

162499
H.C. Knight R.W.

Notes for
Wireless Maintenance
Mechanics
on the
Installation and Maintenance
of
V. H/F Equipment

Restricted.

Issued by R.A.A.F. Directorate of Training

R.A.A.F. (RO4) 886/211/5/45

TR 1133A and B

INTRODUCTION:

1. This set was the forerunner of the later model V.H.F. sets in use at the present time, i.e. TR 1133D, TR 1133E, F, TR 1133H, TR 1143 and finally TR 5043, which is the American equivalent of the English TR 1143, with which it is directly interchangeable, both in wiring and units, power supply etc.
2. Range : Four predetermined frequencies between 100 - 120 Mc/s. Over distances peculiar to normal V.H.F.
3. Communication R/T only. AVC incorporated.
4. R/T switch is voice operated, but manual switching at controller may be used to over-ride V.O. if necessary.
5. M.C.W. on one frequency, Range "D", when contactor controlled.
6. TR 1133A - Input 24 volts - 7.3 Amps. TR 1133B - 12 volts, 15 amps.
7. Main unit and controller, interchangeable with TR9D in a/c.
8. E.M. microphone must be used.

DESCRIPTION:

1. This equipment consists of a number of units:-
 1. The Transmitter - Receiver.
 2. The Power Unit.
 3. Controller Electric.
 4. Junction Box Assembly.
 5. Contactor.
2. The main unit consists of a chassis, into

which are plugged:-

- (a) The Transmitter type T1136A.
 - (b) The Receiver type R1137A.
 - (c) The Amplifier type A1135A.
 - (d) The Chassis, containing the frequency selecting mechanism, etc.
3. Access to the tuning controls is through a section of the main cover. NOTE: Never leave locking screws on cams loose, otherwise cams will jam selector arms.
4. (a) Access to transmitter crystals via crystal door.
 (b) Microphone gain control through hinged cover.
 (c) Receiver gain through hole provided in main cover.
5. The power unit contains a Rotary Transformer together with control relays, providing H/T. bias and L/T.
6. Controller Electric similar to TR 5043.

Transmitter Type T1136A.

Consists of a crystal oscillator, 1st frequency, 2nd frequency trebler, doubler, and push-pull amplifier which operates on the 18th harmonic of the crystal. Crystal frequencies are between 5555 Kc/s to 6666 Kc/s.

Electrostatic screens are fitted between crystals to prevent spurious excitation of a disconnected crystal. Crystals are selected by a rotary switch connected to the frequency setting motor.

The P.A. - push-pull twin triode is neutralised and coupled via a suitable impedance matching coil to the aerial.

For modulation, the output of microphone and amplifier is applied to screen of V4, and amplified by V5 (P.A.) Advantage is that less audio power is required.

For tuning, a meter plug is provided at top of transmitter chassis, together with a switch which connects the meter with the circuits concerned, automatically connecting appropriate meter shunt.

<u>Switch Position</u>	<u>Full Scale Current (MA)</u>	<u>Remarks</u>
A/2	50	Anode Current V2
A/3	100	" " V3
A/4	100	" " V4
A/5	100	" " V5
-	-	No reading-H/T to V5 off Grid current of V5 H/T off.

For frequency stability, the screen voltage of V1 (Crystal Osc.) is supplied from the neon tube stabilising network main chassis.

Valves in Transmitter

V1	VT 52	Crystal Oscillator
V2	VT 52	1st Trebler
V3	VT 60 (807)	2nd Trebler
V4	VT 60 (807)	Doubler
V5	VT 61	Push-Pull Power Amplifier.

Receiver Type R1137A

Superheterodyne with A.V.C. consists of a push-pull frequency changer (V1, V2). Three I/F amplifiers (V3, V4, V5) on a frequency of 12 Mc/s, having a band width of 200 Kc/s, to allow for a certain amount of frequency variation or mis-tuning.

Detector and A.V.C. (V6)(double diode) resistance coupled A/F amplifier (V7). V3, V4, V5 and V7 are all A.V.C. controlled. For frequency stability the anodes of V1 and V2, as well as the screens of V3, V4 and V5, and A.V.C. delay voltage of V6 are supplied from the neon tube stabilising network.

The anode voltage supply to V3, V4, V5 and V7

is supplied via a common metering circuit. The changes in total anode current shown on meter are used for tuning indication when tuning receiver.

Valves in Receiver

V1	VR 56	Frequency Changer
V2	VR 56	Frequency Changer
V3	VR 53	1st I/F Amplifier
V4	VR 53	2nd I/F Amplifier
V5	VR 53	3rd I/F Amplifier
V6	VR 54	Signal and A.V.C. Rectifier
V7	VR 57	Variable Mu A/F Amplifier

Amplifier All35A

This amplifier fulfils three duties:-

- (a) amplifies the receiver output up to telephone level.
- (b) amplifies the microphone output up to sufficient level to modulate the transmitter.
- (c) embodies a special circuit whose function is to work an external relay system (V.O.C.)
- (d) sidetone is provided because the telephones are permanently across the output of amplifier.
- (e) by providing two microphones and two sets of telephones in parallel it is possible to obtain i/c in multi-seater a/c.

V2 is a mixing valve used to isolate signal from microphone and output of receiver. Output of V2 operates through resistance capacity coupling to Power Pentode V3. The output transformer has two windings, one for modulation purposes, the other for telephones.

Valves in Amplifier

V1	VR 55	V.O. switching valve.
V2	VR 57	Pre-amplifier.
V3	VT 52	Power amplifier.

Voltage Supply and Stabilising Network.

Since the input from A/c battery is liable to variation, the more critical voltages are stabilised by means of a neon tube voltage stabiliser.

The power unit has on its armature:-

- (a) A 12 or 24 volt primary,
- (b) 6 volt secondary for valve heaters,
- (c) 150 v - secondary for bias,
- (d) 300 v H/T secondary.

Control Relays.

- (a) Master Relay R/4.
- (b) Thermal overload contacts Z which open upon an extended slight overload or a sudden severe overload.
- (c) The main relay G/4 controlled through R/4.
- (d) The rotary transformer starting relay K/2, which operates and short circuits the starting resistance R1 when the machine has reached a predetermined speed.

The bearings of the power unit should be inspected every 30 hours and, if necessary, repacked with grease. (See instructions for repacking EDG500W).

Controller Electric.

This unit comprises a push button assembly, a telephone key and five indicating lamps with anti-dazzle screen. Is used for selecting the channel to be operated and controlling transmitter and receiver.

UNITED KINGDOM CONTACTORGENERAL

This unit consists of a Master Contactor and a Remote Contactor, and is provided to enable automatic switching from a communication range to the D/F range "D" on TR1133, TR1143 equipment. The accompanying diagram shows the electrical circuit and the mechanical principle. The electrical supply is from the A/c battery.

MASTER CONTACTOR

Consists of a spring driven clock, the escapement of which beats twice per second. Each vibration of the escapement closes an electrical contact which in turn transmits an electrical impulse to the remote contactor. The latter thus receives electrical impulses at a regular rate of 120 impulses per minute. The case of the master contactor contains a thermostatically-controlled heating coil which maintains the mechanism at a constant temperature irrespective of weather conditions or altitude. An electrical filter is fitted in the base to minimize interference with radio reception. Further, the wiring is kept away as far as possible from the mic-tel wiring. The master contactor is installed in a wooden box lined with sponge rubber and in a/c suspended by elastic shockmounts.

REMOTE CONTACTOR

Incorporates a special type of step-by-step motor, the rotor of which performs one revolution per minute. During 14 seconds of each minute, the rotor causes an electrical contact to be closed, thus causing the completion of any electrical circuit connected thereto, i.e. the frequency changing relays.

A tumbler switch is fitted for "ON" - "OFF" switching on the front of this unit, which consists of a clock-like dial, with a pointer which makes one revolution per minute. The dial is marked off into 4

quadrants, one of which is coloured. When the pointer is in this coloured quadrant, it indicates that the external electric circuit is completed.

MAINTENANCE.

Consists of checking the contactor against an accurate timepiece when the accuracy of the former is believed to be doubtful. Normal inspection of connecting cables, etc.

TUNING OPERATION OF TR. 1133A and B

1. In this section instructions are given for tuning up and adjusting the TR 1133A and B equipment. The procedure which is given below must be followed either when installing the equipment in an a/c or when it is required to tune the transmitter or receiver in the course of maintenance tests.
2. The equipment required for tuning and adjusting on the bench consists of:-
 - (i) Test set, type 5 or 5A.
 - (ii) Test set, type 10 or later equivalent.
 - (iii) A battery of suitable voltage of at least 40 amp/hours and preferably a charging booster to maintain the battery voltage constant.
3. For final tuning adjustments of the transmitter output stage, which must be done when the equipment is fitted in the a/c, a field strength meter, Test Set, Type 11 or 98 is also required.
4. The preliminary tuning adjustments should, except in cases of emergency, be done on the bench. The Test Set Type 10 or equivalent should be permanently

connected to the battery via the battery leads and connected to the equipment which is to be tuned via the two ten pin plug and socket connections at the end of the main unit.

