AUSTRALIAN ADDENDUM No. 1
to Chapter 1 of A.P.2548A, Volume I
(February, 1954)

TECHNICAL INSTRUCTIONS.

CRYSTAL DRIVE UNIT

Y10D/500, 550

for use with

TRANSMITTER Type T.1154.

CONTENTS

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INTRODUCTION

Purpose of Crystal Drive Unit

1. The Crystal Drive Unit is an oscillator intended for use in conjunction with Transmitter Type T.1154. Its use will result in improved frequency stability over the operating range, 2-18 Mc/s per second. The transmitter has to be suitably modified to gain this additional facility.

Crystal Operation

2. The Crystal Drive Unit has provision to hold up to twelve crystals, type 310XV, which are housed in a compartment readily accessible from the front of the unit. Any one of the crystals may be selected for operation by means of a twelve-position rotary switch located on the front panel.

3. The Crystal Drive Unit is designed for operation at the fundamental frequency of the crystal over the frequency range 2-18 Mc/s. However, at reduced output, harmonic operation is possible by suitably tuning the transmitter.

4. A toggle switch control is provided for the operator to switch the Crystal Drive Unit off, and restore the transmitter to the conventional Master Oscillator operation.

Power Supply

5. The power required to operate the Crystal Drive Unit is taken from the transmitter. To facilitate installation and maintenance of the Crystal Drive Unit, the interconnection cable is terminated at an eight-pin connector designed to plug into a mating connector attached to the side of the modified transmitter.

Overall Dimensions of the Crystal Drive Unit

6. Width = 3 inches.
Height = 10¼ inches (including mounting bracket).
Depth = 5 inches.

7. The weight of the unit, complete with valve but less crystals, is 2.2 lbs. wt.

GENERAL DESCRIPTION

Transmitter Type T.1154 Circuit Modifications

8. Circuit modifications are limited to the master oscillator section of the equipment, and circuit designations used under the above sub-heading are those shown on the schematic diagram of Transmitter Type T.1154.

9. The modified transmitter works in the conventional manner when the switch on the Crystal Drive Unit is in the "M.O." position. When this switch on the Crystal Drive Unit is switched to "Crystal," the relay in the modified transmitter alters the circuit so that the master oscillator valve V1 operates as a grounded grid, plate-tuned amplifier, cathode-driven by the Crystal Drive Unit.

10. The circuit changeover, as performed by the relay, is as follows:—

(a) "M.O." or Normal Operation.
- (i) Relay is not energised.
- (ii) Cathode of V1 is grounded through relay contacts.
- (iii) Anode coil connected to grid through C5 and relay contacts,

i.e., circuit operates as the conventional self-exciting oscillator.

(b) "Crystal" Operation.
- (i) Relay is energised from L.T. supply through plug and socket interconnection and switch SW1, in Crystal Drive Unit.
- (ii) Relay contacts open, bias developed across impedance in cathode of V1.
- (iii) Grid of V1 is grounded through relay contacts.
- (iv) C5-to-grid connection rendered open circuit by relay contacts.
- (v) Cathode of V1 driven by R.F. output of Crystal Drive Unit,

i.e., circuit operates as a grounded grid, cathode-driven, plate-tuned amplifier.

Crystal Drive Unit

11. The Crystal Drive Unit will provide a signal of sufficient amplitude to drive the final stage of Transmitter Type T.1154 to approximately full output at any frequency within the band 2-18 Mc/s.

12. The circuit used employs a nine-pin (type CV2129) miniature valve of the Noval base series. The circuit arrangement is that of a modified Colpitts. The oscillatory condition is not dependent on any particular setting of the anode tuning capacitor of the transmitter.

13. It will be seen from Figure 1 that facilities are provided for switching into circuit any one of the twelve crystals that may be plugged into their respective sockets. The front section of switch SW2 is arranged to connect the selected crystal between the grid of oscillator valve V1, and the main negative H.T. line. It should be noted that all R.F. returns are connected to the negative H.T. line which, in turn, is connected to the frame through capacitor C5. The second section of the switch is connected to short circuit the sockets of every crystal, the only exception being the one selected for use. This arrangement is intended to prevent oscillation other than at the selected frequency.

