which is tuned by adjustment of the tappings on 1L9, 1L14 and by selection of fixed capacitors 1C69, 1C70 and 3C79 through 3C86. Fine tuning is achieved by the adjustment of the core of 1L9 which is extended to a control on the front of the modulator cabinet. Metering is provided by 1M11 (RFA3 GRID) and 1M14 (RFA3 SCREEN) which are located on the control panel of the modulator cabinet.

The RFA3 stage is partially modulated, the anode voltage being obtained from the 6kV h.t. supply via the modulation choke 1L2 and resistor 1R125. The screen voltage is obtained from the 600V supply via a section of the TUNE-WORK switch (see para. 1.7.3).

1.3.3 Power Output Stage

The power output stage employs two parallel-connected 5762 triodes in a high efficiency Class C circuit which is self-biased. The anodes are shunt-fed via 3L4 and the output circuit consists of a double π-network the output from which is connected to the transmission line via a directional coupler, the nominal output impedance being 200Ω.

The output stage is tuned by the selection of fixed capacitors and tapped inductors with the addition of the fine tuning capacitor 3C24 which is coupled to a drive extended to the front of the rectifier cabinet.

The h.t. supply of 6kV is connected via the modulation choke 1L1 to provide anode modulation of the stage.

Neutralisation is achieved by 3C16 in association with the wide-band neutralising transformer 3TR7 which is coupled in the correct sense in the common grid circuit of the valves. Parasitic suppression is provided by an inductor shunted by a damping resistor in each grid lead and in the common grid return.

The stage is metered by 3M1 (grid), 3M2 (anode), 3M3 (3V8 cathode) and 3M4 (3V9 cathode). The cathode meters are located inside the upper front compartment of the rectifier cabinet while the grid and anode meters are mounted on the front meter panel on the same cabinet.

A portion of the output is coupled by 3C30 to transformers 3TR12 and 3TR13, the secondary windings of which provide outputs for the internal modulation monitor and external monitoring equipment, respectively.

High effieciency operation of the power amplifier is obtained by using the third harmonic to produce an almost flat-topped wave and thus to improve the Class C operation.

Resonant circuits tuned to the third harmonic are inserted in the cathode (filament leads) and common anode circuits of the p.a. valves.

Consider the operating conditions of the stage with the resonators shorted out. The p.a. valves operate in the conventional Class C manner at approximately 75% efficiency, the waveforms corresponding to Fig. 1 in Drg. 60090[illegible]5. The maximum instantaneous efficiency Ep/Eb is restricted to a short portion (T1) of valve conduction.

When the anode resonator (3C54 -3C67/3L2) is tuned to the third harmonic, the third harmonic voltage component adds twice to and subtracts once from the waveform producing the flat-topped wave shown in Fig. 2. The maximum instantaneous efficiency extends over the T2portion of valve conduction improving the average efficiency by 7 to 8%. Since the anode voltage remains constant, improvement in the efficiency is accompanied by an increase in power output, i.e. increase of r.f. current.

When the cathode resonators (3C55/3C59/3C63/3L13, etc.) are tuned to the third harmonic, the mechanism of operation is similar to that described above, except that the primary object is to produce flat-topped grid drive. As the result of the broader and flat-topped grid drive, the anode waveform tends to be almost rectangular. The maximum instantaneous efficiency extends over the T3 portion of valve conduction time (Fig 3) and the peak efficiency equals the average efficiency. That is,

$$\frac{Ec}{Eb} = \frac{Eb - Eg}{Eb}$$

Adjustment of the cathode resonators is accompanied by an increase of the efficiency, of the power output and the power input. The average anode efficiency should be approximately 90%.

With normal anode circuit losses the resultant overall p.a. efficiency is of the order of 85%.

1.3.4 Directional Coupler

The output from the transmitter is fed from the harmonic filter to the transmission line via a directional coupler. This consists of a short wire carrying the r.f. output current, to which coupling is made in a manner which makes possible the determination of the direction of power in the transmission line.