TRANSMITTER TUNING

1. If the appropriate crystals are not in place it is necessary to open the crystal door by loosening the two self-retaining screws. The crystals may then be plugged into the crystal platform in the lettered spaces corresponding to the range required. Close the crystal door.
2. If the crystals are already in place it is only necessary to remove the cover plate on top of the main cover, exposing the tuning mechanism.
3. Connect up Test Set 5 or 5A via coaxial cable. Press button corresponding to the range required to be pre-set. The system should start up and the frequency selector mechanism should move to the range chosen. Switch key "4" to the "transmit" position "T". Allow at least one minute for warming up before any tuning adjustments.
4. Using the key (adjusting) slack off the locking screws for the cams for this range which should be locked by their rockers.
5. Turn the T1133A meter switch to the extreme left hand position (A2) and the meter switch on the test set to the appropriate position. Using the key (tuning) tune the first condenser (C3) to give maximum current reading in the milliammeter. This should be of the order of 0.2. Note this reading. On rotating the tuning condenser in either direction the current in the meter will be found to fall off very rapidly in one direction and less so in the other. Turn the condenser in this latter direction, i.e. on the less steep side of the resonance curve until the anode current reads approximately 0.9 of its maximum value as determined above. This is the correct tuning position.

6. Turn the meter switch to the position A.3 (second from left) and tune the second condenser (C.9) to give maximum current reading. This should be of the order of 0.6.

7. Turn the meter switch to the position A.4 (third from left) and tune the third condenser (C.15) to give maximum meter reading. This should be of the order of 0.5.

8. Turn the meter switch to the extreme right hand position (G. 5) and tune the fourth condenser (C.23) to give the maximum meter reading. This should be of the order of 0.2 to 0.4.

9. Test for neutralising of the output stage. In order to do this leave the meter switch in position G.5 and turn the fifth condenser (C.27) over the frequency band. If the amplifier is not neutralised there will be a sharp change in the grid current reading (as shown in the meter) as the anode circuit passes through resonance. If the neutralisation is only slightly out, do not re-adjust until the other frequencies in use have been tested, as it is possible that correct neutralisation may not be maintained over the whole frequency hand, in which case a compromise must be struck. The neutralisation procedure is described below in para. 15.

10. After checking neutralisation turn the meter switch to position A.5 (third from right) and tune the fourth condenser (C.23) to give maximum anode current. Leave the meter switch in this position, A.5, after adjustments.

11. Tune the fifth condenser (C.27) until a dip in the anode current is indicated by the milliammeter. Now turn the meter switch on the test set to the "transmitter output" position, when it reads proportionately to the output volts across the dummy aerial. Adjust the

fifth condenser (C.27) to give maximum output.

12. The transmitter is now practically in adjustment. Test to see if a slight re-adjustment of any of the condensers, except the crystal oscillator (C.3) gives an increase in output, as shown by the output meter.

13. After completing these adjustments, lock all the cams on the range concerned. Use the key (adjusting) and be careful not to press downwards on the locking screw as this may force the cam slightly out of alignment. A twisting motion between the thumbs and fingers is sufficient, without using force. Do not use pliers or any other tool to tighten these screws as it is very difficult to replace broken locking screws.

14. Repeat the above operations for each of the frequencies on which the transmitter is to operate. If the neutralisation is correct on at least one of these frequencies, no further adjustment of this is necessary. If not, proceed as follows.

15. Switch the meter switch to the sixth position. If the neutralisation is badly out of adjustment, first adjust the two neutralising condensers (C.25 and C.26) so that they are both about half in and approximately equal. To do this it is necessary to slack off the locking screws, which are accessible through the slots in the base plate of the neutralising condensers mounting, by means of the key (adjusting). Neglect to do this will certainly result in damage. On no account attempt to loosen the locking screws with the meter switch in any position but the sixth. Serious damage may result otherwise, apart from a danger of shock to the operator. The neutralising condenser may then be adjusted by means of a screw-driver inserted through the holes in the base situated underneath the neutralising condenser. Now swing the circuit tuning (C.27) through the resonance point and adjust the neutralising condensers until the change in grid current when the anode circuit passes through resonance is reduced to a minimum. The two neutralising condensers should always be approximately balanced, as may be checked by viewing the locking screws through the base plate of the condensers.

16. Check that the neutralising is not far out of adjustment on any of the pre-set frequencies and make any minor adjustments which may be necessary and then tighten up the locking screw of the neutralising condensers.

17. After neutralising always perform the operations described in paras. 4 to 11, slacking off the cam locking screws where necessary.

18. Re-adjustments should only be made when there are indications of an abnormally low output, whether shown by listening tests or by use of the test set Type 5 or 5A.

19. After the transmitter has been tuned on the bench the tuning of the output stage (C.27) should be checked in the a/c with the complete equipment connected up ready for flight.

20. Switch on and set key "U" in position "T". Set up a field strength meter, Test Set Type 11 or 98 near the a/c aerial, say on the wing or tail of the a/c. Tune and adjust the field strength meter to give about half scale deflection. Slack off the locking screw (E) of C.27 on the range being tested and re-adjust C.27 to give minimum deflection (maximum field strength) on the meter. Tighten the locking screw on C.27 and repeat for the other frequencies in use.

21. It may be found by experience that no re-adjustment is necessary after tuning with the test set, but the above procedure should never be omitted if a new test or a/c has been used, as variations may occur between different a/c aerials or the dummy aerials in the test sets.

22. All testing work carried out in an a/c on the ground should be done with the aid of the engine starting battery truck (battery cart). The normal a/c battery is rapidly discharged by the load taken by the TR. 1133A or B.

RECEIVER TUNING.

1. Connect Test Set Type 5 or 5A. The meter

socket is here connected to the meter plug situated inside the tuning compartment on the bracket attached to the aerial relay.

2. Press the button corresponding to the frequency range required to be pre-set. Observe that the tuning mechanism operates on this range. Switch key "U" to the "receive" position "R". Allow at least five minutes for warming up before making tuning adjustment.

3. Using key (adjusting) slack off the locking screws of the cams for this range, which should be locked in position by their rockers.

4. Using key (tuning), tune the oscillator condenser (C.3) on the receiver to give minimum current in the milliammeter on the test set. As C.3 is tuned through resonance there is a sharp dip in the meter current reading and the bottom of this dip is the correct tuning point. It is just possible that an unwanted harmonic of the crystal in the test set may produce another dip in current in the meter. If this should occur, tune to that point which gives the greatest dip.

5. Rotate the aerial condenser (C.1) slightly and retune C.3 as in the previous paragraph. If the current in the meter shows a greater dip than before, move C.1 slightly further in the same direction as before and again retune C.3. On the other hand, if the current dip is not so pronounced after retuning C.3 this shows that C.1 has been moved in the wrong direction. Carry on in this fashion, alternately moving C.1 slightly and carefully retuning C.3 until the greatest possible dip in meter current has been obtained. The receiver is correctly tuned when it is impossible to produce any further dip in the meter current by any other combination of value of C.1 and C.3. A maximum dip of 5 divisions in the meter reading is normally obtained.

6. When tuning, be careful not to push the condenser spindles out of position in a vertical direction. In order to provide easy operation for the mechanical control system, there is always a certain amount of

slack in these spindles. This is not deleterious in normal operation since it is all taken up by pressure of the rocker on the face of the cam. In the tuning operation, however, this slack may be found objectionable. Its effects may be alleviated in part by applying the tuning key to the hexagon nut at the end of the condenser spindle in such a position that it is nearly horizontal during the tuning operation.

7. Lock the aerial and oscillator condenser cams. Use the key (adjusting) and be careful not to press downwards on the locking screw as this may force the cam slightly out of alignment. A twisting motion between the thumb and fingers is sufficient without using undue force. Do not use pliers or any other tool to tighten these screws as it is a difficult job to replace broken locking screws.

8. Check the accuracy of setting by pressing first the button corresponding to another frequency and then the desired one again. so that the cams are first moved away and then back to their present position.

9. Repeat operations given in paras. 2 to 8 for the other pre-set frequencies. Replace the cover plate after tuning.

10. Re-adjustments should only be made when there are indications of abnormally low sensitivity, whether shown by listening tests or by the use of Test Set Type 5 or 5A.

11. Owing to the varying characteristics of a/c aerials at different frequencies it is necessary to check the aerial tuning of the receiver after installation in the a/c. This should be done at the same time as the transmitter aerial condenser is tuned after installation.

12. To check receiver aerial tuning proceed as follows:-

- (a) TR. 1133A or B is installed in a/c and working on a/c aerial.

- (b) Insert plug on flex from Test Set Type 5 or 5A into receiver socket on aerial relay bracket to measure A.V.C. of receiver.
- (c) Set Test Set Type 5 or 5A to "REC AVC" position and remove crystal from Test Set Type 5 or 5A.
- (d) Using either the general transmitter or the transmitter of another a/c to give a carrier on the correct frequency to the aerial condenser C.1 of the receiver to give maximum A.V.C. dip.
- (e) Lock the cam in this optimum position.
- (f) Repeat at all frequencies in use.

AMPLIFIER ADJUSTMENT

1. The only adjustment required on the amplifier is the setting of the gain control (R.4) and the telephone winding tap. The adjustment of the audio gain control (R.24) on the receiver is, however, closely related to this adjustment and is, therefore also dealt with in this section.

2. The gain of the amplifier on "side tone" operation can be adjusted relative to that on "modulation" by means of the tappings provided on the output transformer telephone winding.

3. This tap should be adjusted first and the correct tapping point can only be found by experiment on the actual type of a/c in use. It has been found that in any given a/c pilots will work at a fairly constant side tone level. Hence, if it is found that deeper modulation is required, the telephone tap should be moved down, e.g. from tap 7 to 6. If overmodulation is suspected the reverse should be tried. The correct tap will also, of course, depend on the number of telephones in use in the a/c.