14. The valve V1 forms the dual function of oscillator and buffer-amplifier. The screen grid, which is at earth potential with respect to R.F., serves as the anode of a triode oscillator, while the output of the stage is taken from the main anode of the valve through coupling capacitor C6, carrier voltage being developed across RFC 2. The coupling between the two sections of the valve is principally through the common electron stream. The cathode is maintained at R.F. potential due to isolation caused by RFC 1. Bias is developed across R4 to prevent excessive dissipation at the electrodes, should the unit be left switched on without a crystal in the appropriate socket. Capacitor C2 serves the conventional bypass function.

15. Feedback voltage, necessary to cause oscillation, is developed across the capacitors C1 and C3 which are effectively connected across the "tuned" input circuit, and their junction point is connected directly to the cathode. The amount of feedback is controlled by the ratio of the reactance of the respective capacitors.

16. Resistor R2 provides isolation between the grid circuit and the bias supply. R1 and R3 form a potentiometer or attenuator network to limit the fixed bias voltage applied to the grid during key up and key down conditions. The grid leak of the crystal oscillator is returned to the bias line that is common to both the master oscillator and output stages of the transmitter, hence is keyed in step with them.

17. It should be noted that when the transmitter is operated in conjunction with the Crystal Drive Unit, the grounded grid amplifier stage is not keyed.

18. Toggle switch SW1 controls the potential applied to the anode of V1, and to the coil of the relay that is installed in the transmitter. When the toggle switch it set to the "M.O." position, the H.T. to the stage is disconnected, and current does not flow through the relay coil. Power is applied to both of these circuits when the switch is set to the "Crystal" position.

19. It should be noted that the heater of V1 is connected to the L.T. circuit in the transmitter, hence it is off only when the main switch of the transmitter is turned "OFF".

CONSTRUCTIONAL DETAILS

General

20. The appearance of the Crystal Drive Unit, when attached to the side of Transmitter Type T.1154, is as shown in Photo 3. It is made up of three main parts:—

(a) Main case.

(b) Control panel.

(c) Crystal cover.

Main Case

21. The main case is made of 16.SWG. aluminium, suitably primed and finished with a black brocade, baked enamel. The metal folds and flaps are fastened together by means of aluminium rivets.

22. To facilitate the mounting of the unit on the side of the transmitter housing, the case is fitted with a mounting bracket on the right hand side, and the wall is drilled to accommodate a screw that passes through the hole and into the frame of the transmitter. Five domes are also raised on this side of the case to space it from the side of the transmitter.

23. A rectangular cutout is provided to allow the interconnection plug to pass through the side of the case to mate with the corresponding connector attached to the side of the transmitter.

24. Two fixed anchor nuts are attached to the inner walls of the case to receive the two captive screws that lock the control panel in position.

Control Panel

25. The control panel consists of a 16.SWG. aluminium plate with a turned-up flange on each side. The panel is hinged to the main case on the bottom edge. In the closed position the panel mounts flush to form the closing side of the main case. The two controls are mounted on the top section of the panel, and are termed the "M.O."-"CRYSTAL" control, and the "CHANNEL SELECTOR".

26. The "M.O."-"CRYSTAL" switch causes the transmitter to be connected for use in the conventional manner, or, alternatively for operation in conjunction with the Crystal Drive Unit.

27. The "CHANNEL SELECTOR" switch is a twelve-position switch arranged to select any one of the twelve type 310XV crystals which may be accommodated in moulded sockets mounted on the lower section of the control panel. Each socket is numbered to coincide with the appropriate setting of the selector switch.

28. The control panel is anodised and dyed a deep blue-black, and all letterings and numerals finished in clear aluminium. On the rear of the control panel is mounted a cadmium-plated and passivated sub-chassis of 20 BG. bright mild steel. This chassis or bracket supports a laminated, resin bonded component panel, and the socket for the oscillator valve V1.

29. Wiring, including the connector cable, is carried out with P.V.C. covered, multi-stranded, copper wire.

30. The hinge on the bottom of the control panel allows it to be swung forward and out of the main case, so that the rear of the panel is readily accessible for maintenance purposes.

Crystal Cover

31. The crystal cover is made of 18.SWG. aluminium, suitably primed and finished with a black brocade, baked enamel. It is hinged at its bottom edge to the control panel so that it forms a cover for the crystals housed in their respective sockets. It may be swung forward to give easy access to the crystals.