Capacitive coupling is made by means of two metal segments arranged concentrically around the conductor, and inductive coupling by two coils wound on a square ferrite core surrounding the segments. The capacitive pick-up is dependent on the voltage in the line, whilst the induced voltage in the coils is proportional to the current. The added voltage from one segment and one coil is applied across rectifiers 10MR1, 10MR2 and the added voltages from the other coupling elements are applied to rectifiers 10MR3, 10MR4.

The capacitive pick-up is varied by adjustment of 10C3 and 10C4 to equalise the capacitive and inductive voltages when no standing wave is present on the line. The coils are wound in such a manner that when this condition obtains, the two induced voltages are in phase across 10MR1, 10MR2 and in anti-phase across 10MR3, 10MR4 hence producing zero output from the latter rectifier.

In the event of an aerial or transmission line fault, or if correct matching has not been achieved, i.e. a standing wave is present on the transmission line, the relative phases of voltage and current in the line will alter. As a result, the voltage across 10MR1, 10MR2 will fall and voltage appear across 10MR3, 10MR4.

The outputs of the rectifiers are connected to 2M5 (REFLECTED POWER) via the meter relay 2M8 (AERIAL FAULT) and to 2M6 (FORWARD POWER) via meter relay 2M7 (CARRIER FAIL), the power meters providing a continuous measurement of forward and reflected power. Any deterioration of s.w.r. beyond pre-determined limits will cause the meter overload circuits to operate. Similarly carrier failure will trip the other meter initiating the transmitter overload circuits.

1.4 Audio Frequency Circuits (Drg. 60090G3)

1.4.1 A.F. Amplifiers

The programme input from the station audio equipment is connected via a low-pass filter to the input transformer (1TR1), the secondary of which comprises two balanced windings to provide inputs to the first stage AFA1. This stage employs two tetrodes (1V1, 1V2) arranged in push-pull and biased to Class A by a common cathode resistor 1RV6. High tension for the anodes of 1V1 and 1V2 is derived from the 600V auxiliary supply with the screens being supplied from a voltage divider across the same supply. Metering is provided by 1M5 (1V1 CATH) and 1M6 (1V2 CATH) which are located on a sloping panel in the modulator cabinet.

The output of AFA1 is R-C coupled to the sub-modulator stage (AFA2) in which two tetrodes (1V3, 1V4) operate under push-pull Class A conditions. Cathode bias is used, the bias for each valve being independently adjusted by 1RV11 and 1RV12. High tension is obtained from the 3kV minor h.t. supply. The screens are fed from a voltage divider across the 600V supply via a section of the TUNE-WORK switch (1SWJ/2).

Separate metering for each valve is provided by 1M7 (1V3 CATH) and 1M8 (1V4 CATH) which are located on the same panel as 1M5 and 1M6. The valves are balanced by adjustment of the preset cathode resistors 1RV11 and 1RV12.

1.4.2 Modulator

The modulator consists of two 3X3000F1 triodes operating under Class AB1 conditions. Bias voltage is obtained from the transmitter bias supply and the bias of each valve is adjustable to allow balance of the stage to be achieved.

High tension is supplied from the 6kV main h.t. supply via the limiting resistor 1R21 to the centre tap of the modulation transformer 1TR2. The secondary winding of the transformer is connected via the isolating capacitors 1C31 and 1C91 to the anode of the r.f. power output stage which is connected to the 6kV main h.t. supply via the choke 1L1.

A cathode resistor is included in the modulator to prevent the surges which occur during the initial application of h.t. from overloading the modulator. Contact 1CSL1 of the slow-operating contactor 1CS1 short-circuits this resistor after a delay of approximately 2 seconds.

The cathode current of each of the valves in the modulator is measured by the cathode current meters 1M3 and 1M4.

A network connected across the primary of the modulation transformer provides negative feedback to the grid circuit of the first a.f. stage. Partial modulation of the r.f. driver stage is accomplished by a tapping on the modulation transformer.

1.5 Filament Supplies (Drg.60090A5)

The a.c. input to all filament transformers (except 1TR11) is regulated by a saturable reactor voltage stabiliser, (Accessory Item) the description of which can be found in the maker's handbook supplied with the unit.