4. The main gain control R.4 should next be adjusted. The setting of this will also depend on the type of a/c in use.

Reducing the gain (turning anti-clockwise) will have the effect of increasing the ratio of signal to a/c noise level when modulating, but will also necessitate the pilot speaking more loudly in order to get side tone. A compromise between these two factors must be struck in setting R.4. It may also be found that the ratio of microphone signal to a/c noise level has to be increased in order to prevent spurious noise operation of the voice operated switching. This can also be effected by turning down the gain on R.4.

5. Finally, having obtained satisfactory results with the above adjustments, the audio gain control R.24 on the receiver should be adjusted. This control only affects the strength of telephone signals on reception and R.24 should be so set that a comfortable signal is obtained in the telephones on reception.

6. Once these adjustments have been found for any particular type of a/c, the taps and gain control settings can be adjusted on the bench.

7. The amplifier gain control setting may be reproduced by noting the angular displacement of the volume control from one of its extreme positions. The receiver gain control may be adjusted with the help of the Test Set Type 5 or 5A and an output meter across the telephone output from the amplifier. The gain is adjusted to give a standard output on the output meter when a signal of standard strength and frequency is injected into the receiver from the Test Set.

PERFORMANCE TESTS OF TR.1133A OR B IN AIRCRAFT

1. These tests, which have been primarily designed to check the wiring and equipment in the aircraft, should only be carried out after the individual units and complete equipment have been tested on the bench and found to be satisfactory.
2. Connect up all plug and socket connections on the junction box assembly to their appropriate positions on the equipment. Connect up the engine starting battery to the equipment by means of the connections provided for the purpose on the aircraft.
3. Plug a head set into the mic-tel socket provided on the junction box assembly.

TEST 1

1. Allow about five seconds between each of the following operations:-

Press button A	slowly	-	Rotary	should	start.
"	"	OFF	"	-	"
"	"	B	"	-	"
"	"	OFF	"	-	"
"	"	C	"	-	"
"	"	OFF	"	-	"
"	"	D	"	-	"
"	"	OFF	"	-	"

TEST 2

1. Hold "OFF" button down and depress each of the buttons A, B, C and D in turn. Rotary should not start.

TEST 3

1. Remove the tuning cover from the main start.
2. Set key "U" to "VO" position.
3. Press each button A, B, C and D in turn, allowing time in each case for the selector drive mechanism to come to rest. The rotary should not stop.

5. The appropriate lamp on the controller should light in each case.
6. The cams on the transmitter and receiver should operate in the correct sequence, i.e. A, B, C, D in order, counting from the panel towards the selector motor.

TEST 4

1. Start up by pressing any one of the buttons A, B, C or D and allow time for the valves to warm up.
2. Set key "U" to position "V0".
3. Shout into the microphone and watch the aerial relay T/13. T/13 should release almost immediately the operator speaks. On cessation of speech T/13 should operate and lamp Lr light after an interval of $1\frac{1}{2}$ to $3\frac{1}{2}$ seconds.
4. Short points 7 and 10 through the socket, Type C, on the junction box. T/13 should remain operated whether shouting into the microphone or not.
5. Open circuit points 7 and 10.
6. Note that lamp Lr is all right.
7. Move key "U" to position "T". T/13 should release and Lr go out. Shout into the microphone, T/13 should remain released and Lr go out.
8. Move key "U" to position "R". T/13 should operate and Lr light.

TEST 5

1. Start up by pressing buttons A, B or C.
2. Connect externally points 1 and 9 through the two-pin socket Type 11 on the junction box.
3. The selector motor should move to position "D" and lamp Lr light.
4. The aerial changeover relay T/13 should release.
5. There should be a continuous 1,000 cycle tone in the telephones.
6. Observe that all the foregoing requirements are not under each of the conditions given below. Check that lamp Lr also operates as follows:-

<u>KEY "U"</u>	<u>VOICE OPERATED SWITCH</u>	<u>LAMP LR</u>
"R"	Normal	Lit
"R"	Shouting into mic.	Lit
"VO"	Normal	Lit
"VO"	Shouting into mic.	Out
"T"	Normal	Out
"T"	Shouting into mic.	Out

Open contacts 1 and 9.

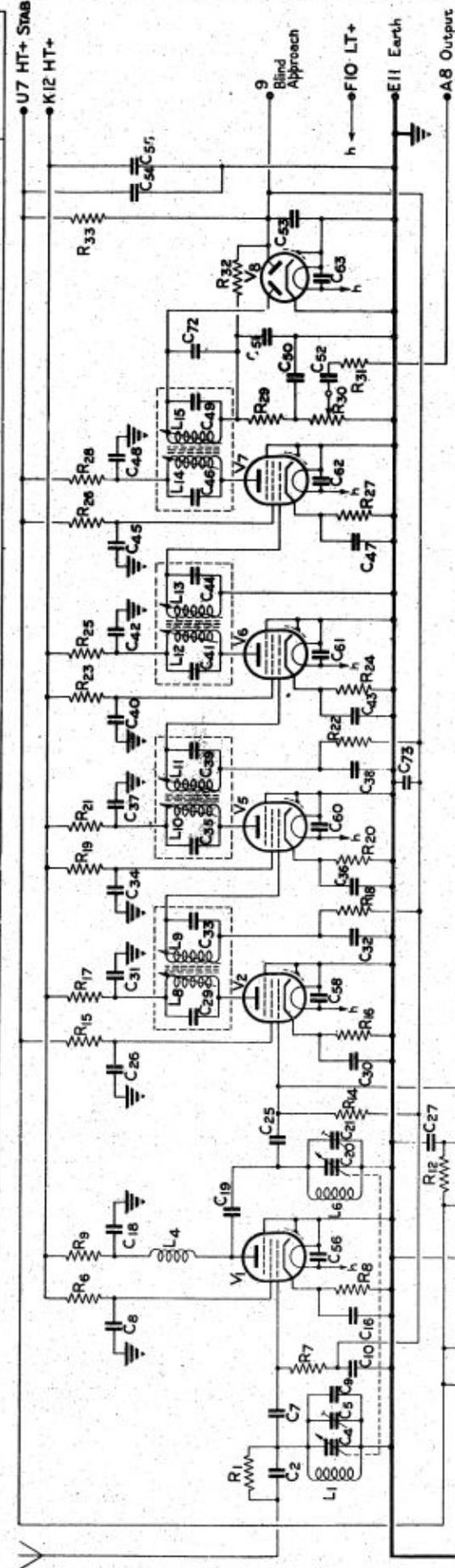
TEST 6

1. Connect up test set, type 5 or 5A in the same manner as in the bench test. Connect an 0-30 ammeter in the battery supply lead.
2. Set key "U" in position "T".
3. Depress each push button in turn and note that the output power readings obtained on the test set are the same as those obtained on the bench test at the same input voltage.
4. Read the total input current and note that this is of the same order as obtained on the bench test.
5. Speak into the microphone and note that the transmitter is modulating as evidenced by an increase of the power output on the test set.
6. Listen to the sidetone and note that it is satisfactory.

TEST 7

1. Connect up Test Set, Type 5 or 5A, in the same manner as in the bench test.
2. Connect an output meter across the telephone terminals as in bench test.
3. Set key "U" in position "R".
4. Depress each push button in turn and note that with the same test set output the same readings are obtained as in the bench tests at the same input voltage.
5. Read the total load current taken from the battery and note that this is of the same order as obtained on the bench test.

R1 R2	R3 R4	R5 R6	R7 R8	R9 R10	R11 R12	R13 R14	R15 R16	R17 R18	R19 R20	R21 R22	R23 R24	R25 R26	R27 R28	R29 R30	R31 R32	R33
C1	C2 C3	C4 C5	C6 C7	C8 C9	C10 C11	C12 C13	C14 C15	C16 C17	C18 C19	C20 C21	C22 C23	C24 C25	C26 C27	C28 C29	C30 C31	C32 C33
L1	L2 L3	L4 L5	L6 L7	L8 L9	L10 L11	L12 L13	L14 L15	L16 L17	L18 L19	L20 L21	L22 L23	L24 L25	L26 L27	L28 L29	L30 L31	L32
V1	V2 V3	V4 V5	V6 V7	V8 V9	V10 V11	V12 V13	V14 V15	V16 V17	V18 V19	V20 V21	V22 V23	V24 V25	V26 V27	V28 V29	V30 V31	V32
X1 X2	X3 X4	X5 X6	X7 X8	X9 X10	X11 X12	X13 X14	X15 X16	X17 X18	X19 X20	X21 X22	X23 X24	X25 X26	X27 X28	X29 X30	X31 X32	X33
S1	S2 S3	S4 S5	S6 S7	S8 S9	S10 S11	S12 S13	S14 S15	S16 S17	S18 S19	S20 S21	S22 S23	S24 S25	S26 S27	S28 S29	S30 S31	S32