32. The crystals are held in position by a gentle pressure exerted by sponge rubber that rests on the ends of the crystals when the case is closed. The sponge rubber is fastened to the inner surface of the crystal cover. The cover is held in the locked position by means of a captive screw fitted to its upper end.

33. An etched acrylic plate is attached to the front of the crystal cover and is provided for the operator's convenience. Data such as channel number, crystal frequency, etc., may be pencilled on the data plate. Such notes may be rubbed out with an ordinary rubber eraser.

INSTALLATION

34. The Crystal Drive Unit is designed for mounting on the left hand side of Transmitter Type T.1154. The installation of the Crystal Drive Unit, and the modifications to be made on the transmitter, are described in R.A.A.F. Wireless Modification, Order (AIR) No. 40.

OPERATION

Tuning Procedure

35. The following procedure should be adopted for tuning Transmitter Type T.1154 for operation in conjunction with the Crystal Drive Unit.

(a) Key Up.

(i) Set the "M.O."-"CRYSTAL" switch on the Crystal Drive Unit to "Crystal".

(ii) Select the required crystal by means of the "CHANNEL SELECTOR" switch.

(iii) Select the appropriate frequency band on Transmitter Type T.1154.

(iv) Place the "M.O."-"TUNING" control of the transmitter in approximate position corresponding to that of the desired frequency.

(b) Key Down.

(i) Vary the "M.O." control on the transmitter until a dip is indicated on the "P.A. CURRENT" meter (this indicates that the grid of the P.A. is being driven).

(ii) Adjust Aerial Loading circuits, using the procedure normally adopted when the transmitter is operating in conjunction with its inbuilt master oscillator.

(iii) Check the dip with the "M.O." control, and retrim Aerial Loading.

MAINTENANCE

Fault Tracing

36. Transmitter not operating satisfactorily with switch on Crystal Drive Unit set to "M.O.".

(i) Undo captive screws on front panel of Crystal Drive Unit, move the panel forward to allow access to main case, and disconnect plug on interconnector cable from its mating socket attached to the side of the transmitter. If the fault persists, the trouble will be located within the transmitter.

(ii) Check the relay contacts to ensure that they are clean and making good connection.

(iii) Check for short circuits between lugs on the interconnection socket.

(iv) Examine soldered connections on relay and socket wiring for poor contact.

(v) Ensure that insulation on leads installed as part of modification kit is not damaged.

(vi) If fault persists after making the above checks, carry out fault finding procedure as instructed in handbook for transmitter.

(vii) Restore the Crystal Drive Unit to its original condition.

37. Transmitter operates under "M.O." conditions when switch on Unit is set to "CRYSTAL".

(i) Changeover relay installed in transmitter not functioning correctly,

(a) Open circuit relay coil (alternatively, shorting turns).

(b) Interconnection plug and socket contacts making poor connection (pin 6).

(c) Relay contacts require cleaning.

38. Transmitter operating satisfactorily when switched to "M.O.", but unsatisfactory when operating under "CRYSTAL" conditions.

(i) Faulty oscillator valve V1 (type CV2129—substitute replacement).

(ii) Faulty crystal (substitute replacement).

(iii) Apply voltage and current analysis (see paragraph 42).

(iv) If valve is not oscillating, as indicated by cathode current being higher than normal, the fault will probably be due to poor switch contact, faulty capacitors, or faulty RFC.

39. Negligible H.T. volts on anode of V1.

(i) Open circuit RFC 2.

40. Excessive voltage at cathode of V1, and reduced anode current.

(i) Open circuit RFC 1 or R4.

41. R.F. drive voltage developed at anode of V1 (type CV2129), but not appearing at cathode of grounded grid amplifier in transmitter.

(i) Interconnection plug and socket making poor contact (pin 7).

(ii) Capacitor C6 open circuit.

Note: Should it be desirable to use the transmitter installation without its associated receiver, it will be necessary to complete the H.T. return circuit. This may be conveniently done by mounting a resistor (2,000 ohms) within the Crystal Drive Unit. Connect the resistor between the centre shield of the valve socket and the frame of the Crystal Drive Unit.

Typical Voltage and Current Analysis

42.