As the input to the filament transformers is stabilised, tappings are not necessary on the primary windings. However +5% and -5% tappings are provided on the transformers which supply the modulator and power amplifier valves, i.e. 1TR4, 1TR5, 3TR8 and 3TR9. Transformer 1TR11 is connected to the 240V a.c. mains and tappings are provided. These tappings should be set to suit the mains voltage at the installation.

The filament hours meter (2M1) is incorporated in the filament supply to record the number of hours the filaments have been operating and hence gives a record of valve life. The stabilised filament supply is measured by 2M2.

1.6 Rectifiers (Drg. 60090A5)

1.6.1 Main and Minor H.T. Rectifiers

The main h.t. rectifier is a three-phase full-wave circuit employing six banks of silicon rectifiers. The input to the rectifiers is supplied by secondary of the main h.t. transformer, the primary of which is connected to the mains supply via the h.t. switching contactor and the MAIN H.T. circuit breaker.

Series dropping resistors are connected in each phase of the main h.t. transformer input and are shorted out by operation of contactor PHL. This arrangement provides for a reduced h.t. voltage when tuning, control of the contactor being invested in the TUNE-NORMAL switch.

The primary winding of the main h.t. transformer is delta-connected via a subsidiary mains tapping auto-transformer and the secondary winding is star-connected, allowing the neutral to be used as a tapping on the output. The full h.t. output is 6kV and is filtered by 3L1/3C2 whilst the minor h.t. of 3kV is obtained from the neutral connection and is filtered by 3L7/3C26.

1.6.2 Auxiliary H.T. Rectifier

The auxiliary h.t. rectifier provides screen and anode voltages to the remainder of the valves in the transmitter and comprises a full-wave bridge rectifier (3MR11 through 3MR22) and a capacitor input filter, the output of which is 600 volts. Single phase mains input to the auxiliary h.t. rectifier (3TR11) is controlled by the AUX. H.T. circuit breaker (2CBE) and contactor 1PBA.

The various voltages are obtained by variable voltage dividers which provide adjustment of audio screen, RFA2 screen and oscillator h.t. potentials.

1.6.3 Bias Rectifier

The bias rectifier provides bias voltages to the modulator. Single phase mains supply is connected to the power transformer after tho BIAS circuit breaker has been closed and contactor 1PBA has operated.

The circuit is a full-wave bridge rectifier comprising 1MR1 through 1MR20 and the associated filter 1L3, 1C41 and 1C42. Provision is made for metering by the inclusion of 1M2 on the front of the cabinet. Modulator bias is adjusted by the preset potentiometers 1RV3 and 1RV4.

A bias failure relay 1BNV is connected to the bias divider network, the contact of which is in series with the h.t. control interlock circuit.

1.6.4 Control Supplies

The control voltages are supplied by a separate transformer and associated rectifier, outputs of +150V, -50V, 110V a.c. and 6.3V a.c. being required to operate the various control circuits, relays and indicators.

The 150V output supplies a stabilised +75V supply for the timing and overload cycling thyratrons.

Contactors and relays are operated from the 110V a.c. and -50V supplies, respectively, with the 6.3V a.c. output being used for the pilot lamps.

1.7 Power Control and Relay Circuits (Drg. 60090H7)

1.7.1 L.T. Switching

The mains input is connected to the main h.t. circuits when the MAIN H.T. circuit breaker (2CBA) is closed, all other circuits of the transmitter being supplied via the DISTRIBUTION circuit breaker (2CBB).

The ON/OFF push buttons control the operation of a latching contactor (6PLA), the contacts of which are in series with the phases of the supply mains. During normal operation of the transmitter, all circuit breakers will be in the ON position with control of the transmitter invested in the ON/OFF push buttons.

Remote ON/OFF push buttons can be wired in parallel with local control buttons changeover being effected by the LOCAL/REMOTE switch (2SWE/1).

The EMERGENCY OFF push button contacts (2SWB1,2SWB2) are in series with the trip coils of the MAIN H.T. and DISTRIBUTION circuit breakers and will cause both circuit breakers to trip when the button is pressed. A REMOTE EMERGENCY OFF button can also be connected.

