TELECOMMUNICATIONS WING - WIRELESS SECTION.

LECTURE PRECIS: W/15.

SUBJECT: A.W.A. Transmitter Teleradio 3BZ, Type J50062.

ASSOCIATED DIAGRAMS: W/15A.

GENERAL DESCRIPTION.

Application. This transmitter is a low power, portable unit, which, in conjunction with A.W.A. receiver of type C6770 series, provides a two way communication installation.

Facilities. The transmitter provides for both RT and CW transmissions and also for a stand-by condition to permit transmission and reception from the one aerial.

Frequency Range. The transmitter is crystal controlled with a frequency coverage of 2.5 to 10 Mc/s. Provision is made for the use of up to six crystals having frequencies between 2.5 and 5 Mc/s. The range of frequencies between 5-10 Mc/s being obtained by doubling in the Power Amplifier stage.

Power Output. The figures given below apply to conditions when the transmitter is driving an aerial via a 600 ohm transmission line at the four given frequencies:-

CARRIER FREQUENCY Mc/s.	OUTPUT (Watts. CW	Speech. x
3.0	12.5	16.5
4.5	13.5	17.5
6.0	10.	13.
9.0	10.	13.

x Modulated 80%.

Power Supply. The transmitter draws all power for its operation from a 12 volt battery, H.T. being derived from a synchronous vibrator of the gas filled type A.W.A. type 1H7220. A petrol driven battery charger may be supplied with the transmitter: but it must be noted that this unit shall not be used to charge the battery while the transmitter is in operation. This will be done only when the transmitter is idle.

L.T. Current Consumption.

CONDITION OF OPERATION	L.T. CURRENT CONSUMPTION (Amps).
CW	7.5
Speech	7.5
Stand-By	1.5

Fuses. A cartridge type 15 Amp fuse protects the L.T. input circuit, the fuse being located in clips on the top of the chassis. Two spare fuses, also located in clips on top of the chassis, are provided.

Battery Connector. This is of the non-reversible three pin plug type.

Crystal Selector Switch. Separate sockets are provided for each of the six crystals, the desired crystal being selected by the use of this switch which is lettered to correspond with each crystal at its fundamental frequency and also at its second harmonic.

Aerials. Provision is made for loading the transmitter into either quarter-wave Marconi or 600 ohms single wire fed, half-wave Hertz aerials. Separate terminals are provided on the front panel to facilitate making connection to each type of aerial. These terminals are designated "AERIAL LOW IMP." and "AERIAL 600 OHM" respectively.

Modulation System. Plate modulation of the Power Amplifier is employed.

TUBES, TYPES AND FUNCTIONS.

Circuit Symbol	Type	Function.
V1	6V6G	Crystal Oscillator
V2	807	Power Amplifier
V3	6V6G	Sub-Modulator
V4)	6V6G)	
V5)	6V6G)	Modulator.

TECHNICAL DESCRIPTION.

Refer to diagram W/154. A tuned plate Crystal Oscillator circuit is employed with the crystal connected between the 6V6G Oscillator grid and ground, a harmonic suppressor resistor, R34-100 ohms, being included in series with the crystal and the grid of this tube. The oscillator cathode return is keyed, the cathode being isolated from ground, CW key up, and the key being shorted out for transmission. The plate circuit is series fed for H.T., the Oscillator output being capacitively coupled to the Power Amplifier grid circuit and the coupling condenser being used to isolate the plate tuning condenser from the H.T. supply. To increase the amount of excitation to the crystal, to ensure its satisfactory operation, C13-9uuF, is included, this condenser being effectively connected in parallel with the plate to grid capacity of the tube.

Power Amplfier Circuit. The 807 Power Amplifier operates into a single ended plate circuit without the use of neutralization. To compensate for the absence of neutralization suppressor resistors R24-500 ohms and R32-100 ohms are included in the grid and screen circuits respectively. The plate circuit of this stage is also serie fed for H.T., this H.T. ebing applied to both plate and screen circuit via the modulation auto-transformer and isolated from the tank tuning condenser by C20-.oo5 uF. When doubling, the Power Amplifier stage is used to cover the range of frequencies from 5-10 Mc/s., and portion of the tank coil is shorted out by the CRYSTAL SELECTOR SWITCH thus allowing the tank circuit to be tuned to resonance at the second harmonic of the Oscillator frequency.