Primary Supply.	=	23 V. D.C.
Heater Supply.	=	5.85 V. D.C.
High Tension.	=	195 V. D.C.
Bias. "Key Up" measured at Junction of R1, R2 and R3.	=	—75 V. D.C.
Total Cathode Current.	=	32 mA. D.C.
Receiver (1155) Current.	=	60 mA. D.C.

Voltage measurements made with respect to frame, using a meter of sensitivity 1,000 ohms per volt.

43. COMPONENT PARTS.

Circuit Desig.	Component	Value	Tolerance	Rating	Manufacturer	Manufact. Type No.	R.A.A.F. Ident.
C 1	Capacitor, Moulded, Mica	220 pF.	± 5%	500 V. D.C.W.	Simplex	M.S.	Y10C/501793
C 2	Capacitor, Ceramic, Dielectric	10 K. pF.	± 20%	500 V. D.C.W.	U.C.C.	C.T.H.422	Y10C/501660
C 3	Capacitor, Ceramic, Dielectric	4.7 pF.	± 1 pF.	250 V D.C.W.	Ducon	N.750, Style A	Y10C/501658
C 4	Capacitor, Ceramic, Dielectric	10 K. pF.	± 20%	500 V. D.C.W.	U.C.C.	C.T.H.422	Y10C/501660
C 5	Capacitor, Ceramic, Dielectric	10 K. pF.	± 20%	500 V. D.C.W.	U.C.C.	C.T.H.422	Y10C/501660
C 6	Capacitor, Ceramic, Dielectric	10 K. pF.	± 20%	500 V. D.C.W.	U.C.C.	C.T.H.422	Y10C/501660

Circuit Desig.	Component	Value ohms	Tolerance	Rating	Manufacturer	Manufact. Type No.	R.A.A.F. Ident.
R 1	Resistor, Carbon	39 K.	± 10%	1 W.	I.R.C.	BTA	Y10W/Z222207
R 2	Resistor, Carbon	27 K.	± 10%	1 W.	I.R.C.	BTA	Y10W/Z222186
R 3	Resistor, Carbon	27 K.	± 10%	1 W.	I.R.C.	BTA	Y10W/Z222186
R 4	Resistor, Carbon	100	± 10%	1 W.	I.R.C.	BTA	Y10W/Z221110

Circuit Desig.	Component	Value	Rating Amps.	D.C. Resistance Ohms	Manufacturer	Manufact. Part No.	R.A.A.F. Ident.
RFC 1	Choke, R.F.	0.75 mH.	0.04 D.C.	25	Kriesler	44—6	Y10C/501659
RFC 2	Choke, R.F.	0.75 mH.	0.04 D.C.	25	Kriesler	44—6	Y10C/501659
SW 1	Switch, Toggle	DP Change-over.	250 V/1A A.C.	—	Arrow	20905LT13	Y10F/500362
SW 2	Switch, Rotary	—	250 V/0.25 D.C.	—	M.S.P. (Oak).	AK32317	Y10F/500337
PL 1	Plug, 8-Pin	—	—	—	Painton	500208	Y10H/500297
SK 1 to SK 12	Socket, Crystal	—	—	—	Teletron	SC22LP	Y10H/500335
SK 13	Socket, Valve	9-Pin Noval.	—	—	Teletron	ST59L/3	Y10H/500334
V 1	Valve, Oscillator	CV2129	—	—		5763	Y10CV/2129