CONDENSERS		RESISTANCES	
C1	0.01 μF	R1	10,000 Ω
C2	3 μF	R2	100,000 Ω
C3	10 μF	R3	10,000 Ω
C4	3-19 μF	R4	220 Ω
C5	1.7-9.5 μF	R5	300 μF
C6	0.02 μF	R6	47,000 Ω
C7	10 μF	R7	100,000 Ω
C8	300 μF	R8	330 Ω
C9	11 μF	R9	10,000 Ω
C10	300 μF	R10	100,000 Ω
C11	30 μF	R11	100,000 Ω
C12	50 μF	R12	10,000 Ω
C13	1.7-9.5 μF	R13	220 Ω
C14	3-19 μF	R14	100,000 Ω
C15	300 μF	R15	100,000 Ω
C16	50 μF	R16	300 Ω
C17	0.01 μF	R17	10,000 Ω
C18	0.01 μF	C32	0.1 μF
C19	10 μF	C33	0.1 μF
C20	3-19 μF	C34	0.1 μF
C21	1.7-9.5 μF	C35	75 μF
C22	0.02 μF	C36	0.1 μF
C23	3-19 μF	C37	0.1 μF
C24	1.7-9.5 μF	C38	0.1 μF
C25	3 μF	C39	75 μF
C26	0.02 μF	C40	0.1 μF
C27	300 μF	C41	75 μF
C28	5 μF	C42	0.1 μF
C29	75 μF	C43	0.1 μF
C30	0.1 μF	C44	75 μF
C31	0.1 μF	C45	0.1 μF
C32	0.1 μF	C46	75 μF
C33	75 μF	C47	0.1 μF
C34	0.1 μF	C48	75 μF
C35	100 μF	C49	75 μF
C36	0.1 μF	C50	100 μF
C37	0.1 μF	C51	100 μF
C38	0.1 μF	C52	0.1 μF
C39	75 μF	C53	0.1 μF
C40	0.1 μF	C54	0.1 μF
C41	75 μF	C55	0.1 μF
C42	0.1 μF	C56	300 μF
C43	0.1 μF	C57	0.1 μF
C44	75 μF	C58	0.05 μF
C45	0.1 μF	C59	300 μF
C46	75 μF	C60	0.1 μF
C47	0.1 μF	C61	0.1 μF
C48	75 μF	C62	0.1 μF
C49	75 μF	C63	0.1 μF
C50	100 μF	C64	0.1 μF
C51	100 μF	C65	0.1 μF
C52	0.1 μF	C66	0.1 μF
C53	0.1 μF	C67	0.1 μF
C54	0.1 μF	C68	0.1 μF
C55	0.1 μF	C69	0.1 μF
C56	300 μF	C70	0.1 μF
C57	0.1 μF	C71	0.1 μF
C58	0.05 μF	C72	0.1 μF
C59	300 μF	C73	0.1 μF
C60	0.1 μF		
C61	0.1 μF		
C62	0.1 μF		
C63	0.1 μF		
C64	0.1 μF		
C65	0.1 μF		
C66	0.1 μF		
C67	0.1 μF		
C68	0.1 μF		
C69	0.1 μF		
C70	0.1 μF		
C71	0.1 μF		
C72	0.1 μF		
C73	0.1 μF		

Note:- C64 to C71 are connected across L6 to L18 respectively in early models of the Receiver.

R.1225. CIRCUIT DIAGRAM

FIG. 2

FIG. 2

TUNING PROCEDURE FOR 1143

The layout for tuning (see fig. 13) is identical with that given in fig. 12, except that the contactor and aerial are not fitted, and a test set, 5A, is connected to the transmitter-receiver as shown. A 12 or 24 volt battery of capacity 250 or 125 amp/hrs. should be used, according to whether a power unit, type 15 or 16, is employed. With the test set type 5A it is essential that an artificial aerial, type 14, should be used.

Having completed the connection of the test circuit, the necessary crystals and valves should be fitted in position in the transmitter, receiver and amplifier. It should be noted that the operational frequency of the transmitter is 18 times the resonant frequency of the crystal, while the frequency F_r of the receiver crystals in kc/s may be determined by the formula:-

$$F_r = F_t - 540 \text{ kc/s.}$$

where F_t equals the transmitter frequency in XTAL kc/s.

TRANSMITTER TUNING

1. The meter sockets of the test set type 5A should be connected to the transmitter and receiver metering plugs and the aerial type 14 connected to the aerial socket. The transmitter-receiver should then be switched on, using the button on the controller corresponding to the lowest frequency and also setting the key switch to transmit. After allowing approximately two minutes for the equipment to warm up, tuning may be started as follows:-
2. Set the switch P in the release position (pointing outwards from the cover) and loosen the locking nuts on the condenser spindles about $1\frac{1}{2}$ turns from fully locked position counter clockwise, set the meter switch on the transmitter to position 1 and that on the test set to trans-anode position. The switch P should be reset in the operative position (lying flat)

and the appropriate tuning condensers Tc1, Tc2, Tc3, Tc4 and Tc5 should be set by movement of the pointer to the approximate frequency. Tc1 should be adjusted until the current indicated on the meter is a maximum.

3. The condenser Tc2 should next be adjusted until the current indicated with the meter switch in position 2 is a maximum and the condenser Tc3 and Tc4 should be similarly adjusted with the meter switch in positions 3 and 4 respectively.

4. The meter switch should then be set in position 5 and the condenser Tc5 carefully tuned to maximum meter reading. This completes the preliminary tuning operation, which should be performed as rapidly as possible to avoid overheating the valves.

5. The meter switch should now be turned to position 6 in order to measure the total grid current of V205 and V206. Condensers Tc4, Tc3 and Tc2 should be carefully readjusted in that order to obtain a maximum reading in position 6. If this reading exceeds 50, the condenser Tc1 should be detuned towards the high frequency end of the scale until a reading of 50 is obtained. This may again necessitate a readjustment of Tc4, Tc3 and Tc2. If a reading of 50 cannot be obtained, then Tc1 should be adjusted for maximum obtainable reading, provided that such adjustment renders the final position of Tc1 on the high frequency side of resonance.

6. The high frequency end of the scale may be identified by noting that the anode current of V202, when the meter switch is in position 1, decreases more gradually than when Tc1 is moved in the lower frequency direction. If no grid current can be obtained the preliminary tuning operations should be repeated with greater care.

7. The tuning process should then be carried out on the other channels in order of increasing frequency, the procedure being the same as before. After tuning all four channels, the switch P should be set in the release position and the tuning condensers locking nuts gently turned clockwise, using the knurled clamp nuts.

Continue movement until nut is tight. This locks the cam assemblies. Finally reset the switch P in the operating position and read meter current in all six positions at all four frequencies. A large change of current in any position at the different frequencies will indicate mistuning, which should be corrected by repeating the tuning procedure of the stage effected.

8. When the transmitter is finally tuned, the meter readings should lie within the limits given in the following table. These values are to some extent dependant on the frequency and tend to increase as the frequency increases. If the readings fall very far outside the specified limits even after thoroughly checking all tuning adjustments, reference should be made to the instructions given in precautions and maintenance.

Switch position	1	2	3	4	5	6
No greater than	62	70	82	65	50	50
Not less than	42	40	60	55	40	35

These figures assume that the power unit supplies the following voltages on load:-

H.T.	300 volts
Bias	150 volts at generator or 120 volts at transmitter.
L.T.	12.6 volts at transmitter or 13.1 volts at generator.

RECEIVER TUNING

1. The receiver is similarly tuned, after inserting the crystals and loosening the tuning cam locking nuts by about one turn as before. The test set control switch should be moved to the position Rec.-Avc. and the key switch on the controller set to receive. The press button corresponding to the lowest operating frequency should then be depressed after resetting the switch "P" to the operate position.

2. The test/^{set} should then be set in operation at the required frequency, using the appropriate crystal. The

output should be set at maximum. The frequency of the crystal (F_x) is given by the expression 23.

$$F_x \text{ equals } \frac{F_s - \text{I.F.}}{18}$$

where F_s equals signal frequency in mc/s and I.F. equals intermediate frequency (9.72 mc/s).

3. The receiver unit tuning condensers should then be set manually to the approximate operating frequency

selected and adjusted in the following manner.

4. Swing Tc6, Tc7 and Tc8 until an audio output is heard. With large output from the test set, type 5A many responses may be obtained whilst swinging Tc6 hence it is important to reduce this output until the response corresponding to the smallest input is obtained. Having identified the correct response in this manner, Tc6, Tc7 and Tc8 should be adjusted in that order until the maximum sensitivity is obtained. Particular attention should be given to the adjustment of Tc8. As stated in para. 29, this controls the tuning of the cathode feedback circuit to the crystals and, provided that the crystal in use is of normal activity, the characteristic of this circuit will be flat and no definite tuning point may be obtainable. In all cases it is important that Tc8 should be set to the same approximate scale setting as Tc6 so that if for any reason the the activity of the crystal should decrease, the cathode feedback circuit will be correctly tuned to assist the requisite drive from the anode circuit of V303.

5. The tuning operations described may first be carried out aurally as stated, but the final tuning should be carried out using the A.V.C. meter in the test set, and adjusting until the maximum "backing off" is observed. The test set output must be reduced during the final tuning until a "backing off" of approximately 10 scale divisions is obtained. Under these conditions more accurate settings of Tc6 and Tc7 will be obtainable.

6. The tuning operation should be performed for the three higher frequencies in ascending order, switch "P" released and the mechanisms finally locked as for adjustment of the transmitter. The switch "P" should then be reset in the operate position and the tuning checked by reading the current at each frequency in turn, using the same output settings for the test set, but resetting the test frequency each time. The current reading at each frequency should be approximately equal.

7. On completion of the tuning, the instrument should be installed in the aircraft and connected up. A test set, type 11, should be used to check the radiation of the transmitter on all frequencies and the output tuning condensers readjusted, if necessary, to obtain maximum output. Instructions for the setting of the lock of the S/R switch of the controller electric are to be obtained from the signals officer. The setting of the contactor is dealt with in Section 2, Chap. 4 of A.P. 1186.