Closure of the ON/OFF contactor starts up the air blowers and connects the mains supply from the DISTRIBUTION circuit breaker to the CONTROL and BIAS circuit breakers.

Operation of the CONTROL circuit breaker (2CBC) connects the mains to the control supply transformer. The 110V a.c. control voltage becomes available and contactor 6PLB will operate provided the airflow switches (1SWG,3SWE) have closed. The contacts of 6PLB complete the input circuits to the filament voltage stabiliser, (if supplied) to the control thyratron filament transformer (1TR11) and to the BIAS circuit breaker. An additional contact (6PLB1) prepares the circuit of relay [illegible] in the timing circuit.

Providing all gate switches are closed, contactor 1PBA will now operate and complete further interlocks in the bias and auxiliary h.t. supplies. The L/T [illegible] pilot will also be illuminated. If the AUX. H.T. and BIAS circuit breakers are closed these supplies will become available and relay 1BNV will operate closing contact 1BNV2 in the h.t. switching interlock.

The timing and cycling circuit will function as described in para. 1.7.4 and if the H.T. toggle switch (2SWN) is set to ON, the main h.t. will come on after a delay of approximately 60 seconds, the delay being controlled by the STARTING DELAY potentiometer (1RV13).

1.7.2 Gate Switches and Fault Locator

When the gate switches are closed, the 110V a.c. supply is connected to contactor 1PBA which functions as described above. However, if a gate switch is open, the circuit to 1PBA will be opened preventing the contactor from operating and hence preventing any further sequential switching of the power control circuits. (Alternatively, if a gate switch is opened while the main h.t. is on the h.t. will be removed via contactors PHA and PHB).

While the gate switch is open, the 110V a.c. control supply is connected via the back contact of the open switch to contactor 1PSS1, the contacts of which break the 110V a.c. line ahead of and after contactor 1PBA and also lock contactor 1PSS1 in the operated condition. After the gate switch is closed it is necessary to press the INDICATORS CLEAR button to permit further operation of the switching contactors. Momentary depression of the button completes the supply to contactor 1PCL, contact 1PCL1 of which breaks the holding circuit to contact 1PSS causing it to release thus restoring the supply to contactor 1PBA and to the main h.t. switching contactors 6PHB and 6PHA.

NOTE: Further contacts on 1PCL interrupt the supplies to the cycling overload relay holding circuits and to the arc-back indicators, enabling the use of the INDICATORS CLEAR button to clear lockouts due to cycling overloads and for resetting the indicator lamps following an arc-back.

When the gate switches are closed, the 110V a.c. supply is also connected via the FAULT LOCATOR switch (2SWH) to the FAULT LOCATOR pilot (2LP8). This switch has eight positions, one for each gate switch in the transmitter. When the position corresponding to a particular gate switch is selected, the lamp will light indicating an operated gate switch. This fault locator provides a rapid means of identifying an open door or an incorrectly fitted cover. Further instructions in using the fault locator are given in Volume 1 Sub-Section 5.2.

Auxiliary contacts on the gate switches in the top sections of the cabinets earth the h.t. lines when the doors are not closed

NOTE: The top sliding doors must be opened before the bottom access covers can be removed thus complete personnel protection is afforded by the h.t. grounding switches.

1.7.3 Tune-Work Switch

The TUNE-WORK switch (1SWJ) connects the supply phase for the auxiliary h.t. rectifier from the live side of the main h.t. switching contactor 6PHA, so that the lower level stages of the transmitter can be tuned without the main h.t. being applied.

In the NORMAL position of the switch, the supply for the auxiliary h.t. rectifier is connected only after operation of contactor 6PHA. Additional sections of this switch are arranged to remove the screen voltages from the sub-modulator and r.f. driver stages in the TUNE position in order to prevent these stages drawing excessive screen currents in the absence of anode voltage.

1.7.4 Starting Delay Circuit

The starting delay circuit provides a delay of 60 seconds to permit the power valve filaments to heat up before the application of voltage to the anodes.