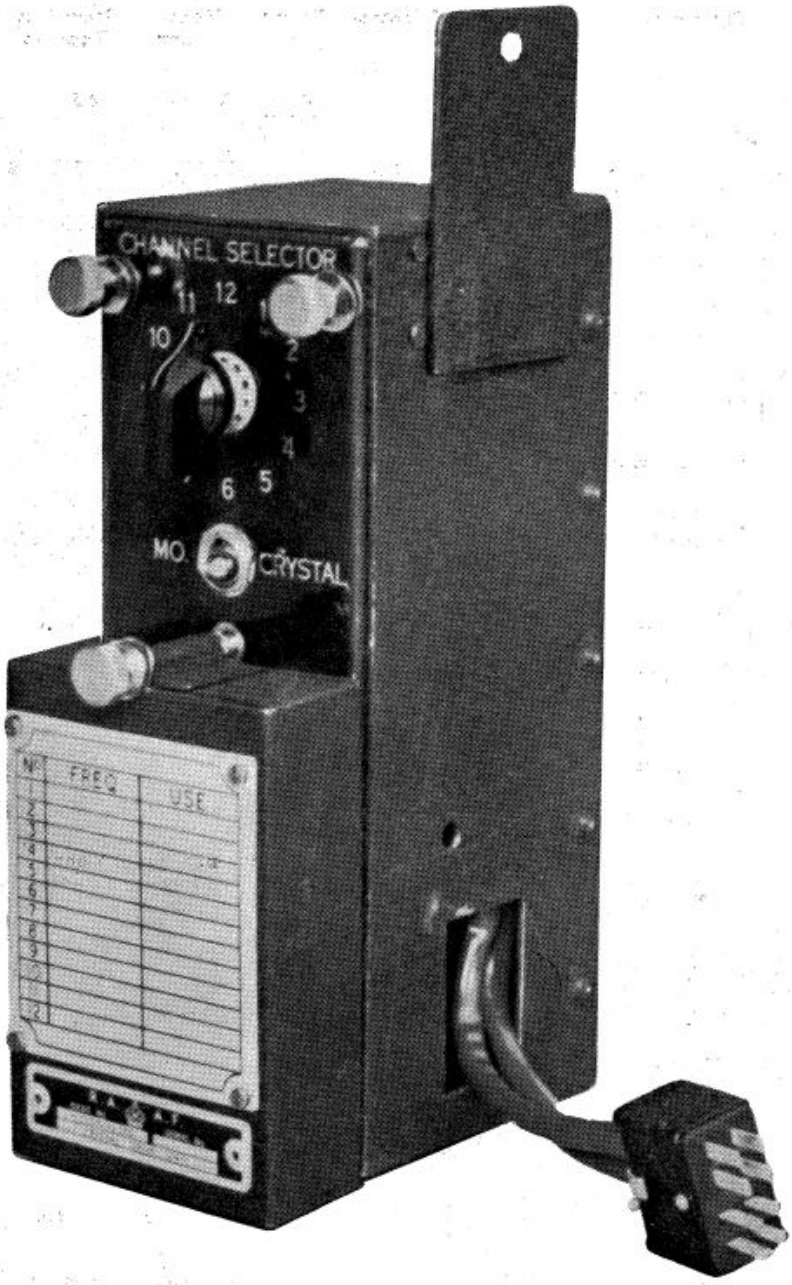

PHOTO. 1.