SETTING UP OF AMPLIFIER

1. Referring to fig. 19, control A (R 423 in fig. 1) on the top panel should be adjusted with the microphone switch until the standing current is 50. The gain control B (R 402 in fig. 1) should then be adjusted to reduce anode current to 45 with the engine running and the pilot's microphone switched on.

OPERATION IN THE AIR

Switching on and selection of the required frequency is effected by depressing the appropriate push button on the controller electric and switching off is similarly effected by means of the off button. Where full facilities, namely Send, Receive and V/O. are required it will be necessary to set the key switch lock in the release position, otherwise it will be necessary to hold the key switch over in the T position for transmission or it will revert to the receive position.

PRECAUTION AND MAINTENANCE

The equipment should be kept in good, clean condition throughout, dust being removed by blowing out with clean, dry air wherever necessary. All key, relay and plug contacts should be cleaned at intervals with carbon tetrachloride, care being taken not to deform them in the process. Suitable procedure is to pour a few drops of the liquid over the contacts, then operate the contacts manually several times. Moving parts of the tuning mechanism and tuning motor, etc. should periodically be lubricated with a trace of anti-freezing oil, applied to the bearings with the end of a piece of wire dipped in the oil. No oil should be applied to the variable condenser cam assemblies, nor to switch contacts nor insulators.

On no account should any of the trimming condensers of the receiver ganged condensers nor the I/F tuning adjustments be interfered with, except by authorised personnel provided with the appropriate testing equipment. The same applies to the pre-set variable resistance controls on the receiver and amplifier.

CONTROLLER

Apart from contact cleaning and lubrication of the press button mechanism and key switch detent, the controller should need no maintenance. Renewal of pilot lamps, when necessary, may be effected by removing the front panel assembly, held by two screws, extracting the lamp cap with pliers and withdrawing the affected lamp by means of an ordinary pen holder. The renewal may be pushed home with the finger tip, followed by a pencil.

POWER UNIT

1. Power unit should be cleaned periodically by blowing out and the brush gear inspected to ensure that the brushes slide easily in their holders and are firmly held against the commutator by their springs. Brushes showing signs of excessive wear should be renewed and the fit of the new brushes checked.

2. If the commutator appears to be excessively coated with carbon dust, this should be removed by blowing out, removing the brushes for the purpose. The relay contacts should be cleaned as previously described.

3. The dust cover of the voltage regulator should be removed after unscrewing the three captive nuts and the interior cleaned. If the insulation resistance as measured between the live parts and the frame is less than two megohms, the insulator should be cleaned and if this measure fails to correct the fault the regulator should be renewed.

4. Referring to fig. 2A, it will be seen that the rotary transformer in the power unit is provided with three field windings, the shunt field, the series field and the boost field. The L.T. output voltage is fed to the regulator coil RC of the carbon pile through the variable resistance, R1. This resistance is set and should under no circumstance be altered by unauthorised personnel.

Should the input voltage tend to rise, the current through the boost field winding F3 will be increased causing the resistance of the carbon pile to increase also. As the pile is in series with the boost field winding, the current through this field winding will decrease and the field strength will also be decreased. The boost field winding is arranged to oppose the main shunt field winding F2 of the motor only. Any increase in output voltage will therefore cause an increase in the shunt field strength. The machine will then slow down, tending to restore its output voltage to the original figure. The reverse effects will be obtained should the output voltage fall. The speed of the machine will accordingly tend to increase as the input voltage decreases. Reference to the circuit of the power unit, type 15 in fig. 2A will facilitate a clear understanding of this action.

5. As stated in para. 4 the current flowing in the regulator coil is controlled by the setting of the pre-set resistance R1. The carbon pile regulator will only operate correctly if the large adjusting screw in the base of the unit is correctly set. Failure to operate correctly

is shown by large variation of output voltage with input or failure of the rotary transformer to settle down to a steady speed. Such conditions should not be allowed to persist as it will rapidly cause damage to the carbon pile regulator.

BENCH TESTING

1. Before commencing any tests on the power unit, type 15 or type 16, the unit to be tested should be allowed to run for a period of not less than 5 minutes under full load conditions at minimum input voltage respectively. The input voltage should then be increased approximately to 12.5 volts or 25 volts, when the L.T. output voltage should lie between the limits of 12.8 and 13 volts.
2. If the L.T. output voltage does not lie within the limits, the unit should be switched off and a slight adjustment made to the voltage regulator core adjusting screw to which access is provided through the base of the unit and the unit again tested for correct output voltage.
3. Assuming that the output voltage lies within the limits prescribed, the following measurements should then be made.

Each unit under test should be capable of supplying continuously the following outputs when run from a supply voltage ranging from 11.2 to 14 volts in the case of the power unit type 15, and 21.8 volts to 29 volts in the case of the power unit type 16.

L.T. 3.9 amps. for 13 volts.

M.T. 10 ma. at 165 volts for power unit type 15.

M.T. 10 ma. at 150 volts for power unit type 16.

H.T. 260 ma. at 300 volts for power units type
15 and 16.

All voltages should be measured at the input and output plugs with a suitable meter.

4. Instability. If, on initial test, the rotary transformer in the power unit does not settle down to a

steady speed, which will be indicated by large variations of output voltage, the carbon pile compression adjusting screw may be screwed gradually in a clockwise direction in progressive steps until the speed variation just ceases. From this point the compression adjusting screw should be further rotated in the same direction by 45 degrees as a safety measure and the voltage regulator core adjusting screw readjusted as required.

5. The adjustments described in the preceding paragraph must in no circumstances be carried out by unauthorised personnel.

If conditions of satisfactory stability and regulation are not fulfilled by these adjustments, the power unit should be readjusted.

TRANSMITTERS

1. If any difficulty is experienced in tuning the transmitter to obtain the required output or grid current, one or more of the valves may need renewal. A faulty valve is usually indicated by the fact that when the set is tuned the anode current of the earlier valves will be high while those of the subsequent valves will be low. When changing the valves, it is convenient to remove the top cap connections by leverage, using the end of a screw-driver. When two valves have a common retainer, both caps and retainer should be removed before changing the valve. In the case of the valve V205 and V206, the locking clamp at the base of the valve should be loosened by unscrewing the clamping screw.

2. A check of the efficiency of the valves may be made by checking the anode current of each valve when its anode circuit is tuned. This entails tuning Tc3 with the meter switch in position 1, Tc3 in position 2, Tc4 in position 3, Tc5 in position 4. A pronounced dip should be observed at resonance in each case.

NEUTRALISING PROCEDURE FOR TR.1143

1. Neutralisation of output stage may be necessitated after changing output valves or for other

reasons. Faulty neutralisation is indicated by instability when the equipment is set to receive and high input is applied to the pilot's mike, in which case a howl may be heard in the receiver, or the receiver may be blocked. Alternatively, the transmission may be terribly distorted. A check of the neutralisation may be made after releasing switch "P". Switch equipment to receive and short circuit contactor contact at the transmitter. This will set amplifier oscillating and apply high modulation voltage to V205 and V206 (P.A.). Most convenient place to short contactor is at the junction box. With meter switch in position 5, verify whatever positions (relative) of Tc4 Tc5 within complete frequency range, no meter reading is observed in these conditions. If no reading is observed, transmitter is correctly neutralised.

2. If as a result of the test prescribed in the preceding paragraph, output current is found in position 5, it will be necessary to re-neutralise transmitter by proceeding as follows:-

Remove amplifier unit - set equipment at transmit - after inserting crystal for 6225 kc/s or a crystal of the nearest frequency to this available, tune set as described in the tuning procedure. Then set switch to position 6 and adjust Tc4 to maximum - set switch to position 5, adjust Tc5 to maximum. If the reading exceeds one division full scale corresponding to 100, readjust neutralisation condensers C219, C220 until meter reading becomes less than one division, then repeat test procedure described in para. 1.

3. The neutralising condensers are adjusted by moving shutter upwards or downwards after loosening clamping screws; these should only be loose enough to permit easy movement of the shutter when pushed down by a screw-driver applied as a lever between tabs on the shutter and chassis. When making final adjustments it is advisable to tighten one of the clamping screws and pivot the opposite side of the shutter down as necessary.

4. As a guide to the directions of movement necessary, if the frequency at which a reading was obtained (under the described conditions in para. 1), lies at the

low frequency end of the frequency range, move the shutter upwards and if at the high frequency end, move the shutter downwards. Adjustment should be continued until conditions in para. 2 are satisfied and operation should again be checked in accordance with the test given in para. 1.

5. Note as regards changing valves that the valve, even if unsuitable in one position, may be frequently useful in another position, i.e. a valve which will not perform in a proper manner as a frequency trebler V3 or doubler V4 may be suitable for use as an output valve in position V5 or V6.

6. Apart from poor neutralisation apparent trouble in tuning the output stage involving low output readings in position 5 with normal performance of V5 and V6 may be caused by failure of monitor valve V7, or the wrong setting of the monitor coupling condenser C310. If the locking nuts of movable disc of this component have become loose, C310 may possibly have been set too far away from Tc5. The normal position of this disc is approximately two-thirds of an inch from the nearest point of the stand off insulator.