Immediately the air flow switches have caused contactor 6PLB to operate, mains voltage is applied to the control supply and to the filament transformer for the thyratrons 1V10, 1V11. The operation of the thyrations is as follows.

The +75V regulated supply is connected to the anode of 1V10 via 1TDC3 and relay coil 1TDA. The grid is connected to the junction of 1R45, 1R46 forming a divider across the regulated +75V and the -50V supplies and will therefore quickly attain a slightly positive potential. After the filament has heated (approximately 10 seconds after operation of 6PLB) valve 1V10 will conduct causing relay 1TDA to operate.

Contact 1TDA3 connects the grid of 1V10 directly to -50V preparing it for future use as part of the overload cyling function while contact 1TDA1 connects the ±75V line to the top of the chain 1R49, 1RV13, 1RV8, 1R48 thereby causing 1C38 (already changed to -50V via 1R51) gradually to approach a positive potential. The time constant of the circuit is adjusted by 1RV13 (STARTING DELAY) so that 60 seconds after PLB closes, the grid voltage on 1V11 will reach trigger potential causing the valve to strike and therefore to operate 1TDB. Contact 1TDB2 causes 1TDC to operate and lock on via 1TDC2. Contact 1TDC5 breaks the anode supply to 1V11 causing 1TDB to drop out. The closing of 1TDC1 prepares the h.t. interlock for h.t. switching.

1.7.5 H.T. Switching

Closure of the H.T. switch ([illegible]) or the REMOTE H.T. switch will cause relay 1HTA to operate. Provided the interlock chain is complete, contact 1HTA4 will complete the circuit to 6PHA which will operate and connect the 3-phase supply to the main h.t. transformer via resistors 6R1 through 6R6. An auxiliary contact 6PHA4 opens the circuit to relay 1HTB which is slow to release.

The resistors in series with the three phases to the main h.t. transformer give very poor h.t. regulation allowing the final stage of the transmitter to operate on reduced h.t. When the TUNE-NORMAL switch (2SWM) is set to NORMAL, contactor 6PHB will operate via 1HTB. Contacts 6PHB1 through 6PHB3 short out the resistors and full h.t. is applied to the transmitter. Contact 6PHB4 applies 6.3V a.c. to the thermal delay 1THA4.

<u>NOTE</u>: If the transmitter is under remote control, contactor 6PHB will operate immediately after the slow-to-release relay HTB has dropped out.

The thermal delay contact 1THA will remain closed for approximately 15 seconds after a mains failure thus allowing 1TDC to operate (after the brief time taken for 1TDA to operate), should the mains be restored within approximately 10 seconds.

1.8 Overload and Recycling Circuits

Two overload systems are employed in the transmitter. Overloads in the power amplifier, modulator or any aerial fault initiate a cycling sequence whereby main h.t. is removed and reapplied several times before finally locking out the main h.t. supply, whereas overloads in the sub-modulator, auxiliary h.t. and the r.f. driver stage result in immediate lockout of the main h.t. supply.

The modulator overload circuit is typical of the former group and its operation is as follows:

If an overload occurs in the modulator, relay 1MOA will operate and lock in via "x" contact 1MOA2 which also causes relay 1MAX to operate. Contact 1MOA1 causes relay 1TOL to operate and lock in via 1TOL2 which also opens an earth return from 1MOA1. Contact 1TOL3 opens the h.t. interlock releasing 6PHA thus removing main h.t. from the transmitter.

Simultaneously with the operations detailed above, relay 1MAX locks on via 1MAX3 while 1MAX2 illuminates the AFA3 pilot lamp. Should 1TOL operate before 1MAX (both are operated by 1MOA) positive operation of 1MAX is ensured by the alternative earth return 1LFX1, 1MAX1 and 1FAX1.