Aerial Circuit. When the transmitter is loaded into a Marconi Aerial a variable inductance is employed to tune the aerial to resonance at the operating frequency whilst variable coupling to the power amplifier tank circuit is provided to enable correct loading of this stage. When working into a 600 ohm line circuit the line is capacitively coupled to the correct impedance tap on the tank coil. Under conditions of doubling in the power amplifier, a portion of the tank coil being shorted out necessitates the 600 ohm tapping point on the coil being altered to suit the new circuit conditions, this operation being performed by a section of the CRYSTAL SELECTOR SWITCH. In either Stand-by position of the Speech-OFF-CW switch the aerial is removed from the transmitter and connected to the "AERIAL TO RECEIVER" terminal on the front panel.

SUB-Modulator and Modulator Circuits.

Microphone Supply: The voltage drop across the Power Amplifier cathode resistor is employed to energise the microphone which is capacitively coupled to the 6V6G Sub-Modulator grid. R11-1600 ohms performs the function of microphone load, C24-100 uF bypassing cathode resistor R29-250 ohms. On CW operation the microphone is short-circui by the action of the Speech-OFF-CW switch.

Sub-Modulator. This tube operates with reduced screen voltage and it is resistance-capacity coupled to the 6V6G Modulator tubes grid circuits. Inverse feed-back is applied to the Sub-Modulator screen for the lower voice frequencies, a high frequency by-pass circuit being included from the screen of this tube.

Modulator Stage. The two 6V6G Modulator tubes are connected in parallel, both tubes having included in their grid circuits oscillation suppressor resistors of 100 ohms resistance each. Auto-transformer coupling of the Modulator stage to the Modulated Amplifier is employed.

SPEECH-OFF-CW Switch. The functions of this switch are as follows:-

(a) In the OFF position all power is removed from the transmitter and the transmitter AERIAL terminals are connected to the "AERIAL TO RECEIVER" terminal.
(b) In either "STAND-BY position the tube heaters, in a series-parallel circuit, are energised from the 12 volt supply and the GREEN "STAND-BY" pilot lamp, which is connected in parallel with the heater circuit, is lighted. The aerial connections remain as in (a).
(c) In the SPEECH position the tube heaters remain energised while the green pilot is switched off, the transmitter AERIAL terminals are removed from the "AERIAL TO RECEIVER" terminal and connected to the appropriate transmitter output circuits, the vibrator, in parallel with the RED "TRANSMIT" pilot lamp, is energised from the 12 volt supply and, in addition, the microphone is connected in circuit whilst the Crystal Oscillator cathode return is grounded.
(d) In the CW position this switch functions as in (c) above with the exception that the microphone is short-circuited and the crystal oscillator cathode return is isolated from ground and returned to the MARK contact of the key.

METERING.

The Panel Meter, in conjunction with the "METER SELECTOR" switch, is used to read OSCILLATOR CATHODE CURRENT, MODULATOR CATHODE CURRENT, or P.A. cathode current at will. The above switch has four positions namely:- OFF-OSC. CATH.-MOD. CATH.-P.A. CATH.

Alternately, by using an external meter, details of which are given below, in conjunction with the "METER SELECTOR" Switch the following additional measurements may be made. The external meter is connected to the two terminals located on the top of the chassis, and with the switch

(a) in the OFF position the meter will indicate P.A. GRID CURRENT.
(b) in " OSC.CATH " " " " " OSC. SCREEN CURRENT.
(c) in " MOD.CATH " " " " " MOD. SCREEN CURRENT.
(d) in " P.A.CATH " " " " " P.A. SCREEN CURRENT.

Note that in ALL cases the actual meter reading is the voltage drop across resistors included in series with the circuit the current in which is to be measured. When the panel meter is employed these resistors are of 10 ohms each while corresponding values in use with the external meter are all of 100 ohms.

SOCKET VOLTAGES AND CURRENTS.

	OSCILLATOR.	SUB-MODULATOR	MODULATOR.	POWER AMPLIFIER.
Plate Volts.	300	130	350	360.
Screen Volts	130	40	330	280
Cathode Volts	3	8	22	14
Plate m/A		0.6		
Screen m/A	x 0.5		xx 6	xx 8
Cathode m/A	13		70	60
Grid m/A	0.6			x 0.5

Figures taken with transmitter operating at output of 15 watts, modulated 50% at 400 cps.

x 0-1 m/A meter at test meter terminals.
xx 0-10 m/A meter at test meter terminals.