7. If difficulty is experienced in tuning Tc2, Tc3 or Tc4 at extreme end of frequency range scale, this may be due to either C210 or C214 having become displaced (due to maintenance repairs or careless handling) from their correct positions so that they are in close proximity to the chassis or other earthed component. Alternatively a faulty valve may cause this trouble.

VOLTAGE AND CURRENT ANALYSIS FOR TR.1143

All measurements made with Avometer Type F,
Stores Ref.10S/1. Transmitter Unit Type 17.

STATIC CONDITION

Test	Freq.in Mc/s.	Meter Setting	V-1	V-2	V-3	V-4	V5-6	V-7
Anode-Earth	-	0-400 V.	165	280	300	298	295	-
Screen-Earth	-	0-400 V.	72	170	236	242	190	-
Bias -Earth	-	0-400 V.	-	58	73	100	26	-
Anode Current	-	0-1 mA	0.9mA	-	-	-	0.13	-

DYNAMIC CONDITION

Anode-Earth	108	0-400 V.	217	225	300	270	280	-
Screen-Earth	108	0-400 V.	115	120	193	180	150	-
Bias -Earth	108	0-400 V.	-	58	75	102	27	-
Anode Current	108	0-1 mA	* 5	.43	.47	.59	.56	.44
Anode Current	124	0-1 mA	* 5	.49	.55	.68	.51	.47
Grid Current	108	0-1 mA	-	-	-	-	.50	-
Grid Current	124	0-1 mA	-	-	-	-	.36	-

NOTE:- Current readings : 75 ohms 0-1 mA meter range
except for currents marked *
where 0.01 amp. range is used.

RECEIVER UNIT TYPE 19STATIC CONDITION

Test	V-1	V-2	V-3	V-4	V-5	V-6	V-7	V-8
Anode -Earth	240	270	250	240	240	240	240	150
Screen -Earth	200	240	250	100	100	100	200	-
Cathode-Earth	1.6	3.4	20	-	2.3	2.3	1.6	-

Total Current
= 79 mA

DYNAMIC CONDITION

Test	V-1	V-2	V-3	V-4	V-5	V-6	V-7	V-8
Anode -Earth	240	270	240	260	240	240	240	200
Screen -Earth	200	240	240	150	100	100	200	-
Cathode-Earth	1.6	3.4	25	-	2.3	2.3	1.6	-

Total
Current =
74 mA

- NOTE:-
- (i) All dynamic readings obtained at point of relay release at frequency 110 Mc/s.
 - (ii) All readings taken on 0-400 V.D.C. Range except V3 cathode on 100 V.D.C. Range and all other cathodes on 10 V.D.C. Range.

AMPLIFIER UNIT TYPE 18VOLTAGE READINGS

Test	V1	V2	V3	V4/V5 No Input	V4/V5 30 mV Input	V6 No Input	V6 30 mV Input
Anode -Earth	130	290	297	297	297	230	290
Screen -Earth	60	-	40	265	230	-	-
Cathode-Earth	3.0	-	0.9	-	-	-	-

CURRENT READINGS

Test	V1	V2	V3	V4/V5 30 mV Input	V4/V5 60 mV Input	V6 No Input	V6 30 mV Input
Current Working							
Anode Current	0.6	5.5	1.2	33	60	5	-
Screen Current	0.2	-	0.35	5.8	14	-	-

- NOTE:-
- (i) Total bias current, i.e. through R19 - 1.2 mA
 - (ii) Voltage to earth at junction of R18 and R19 - 35 V.
Voltage to earth at junction of R17 and R18 - 26V
Voltage to earth at junction of R15 and R17 - 6.0 V.
 - (iii) All voltage measurements made on 0-1000 v. range except cathode voltages taken on 100 V. and 10 V. ranges.

Power Units Types 15 and 16Power Unit Type 16

Input brush rocker pressure - 9 ozs.
H.T. output brush rocker pressure- $3\frac{1}{4}$ ozs.
H.T. output brush rocker pressure- $3\frac{1}{4}$ ozs.
L.T. output brush rocker pressure- 6 ozs.

Power Unit Type 15

Input brush rocker pressure - 6 ozs.
Power Units should be lubricated as follows:-

Two drops of oil type 34A/60 applied to
each bearing after every 30 hours running.

COMPONENTS OF TR. 1143POWER UNIT

Ref.	Value	Ref.	Value
R1	12	C3	.002 mf
R2	0 or 0.3	C4	.002 mf
R3		C5	.002 mf
C1	.001 mf	C6	.002 mf
C2	.001 mf	C7	.002 mf

CHASSIS

R101	3900	C103	2 mf
R102	47	C104	2 mf
R103	33	C105	20 mmf
C101	2 mf	C106	.0003 mf
C102	2 mf		

TRANSMITTER

R201	100000	R219	620
R202	15000	R220	1000
R203	100000	R221	1000
R204	47	R222	10.72
R205	100000	R223	1.92
R206	15000	R226	47
R207	150000	R227	6200
R208	39000	R228	6200
R209	47000	R229	6200
R210	39000	R230	6200
R211	1000	R231	47
R212	47000	R232	47
R213		R233	6800
R214		R234	27
R215	15000	R235	42
R216	15000	R236	9100
R217	33	R238	47000
R218	620	R237	9100

Ref.	Value	Ref.	Value
<u>AMPLIFIER (Cont'd.)</u>			
R433	10000	R314	100000
R434	125	R315	47000
R435	1M	R316	
R436	4700	R317	1000
R437	1.5	R318	10000
C401	100 mmf	R319	10000
C402	100 mmf	R320	100000
C403		R321	100000
C404	300 mmf	R322	68000
C405	0.01 mf	R323	330
C406	0.25 mf	R324	10000
C407	0.25 mf	R325	100000
C408	0.01 mf	R326	100000
C409	0.1 mf	R327	68000
C410	0.25 mf	R328	330
C411	0.5 mf	R329	10000
C412	0.25 mf	R330	47000
C413	0.5 mf	R331	220
C414	0.25 mf	R332	10000
C415	.001 mf	R333	47000
C416	.0003 mf	R334	200000
C417	.002 mf	R335	470000
C418	0.1 mf	R336	82000
		R337	33000
		R338	2.2M
		R339	4700
		R340	68000
		R341	22000
		R342	22000
		R343	2.2M
		R344	2.2M
		R345	2.2M
		R346	2.2M
		R347	47000
		R348	47
		R349	100000
		R350	100000
		R351	100000
		R352	100000
		R353	100000
<u>RECEIVER</u>			
R301	10000		
R302	47000		
R303	47		
R304	100000		
R305	47000		
R306	1800		
R307	1800		
R308	220		
R309	2200		
R310	10000		
R311	8.3		
R312	100000		
R313	100000		

Ref.	Value	Ref.	Value
<u>RECEIVER</u> (Ctd.)			
R354	100000	C334	3 mmf
R355	100000	C335	75 mmf
R356	100000	C336	.01 mf
R357	22000	C337	75 mmf
R358	47000	C338	.01 mf
C301	3 mmf	C339	.01 mf
C302	4/16 mmf	C340	.01 mf
C303	2/6 mmf	C341	75 mmf
C304	8 mmf	C342	.01 mf
C305	.0003 mf	C343	.01 mf
C306	.0003 mf	C344	75 mmf
C307	.01 mf	C345	.01 mf
C308	.01 mf	C346	75 mmf
C309	40 mmf	C347	.01 mf
C310	.01 mf	C348	.01 mf
C311	3.2/20 mmf	C349	75 mmf
C312	2/6 mmf	C350	.01 mf
C313	.003 mf	C351	50 mmf
C314	4/16 mmf	C352	50 mmf
C315	4/16 mmf	C353	75 mmf
C316		C354	0.1 mf
C317	2/6 mmf	C355	.05 mf
C318	300 mmf	C356	.02 mf
C319	300 mmf	C357	0.1 mf
C320	4/16 mmf	C358	.002 mf
C321	.01 mf	C359	.01 mf
C322	20 mmf	C360	.01 mf
C323	2/6 mmf	C362	.0003 mf
C324	5 mmf	C361	.0003 mf
C325		C363	.01 mf
C326	4/16 mmf	C364	.01 mf
C327	.01 mf	C365	.01 mf
C328	75 mmf	C366	.01 mf
C329	2, 6 mmf	C367	.0003 mf
C330	.01 mf	C368	.0003 mf
C331	.01 mf	C369	.01 mf
C332	6 mmf	C370	.01 mf
C333	.01 mf	C371	.01 mf
		C372	.002 mf
		C373	.01 mf
		C374	75 mmf

Ref.	Value	Ref.	Value
<u>RECEIVER (Contd.)</u>		<u>CONDENSER MOTOR.</u>	
C375	20 mmf	R501	10
		C501	1 mf
		C502	1 mf

SERVICING TR. 1143

GENERAL

1. The Tr. 1143 Power Unit Type 16, Controller Electric Type 3, Junction Box Assembly Type 17B and Connectors should be removed from the aircraft to the signals workshop. All necessary batteries and testing apparatus should be readily available there.
2. All numbered references to figures and diagrams refer to those used in AP. 1186A, Vol. 1, Sec. 10, Chap. 4 (provisional) or AP. 2528, Vol. 1, Sec. 1.
3. Where relay contacts have to be cleaned the best method to adopt is to cut from thin stiff clean card several narrow strips approximately 4" x $\frac{1}{2}$ ". If one of these, with a moistening of carbon-tetrachloride (ref. 33C/620) is placed between the actual relay contacts and given several forward and backward movements while manually operating the relay, cleaning the actual bearing surface of the contacts will be accomplished without distortion of the leaf springs.
4. Where oil has to be applied to moving parts, use anti-freeze oil very sparingly, ensuring that it does not penetrate to other parts on the chassis.