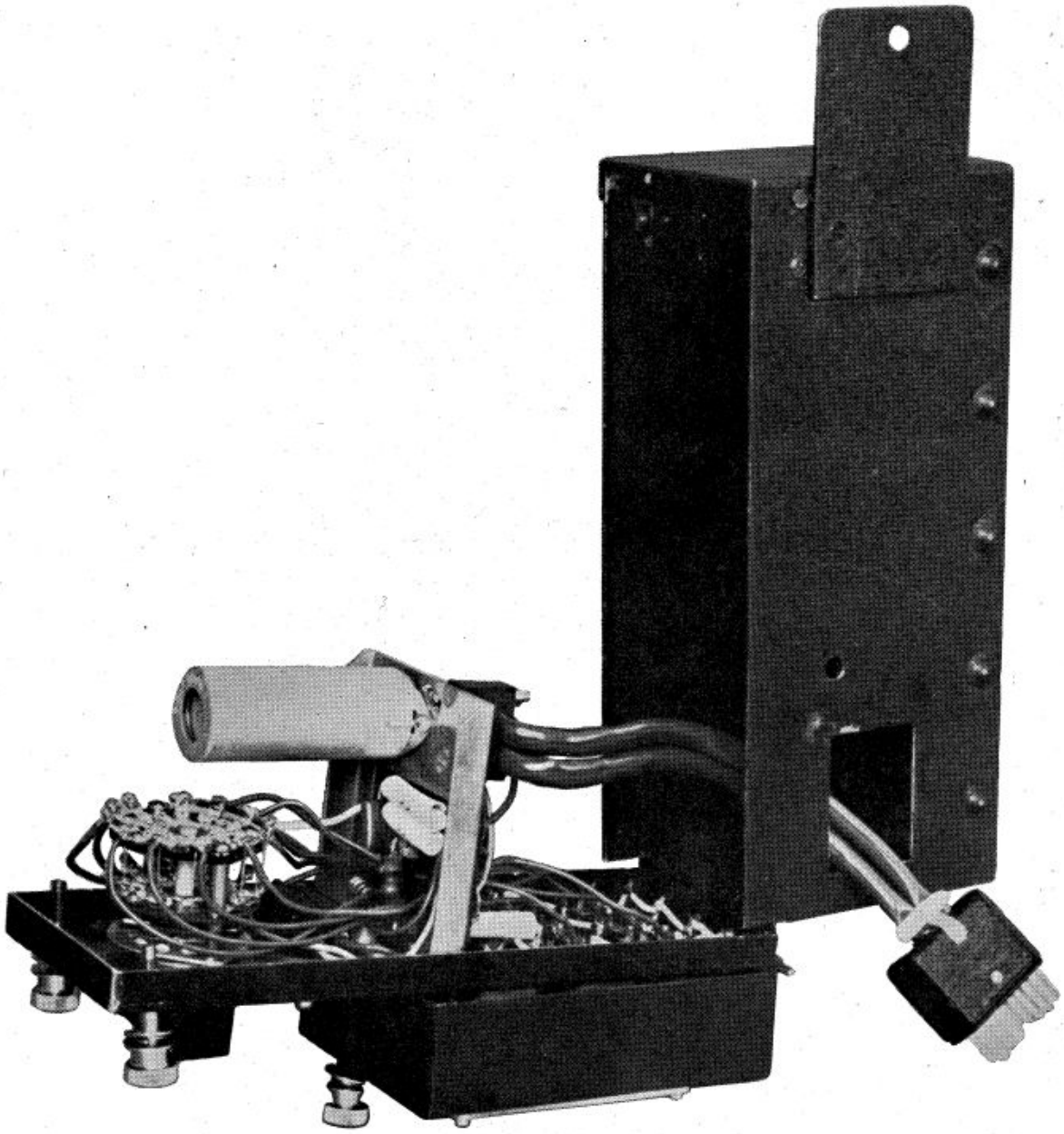

PHOTO. 2.
Photograph of Interior of Crytsal Drive Unit.