Particulars of Aerials.

Half-Wave Hertz. This type of aerial is normally used only when distances of from 80-500 miles are desired. If possible make the supporting poles 70 feet high for best efficiency, although a height of 40 feet will yield quite good results. The dimensions of a half-wave aerial of this type cut for a given frequency are as follows:-

Length of Aerial in Feet: $\frac{468}{f. \text{ Mc/s}}$.

Feeder Length: Not critical but feeder must be run at right angles to the aerial proper for at least ¼ wavelength.

Tapping Point: Attach feeder to aerial at position 13% of aerial off centre.

Marconi Aerial: For use when distances desired are not greater than 100 miles.

Length of Aerial in Feet. $\frac{234}{f. \text{ Mc/s}}$

If the earth wire is in excess of a few feet a reduction must be made to the above figure.

Earthing. Due to the nature of the aerials used with this transmitter it is essential that an efficient earth system be employed. This may consist of a properly erected and insulated counterpoise system or earthing pins may be used. In both cases ensure that the earth wire is of suitably heavy cross section and that it is as short as possible It is essential that the earth wire makes good contact to the earthing pin and that this pin, in turn, makes good connection with ground. A good earth to a vehicle chassis or a watercraft hull is essential for mobile use.

Transmitter Tuning. After permitting the tube heaters to reach operating temperature with the SPEECH-OFF-CW switch in the STAND-BY position and ensuring that the AERIAL COUPLING control is in the zero position and also that the correct crystal has been selected, move this switch to the CW position.

Oscillator Tuning. Place the METER SELECTOR SWITCH in the OSC. CATH. position, press the key, and tune the OSCILLATOR tank circuit to resonance by means of the CRYSTAL OSCILLATOR TUNING control, resonance of this circuit being indicated by maximum dip on the meter which should then read 10-12 mA. Next adjust the CRYSTAL OSCILLATOR TUNING control to a position slightly on the minimum capacity side of maximum dip to provide oscillator stability on CW.

Power Amplifier Tuning. Move METER SELECTOR switch to the P.A. CATH. position, press the key and adjust the P.A. ANODE TUNING control for resonance as for the OSCILLATOR tuning. The P.A. CATH. current at maximum dip on the meter should be approx. 20-30 mA. N.B. WHEN TUNING THE POWER AMPLIFIER IT MAY BE FOUND THAT TWO POSITIONS ARE OBTAINED ON THE "P.A. ANODE TUNING" DIAL WHICH INDICATE RESONANCE. IN SELECTING THE CORRECT POSITION REMEMBER, ALWAYS, THAT THE "P.A. ANODE TUNING" DIAL AND THE "CRYSTAL OSCILLATOR TUNING" DIAL READING SHOULD CLOSELY CORRESPOND. IF THIS CONDITION IS NOT SATISFIED IT IS PROBABLE THAT THE EMMITTED FREQUENCY IS DOUBLE THE DESIRED FREQUENCY.

P.A. LOADING AND AERIAL TUNING.

600 Ohm Aerial. Connect the 600 ohm line to the "AERIAL 600 OHM" terminals and re-adjust the P.A. ANODE TUNING control for maximum dip, this occurring at 60 mA approximately.

LOW IMPEDANCE AERIAL. Connect the LOW IMPEDANCE AERIAL to the AERIAL LOW IMP. terminal and increase the AERIAL COUPLING until the P.A. CATH. current rises by about 10 mA. Adjust the AERIAL TUNING control until maximum peak in the meter is obtained. Increase the AERIAL COUPLING for a further increase in P.A. CATH. current of about 20 mA and re-adjust the P.A. ANODE TUNING. Again increase the AERIAL COUPLING for another 20 mA rise in P.A. CATH. current and re-adjust the AERIAL TUNING control for maximum peak on meter. Continue in this manner until the P.A. CATH. current reaches about 65 mA.

BATTERY CONDITION. Due to the fact that the 807 tube is rather critical in regard to its heater voltage it is essential that the transmitter battery be maintained fully charged at all times, or inefficient operation will result. Ensure that all battery terminals and lugs are kept clean and smeared with mineral jelly and that the battery cable is in good condition.