DISMANTLING

5. Remove outer casing by releasing four large Dzus fasteners and lift set out. Clean outer case.
6. Remove two, slide back metal covers by unscrewing retaining screws at each end.
7. Ensure that all selector mechanism is at neutral i.e. all selector fingers are disengaged from slide bars controlling rotation of transmitter and receiver tuning condensers. If this is not already so, connect set to a supply and operate release switch on top of motor unit.
8. Remove center metal cover bearing TR. 1143 aerial and reference numbers by unscrewing four nickel plated round head screws. No black enamelled screws need be removed. Removal of this cover exposes the aerial change-over relay and all connections of the Jones socket into which the transmitter, receiver and amplifier chassis plug.
9. Remove transmitter, receiver and amplifier chassis by removing red painted screws (four for transmitter, three for receiver, three for amplifier). If the whole chassis is stood on the end nearest the selector mechanism, the transmitter, receiver and amplifier will ease out gradually without distortion of the chassis.

TRANSMITTER UNIT, TYPE 17 (10 R/1)

10. Remove crystals. Check for wear on small insulating cylindrical washers which operate the crystal switch contacts. Clean crystal switch contacts.
11. Remove end and side panels to expose valves.
12. Remove valves and examine valve pins and caps for cleanliness and security. Examine valve holders and retaining clips and springs. Clean valve pins with carbon tetrachloride. Examine braided flexible lead to valve top cap clips for evidence of fraying and renew if necessary.

13. Ensure that the braided leads to the valve caps of the VT. 501 valves in the second trebler and doubler stages (V203 and V204) are not long enough to permit them to earth against the chassis under vibration.
14. Inspect coils for security and check for foreign matter or dust between tuning condenser vanes. Clean out with stiff card if necessary.
15. Screens exist between the variable condensers. In some cases the washers on the condenser assembly pillars project to a degree where they touch these screens. In such cases the side of the washer nearest the screen is to be filed flat, using a small flat file. Care must be taken to remove the filings after this operation.
16. Check that condenser spindle extensions are not loose.
17. Check all four selector slides for cleanliness, freedom of movement and their prompt return to neutral position when free. Oil may be used sparingly on the slides, care being taken to ensure that it is not allowed to reach the condenser assemblies which are not intended to be oiled.
18. If meter switch contacts are dirty, clean with a small camel hair brush moistened with carbon tetrachloride.
19. Inspect wiring for dry joints and security.
20. Clean out under chassis, particularly near the R.F. sections of the circuit, using a small soft brush and/or a blower. Do not distort the R.F. wiring or coils in any way and do not twist either condensers or resistors on their end wires.
21. Inspect all screw connections and component supports and tighten where necessary.
22. Clean or blow out dust that may be lodged between the two flat metal plates mounted together and running from the aerial coupling coil to the aerial socket.

23. Replace valves retaining clips, etc. and metal panels.

RECEIVER UNIT, TYPE 19 (10 P/2).

24. Remove crystals. Check for wear on small insulating cylindrical washers which operate crystal switch contacts. Clean crystal switch contacts.

25. Remove valves and check as in para. 12 (care must be used in the extraction of the VR 91's).

26. Inspect components above and below chassis for security and cleanliness. Use blower to remove dust. Do not distort RF coils or wiring.

27. Inspect tuning condenser vanes for freedom of movement and cleanliness. See para. 14 re cleaning. Pay particular attention to oscillator tuning condenser which, because of its position, is liable to be overlooked.

28. Check condenser tuning spindle extensions for looseness.

29. Do NOT move settings of any of the trimming condensers nor the I.F. transformer adjustments.

30. Check muting relay adjustment and clean contacts.

31. Check selector slides as in para. 17.

32. Clean out the aerial coaxial socket and check wiring.

33. Replace valves retaining clips and bands. Ensure that the top cap connections are secure when fitted and that their flexible leads are not fraying. In the case of the oscillator valve VT 52 ensure that the top cap connection does not make contact with the earth screening can.

AMPLIFIER UNIT TYPE 18 (10 U/2)

34. Remove valves and deal with them and their holders as in para. 12.
35. Examine components and wiring for security and cleanliness.

RELAY UNITS (10 A/13027)

36. Turn the main chassis over carefully with the "W" sockets undermost and with the selector motor nearest the front of the bench. The relay unit is now uppermost and may be removed by releasing Dzus fasteners which are on a cross member between the relay unit and the selector motor assembly. Remove unit by sliding and lifting and remove the dust cover which is retained by one screw.
37. Inspect row of knife connections arranged in ten pairs. Clean carefully without distorting or shorting any connections.
38. Clean relay contacts carefully. Depress each relay armature manually and see that it opens and closes contacts and has not become dislodged from its normal pivoting position.
39. Examine wiring and connections and check security of relays.
40. Replace dust cover carefully.

SELECTOR MOTOR UNIT (10 D/635).

41. Place main chassis in normal position, i.e. aerial relay uppermost.
42. Lift off each of the extension rod yokes (4 off) going to receiver selector fingers across the top of the chassis. These rod yokes are each held in position on the selector motor bell cranks by a thin leaf spring which normally prevents them slipping off. Gently lift each spring and ease the rod yoke free, starting with the topmost. When all four are free and

clear of the selector motor mechanism, and not before, the three screws holding the selector motor unit to the main chassis may be unscrewed and the unit withdrawn upwards.

43. By depressing and releasing manually the selector motor and driving motor armatures, the normal movement of the mechanism may be observed in slow motion. Check that each ratchet movement is moving correctly.

44. The longer armature found underneath the release which operates the cams and insulating discs associated with the leaf spring contacts. These should be inspected and the relative movement of the contacts checked. Clean carefully.

45. The other motor armature should be operated manually through a whole cycle and the movement and the return of the selector fingers checked.

46. Other contacts on the leaf spring should be cleaned carefully, care being taken not to distort them.

47. Oil must be used sparingly and then only on the working bearings, cog teeth and sliding parts.

48. Check wiring.

49. Leave all selector fingers and boll crank levers in neutral position.

MAIN CHASSIS (TOP TRAY).

50. Clean all dust from chassis with small soft brush and/or blower.

51. Check return springs on receiver selector fingers.

52. Inspect all wiring and connections for security.

45.
53. Inspect all knife connections into which slide the appropriate connections of the motor unit and relay unit and where these show signs of being open unduly, careful re-positioning should be done.

AERIAL CHANGE-OVER ASSEMBLY (10 F/774).

54. This unit is attached to the main chassis by three screws which are accessible from the top of the chassis. They can be readily identified by observing the underside of the main chassis near the two aerial sockets into which the transmitter and receiver plug.

55. Clean relay contacts.

56. Clean between strips connecting aerial sockets and relay leaf springs. Do not distort them in any way.

57. Clean dust from insulating materials inside and outside of the three aerial sockets.

58. Check wiring and connections for security.

RE-ASSEMBLING.

59. Replace aerial change-over assembly.

60. Replace relay unit, carefully engaging knife contacts.

61. Replace selector motor unit. Do not screw down tightly at this stage. Connect up extension rod yokes to boll crank levers in original position.

62. Replace amplifier and screw to chassis firmly.

63. Replace receiver. Screw up to chassis firmly, ensuring that the selector fingers on the main chassis register with the appropriate channel slides on the receiver.

64. Replace the transmitter and screw up to chassis firmly.

65. Now loosen and line up selector motor mechanism so that the selector fingers on the motor unit engage correctly with the slide bars on the transmitter chassis and screw tightly when positioned.

66. The whole unit may now be tested for correct operation, using a known serviceable junction box assembly. If satisfactory, covers may be replaced.

CONTROLLER ELECTRIC TYPE 3 (10J/26).

67. Apart from contact cleaning and lubrication of the press button mechanism and key switch detent, the controller should need no maintenance. Renewal of the pilot lamps, when necessary, may be effected by removing the front plate assembly, held by two screws, extracting the lamp caps with pliers and withdrawing the U/S lamp by means of an ordinary pen holder. The renewal lamp may be pushed home with a pencil.

JUNCTION BOX ASSEMBLY TYPE 17B (10/12650).

68. All connectors are easily detachable from the junction box and should be completely removed for testing.

69. Ensure that all connectors are firmly attached to the Breeze metallic sleeving and that the knurled locking nuts are undamaged.

70. Check continuity of wiring in junction box and connectors.

71. Re-assemble and connect up to associated Tr. 1143 controller electric, type 3 and power unit type 15 or 16, as the case may be. Check and tune for correct channel selection and operation before replacing in aircraft.

POWER UNIT TYPE 16 (10K/12650).

72. See Signals Pamphlet A/L1.

POWER UNIT TYPE 15 and 16.General Description.

73. These power units are designed to provide power for the low voltage, bias and high voltage supplies of the transmitter, receiver and controller circuits. They include a carbon pile voltage regulator type G which maintains the output voltages within close limits at any battery input voltage over the ranges 21.6 to 29 volts in the 24 volt unit (type 16) and 10.8 to 14 volts in the 12 volt unit (type 15).

74. For satisfactory operation of TR. 1143 this regulator is most important; if out of adjustment the output voltages vary greatly with variation of input voltages, the filament supply volts being as low as 8.9 at 12 volts input and as high as 16.8 volts at 14.5 volts input. Corresponding increases occur in H.T. and G.B. volts with consequential damage to sets.