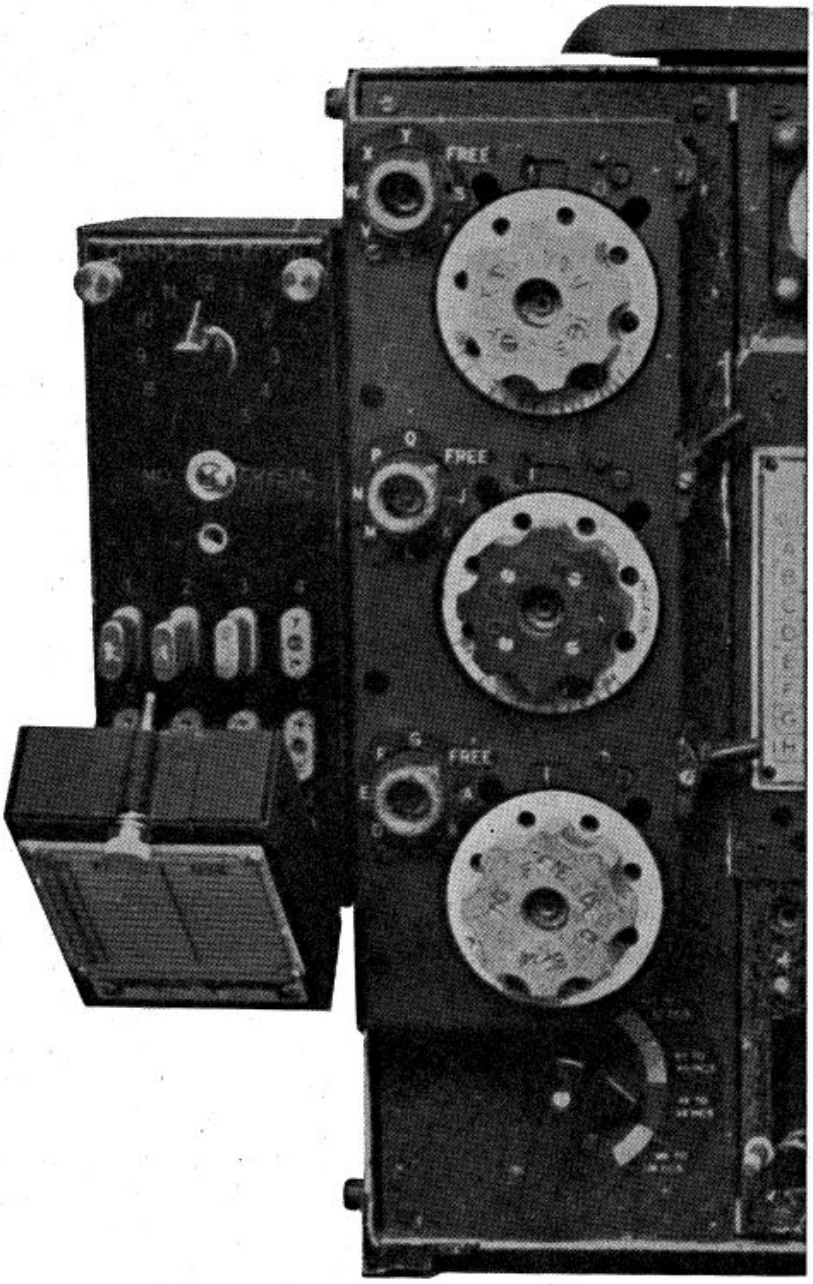

PHOTO. 3.

Photograph of Crystal Drive Unit attached to side of Transmitter Type T.1154, with Crystal cover lowered to reveal Crystals.