SILICA-GEL. The ample space within the transmitter case permits bags of silica-gel being included both above and below the chassis to minimise moisture condensation on components.

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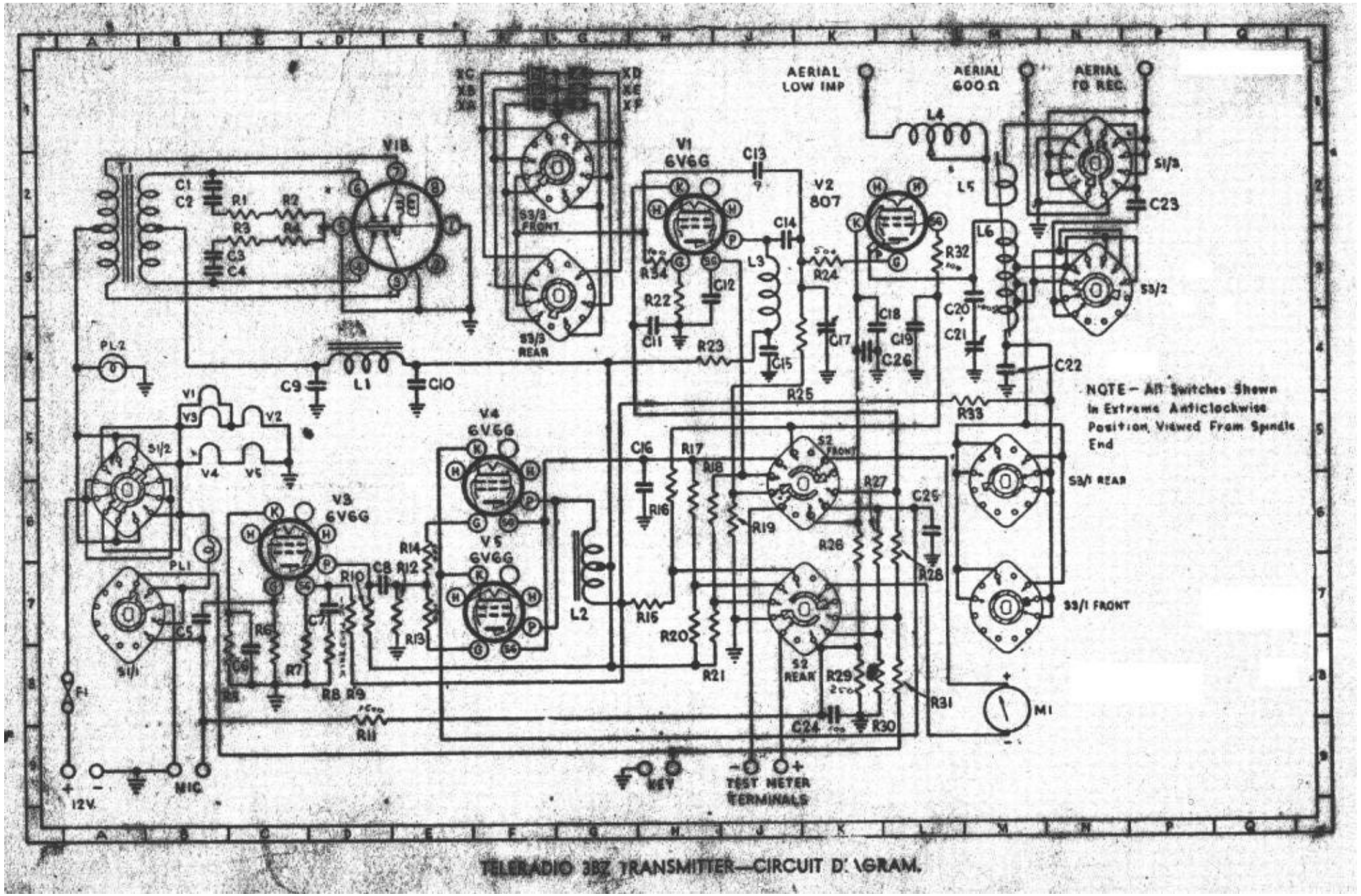

TELERADIO 3BZ TRANSMITTER—CIRCUIT D'AGRAM.