When 1TOL operates, contact 1TOL1 will apply +75V to the anode circuit of 1V10 and to the top of the voltage divider 1R15/1R16, the bottom of which is connected to -50V. Capacitor 1C37 will become less negatively charged and after approximately 1 second the grid of 1V10 will reach trigger potential. The thyratron will strike causing relay 1TDA to operate. Contact 1TDA2 opens the holding circuit to 1TOL which releases allowing 1TOL3 to restore the h.t. interlock and reapply h.t. to the transmitter. Contact 1TOL1 removes the +75V supply from the anode circuit of 1V10 causing 1TDA to release thus resetting the circuit.

Should the overload persist, relay 1TOL will operate each time h.t. is reapplied. During the closure of 1TOL (and 1TDA) capacitor 1C38 in the grid circuit of 1V11 will be progressively charged at a rate dependant upon the setting of the OVERLOAD CYCLE control (1RV8) until trigger potential for 1V11 is reached. The valve will strike energising relay 1TDB contact 1TDB3 which will break the h.t. switching interlock. Contact 1TDB4 will complete the circuit to the LOCKOUT pilot. The OVERLOAD CYCLE control is usually set to cause 1V11 to strike after three cycles of the overload circuit.

The h.t. is restored by first setting the H.T. switch to OFF, thus releasing 1HTA contact 1HTA2 of which opens the -75V supply to 1V11. Operation of the H.T. switch will now apply h.t. to the transmitter in the normal manner.

The overload pilots are cleared by momentary depression of the INDICATORS CLEAR button which operates 1PCL to break the indicator relay holding circuit.

Overloads in the power amplifier cause 1FOA to operate and to initiate the overload cycling as described above. In the case of a line fault, the LINE FAULT meter relay is tripped which in turn operates relay 1LFA to produce the same overload cycling. The meter relay is reset when the indicator relay 1LFA operates.

NOTE: To ensure visual indication of operation of the overload circuits described above, it is essential for the indicators to be cleared as soon as possible thus restoring the earth return circuit through the series connected contacts of the indicator relays.

Overloads in the sub-modulator, auxiliary h.t. and r.f. driver stage are handled by relays 1DOA, 1AHO and 1DOR, respectively. Operating of these relays opens the h.t. interlock and holding contacts cause the relays to remain operated. Further contacts illuminate the associated fault indicator pilots. It is necessary to operate the H.T. switch to release the relays.

1.9 <u>Carrier Failure Indication</u>

In the event of carrier failure, the CARRIER FAIL meter relay will trip causing the earth return of relay 1CFA to be completed via contact 1HTB2. Relay 1CFA is arranged for automatic on-off cycling operation causing the alarm bell to ring intermittently via 1CFA3 and the CARRIER pilot to blink via 1CFA2. The meter relay is reset when the main h.t. switching contactor 6PHA releases.

1.10 <u>Ancillary Mains Distribution</u> (Drg. 60090[illegible])

The ancillary mains circuit supplies power to the cabinet lights and power outlets, the crystal oven heaters and the rectifier compartment heater when the ANCILLARY MAINS circuit breaker is set to ON. The cabinet lights will not light, however, until the CAB. LIGHTS switch (2SW[illegible]) is set to ON.

The oven heater elements are supplied from the secondary of transformer 1TR10, the output from this winding being 12 volts.

Cabinet heaters 1R126-9 3R19-22 are provided to maintain the cabinet temperature slightly above ambient temperature to prevent condensation within the transmitter during any extended or overnight shut-down period. The heaters are controlled by CAB. HEATERS switch (2SWC) and a contact set 6PLA4, which automatically removes power from the cabinet heaters when the transmitter is started up.

1.11 Aerial Changeover Switch

In case an artificial aerial and matching network (accessory items) are supplied, an aerial changeover switch is fitted. This switch connects the transmitter output either to the line or to the artificial aerial.

Neither the aerial changeover switch nor the artificial aerial matching network are fitted to transmitters operated in parallel.

1.12 Subsidiary Air Flow Switch

Provision has been made in the control circuits for the installation of an external exhaust blower should this be necessary due to complicated or long exhaust duct arrangements. The additional motor starter is wired in parallel with 1MSA and an air flow switch should be connected in circuit to replace the interwiring link between 1A3 and 3B7.

- End of Part -