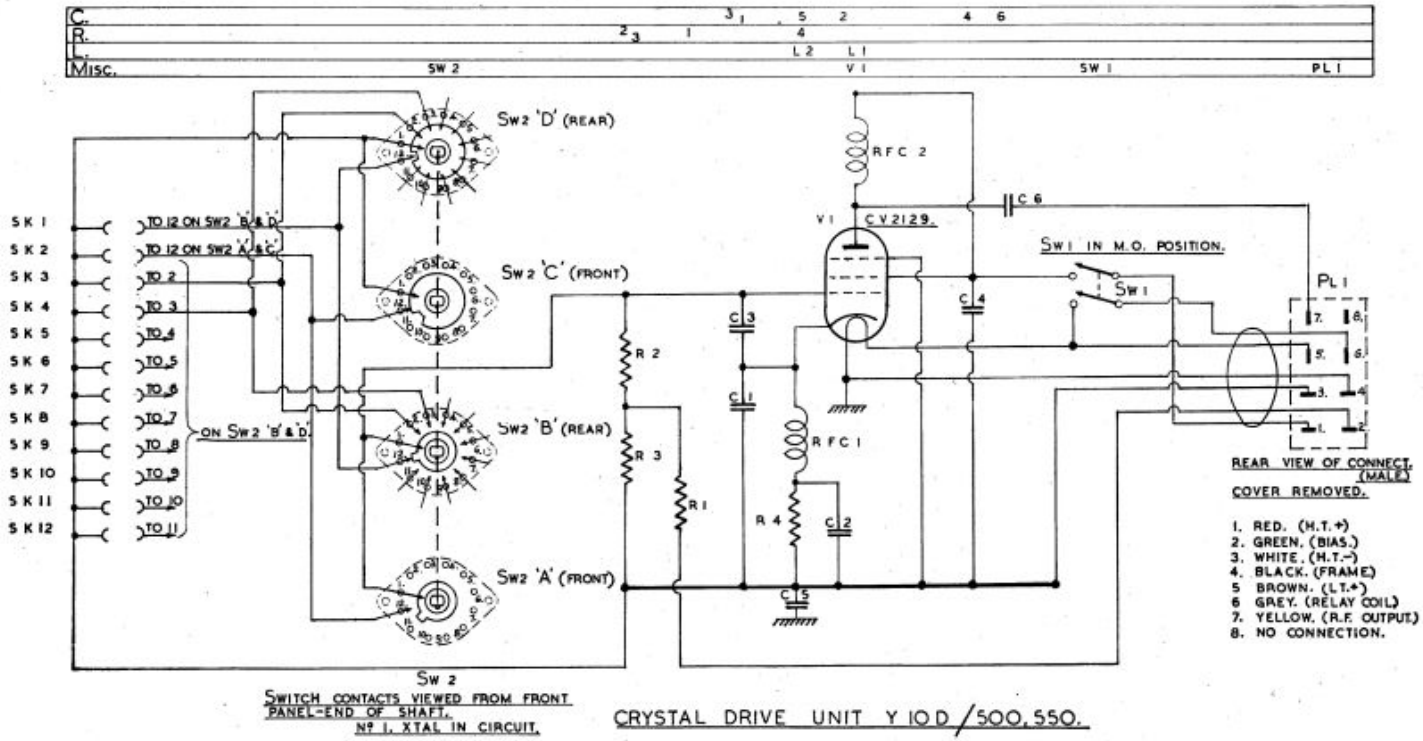

FIGURE 1.
Crystal Drive Unit, Schematic Diagram.

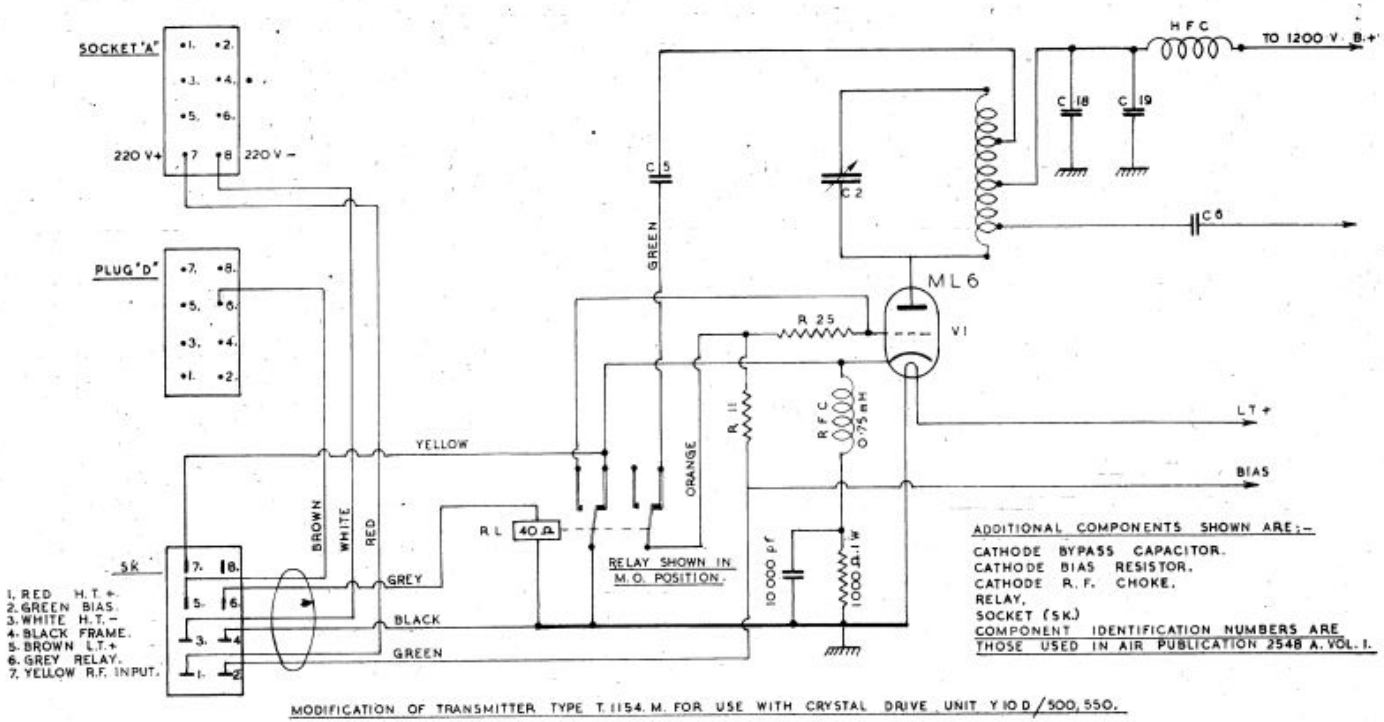

FIGURE 2.

Transmitter Type T.1154. Schematic Diagram of Circuit Modification.