DESCRIPTION OF ASSEMBLY OF POWER UNITS.

75. The power unit has three generator commutators supplying 300 volts at .26 amp. H.T., minus 150 volt at .01 amp G.B. and 14.5 volts at 4.9 amps L.T., also one motor commutator (input). There are three fields operating from the battery voltage. A long shunt field and a series field, which ensures sufficient starting torque at low temperatures are both assembled on the same pair of poles and act on all four armature windings. A second pair of poles is provided on which are wound the regulator field coils. This regulator field acts only on the motor winding and is so constructed that its flux induces a voltage in the motor winding that is in direct opposition to the counter E.M.F.

SERVICING OF POWER UNITS.

76. (a) Remove rotary transformer from cradle and disconnect all leads. Remove all brushes by lifting brush spring. Withdraw armature from casing. Thoroughly inspect all parts and clean. Make continuity checks of all windings on the armature, segment to segment. These should be 5 to 7 ohms H.T. and G.B. and 1 to 2 ohms input and L.T. Give megger insulation test (500 volts) between windings, i.e. L.T. windings to G.B. windings, etc. Reading should not be less than 8 ohms. Megger test windings to frame. Readings should not be less than 8 Megohms. The above tests should be carried out when the power unit has been brought to its normal working temperature by running on the bench.

(b) Certain units (power) may contain a high resistance joint in the motor generator positive input circuit. In some instances the red lead connecting the motor generator to the starter has not been tinned prior to soldering at the starter and nor has sufficient heat

been applied to the cable lug, and a dry joint has resulted. The fault may not reveal itself under normal testing conditions, but under service conditions vibration may cause further deterioration of the connection with consequent "hunting" of the generator. It is believed that power units containing this fault lie within the following limits:-

Power unit type 15	G13400 - G14700
Power unit type 16	G9800 - G11000

All power units to be inspected and rectified where faulty.

(c) Megger all parts of the circuit which are above earth or frame potential, including brush holders and connections.

(d) If the above tests are satisfactory, clean all parts thoroughly with lead-free petrol applied sparingly. Reassemble armature fit input brushes only. Inspect and service commutators. If these are in bad condition they should be skimmed in a lathe as finely as possible and then rubbed down with successive grades of glass paper with a final finishing with crocus paper and Belco No. 1 rubbing down compound. An additional aid is a brush, commutating, cleaning (ref. 1A/3947). This glass wool brush is quicker than crocus paper but, being more severe, must be used carefully. If commutators are in good condition apply Belco No. 1 Compound with a soft pad pressed firmly on the commutator and run at normal speed for a few minutes. Clean off remains of compound with carbon tetrachloride. To clean the input commutator the armature must be turned by hand or coupled to another unit.

DO NOT USE EMERY PAPER OR CLOTH ON COMMUTATORS.

(e) Inspect bearings, end plates and armature for wear and end play. If end play is marked, "shims" should be made and fitted to prevent this. Lightly oil with lubricant. DO NOT USE GREASE.

(f) Inspect brushes and renew if cracked or worn badly. Refit brushes. Ensure brushes are free to move

longitudinally in holders and that they are bedded down correctly. Bedding down should be carried out in the normal manner, using a strip of fine glass paper wrapped around the commutator. Brushes which appear to be soft should be discarded.

(g) Check for central positioning of brush springs on heads of brushes and for spring tension. Spring tension should be $8\frac{1}{2}$ ozs. on the input and L.T. output brushes and 3 ozs. on the 300 V. H.T. and 150V. G.B. brushes. Adjustment of spring tension should be made by means of the adjusting screw and not by bending or reshaping the springs.

(h) Reassemble power unit and connect to TR.1143 (tuned) on the test bench with test set type 44 and listen, with telephones connected in the normal way to TR.1143, to generator noise in the phones. Excessive noise is a sign that the power unit needs more servicing and attention should again be given to bedding down, spring connections, etc.

(j) When reassembling the power unit care must be taken to ensure that whilst replacing the main cover the gauze ventilator does not displace the rubber ring on the input, i.e. single commutator, end of the rotary transformer. Cases have occurred where this rubber ring has been displaced and has fouled the ventilating fan, thus causing the main fuses to blow. This ring should be inspected to ensure that it is firmly fixed to the machine frame, and, when necessary Bostic cement should be applied to effect good adhesion.

DESCRIPTION AND OPERATION OF REGUIA TOR.

77. (a) A large scale wall diagram, A.D. 5086 is available for this voltage regulator and should be displayed in Squadron Signals' Workshops.

(b) The carbon pile regulator consists essentially of 78 thin carbon washers, each of .5 mm. thickness (the carbon pile), a spring assembly which compresses the carbon pile and a coil and magnetic circuit which is energised by the L.T. output winding of the power unit and pulls on the spring assembly.

(c) The spring assembly contains a three-leaf spring. Attached to one side of this spring is the lower contact of the carbon pile and to the other side is a disc of steel which is part of the magnetic circuit. The fingers of the spring rest upon a bi-metal washer which provided compensation for changes in temperature due to the fact that it distorts with changes in ambient temperature.

(d) A ceramic tube extending vertically from the spring assembly into the top casing contains the carbon pile. A screw on top above the pile adjust the initial pile pressure and the larger screw on the bottom adjusts the air gap of the magnetic circuit. Under ordinary circumstances, these adjustments should not be touched. However, if it is determined that adjustment is necessary it should be done carefully in accordance with instructions given below in para. 79.

(e) The operation of the regulator depends upon the fact that the electrical resistance of carbon decreases with an increase of applied pressure. When the regulator coil is not energised the spring applies the maximum pressure to the carbon pile. Energising the coil pulls the spring downward, thereby relieving the pressure on the pile and increasing its resistance.

(f) If for some reason the supply voltage should decrease, at the instant of decrease the main field will weaken, the speed of the armature will not have changed appreciably, and the L.T. output voltage will therefore fall. This immediate fall in output voltage will cause the resistance of the carbon pile to decrease, with a resultant increase in boost field strength. Decreasing the regulator coil current reduces the pull on the regulator armature and compresses the carbon pile, compensating for the decrease of input voltage as applied to the armature, thus finally returning the L.T. voltage output to the required working level.

(g) An increase of supply voltage causes a sequence of operations in the opposite direction, therefore the output voltages remain very nearly constant for fairly large variations of supply voltages.

(h) The successful operation of these power units is plainly dependant on the accurate setting up of the

voltage regulator type G. These regulators are very carefully set and locked by makers before being assembled to the power unit chassis. Every care should be exercised and inspection made that the poor operation of power unit is, in fact, due to this regulator before making any adjustment. If adjustment is necessary, complete knowledge of operation of this regulator and method to be adopted must be understood.

(j) The carbon pile takes some 60 to 100 hours of use before really settling down to stable operation and before adjustments remain reasonably constant. Should it be found that the output volts vary with variations of input voltage, the procedure as laid down should be first carried out.

ADJUSTMENT OF OUTPUT VOLTAGES.

78. (a) Connect power unit to TR. 1143 equipment and battery supply. A connector set and conductors for this supply should be similar in length and gauge for aircraft with which TR. 1143 is to be used. Resistance of input leads should not exceed 0.15 ohms.

Battery supply 24 volts for type 16 - Boosted
by type 115 power unit 10K/315
if available.

Battery supply 12 volt for type 15.

(b) An additional 4 volts should also be available for connecting in series with 12 or 24 volts for checking regulation of power units. Allow equipment to warm up for at least 10 minutes. Measure L.T. output using accurate voltmeter connected between chassis and L.T. positive located on top of output filter box.

Input must be between 26 and 28 for type 16. These figures can be obtained by boosted and unboosted supply.

Input must be 12.5 to 14.5 for type 15.

(c) The L.T. output voltage should read 13 to 13.2 volts. If this reading does not fall in this range, very carefully adjust the tap on regulator ballast series resistance until it does. If still not obtained, return resistance tap to original position. Tighten screw on tap.

ADJUSTMENT OF CARBON PILE REGULATOR.

79. There are three adjustments to type G regulator:-

- (a) a variable ballast resistance already referred to which adjusts regulator coil current; (should not exceed one amp.)
- (b) compression of carbon pile, screw located under top cover.
- (c) regulator air gap adjusting screw, located through base of power unit.

NOTE: Great care should be exercised and every precaution taken to prevent damage to the regulator by haphazard adjustment.

80. The above adjustment can only be compromised between regulation and stability and this should be borne in mind.

81. If the power unit is connected to a poorly regulated supply and/or long high resistance leads, there is a tendency for instability, i.e. speed of power unit may fluctuate.

82. To test for regulation, the input voltage at the terminals of the input filter box should be varied over the ranges of 22 to 28 volts in the case of 24v, type 16 and 11 to 14.5v. in type 15 (12) as described in para. 77.

83. The L.T. output measured between chassis and output terminals on output filter box should remain within the limits of 12.7 and 13.3 volts; better figures can often be obtained.

84. Stop and start the unit under test several times to ensure that regulator will be stable in actual operation. It should start up without making more than two or three cycles of speed fluctuation. If **unstable** it may only be necessary to adjust very slightly the compression screw on the top of the regulator under the cover.

85. In adjusting this screw after loosening the clamping screw it should be borne in mind that turning the screw in a clockwise direction increases stability but decreases regulation. Anti-clockwise turning decreases stability and increases regulation.

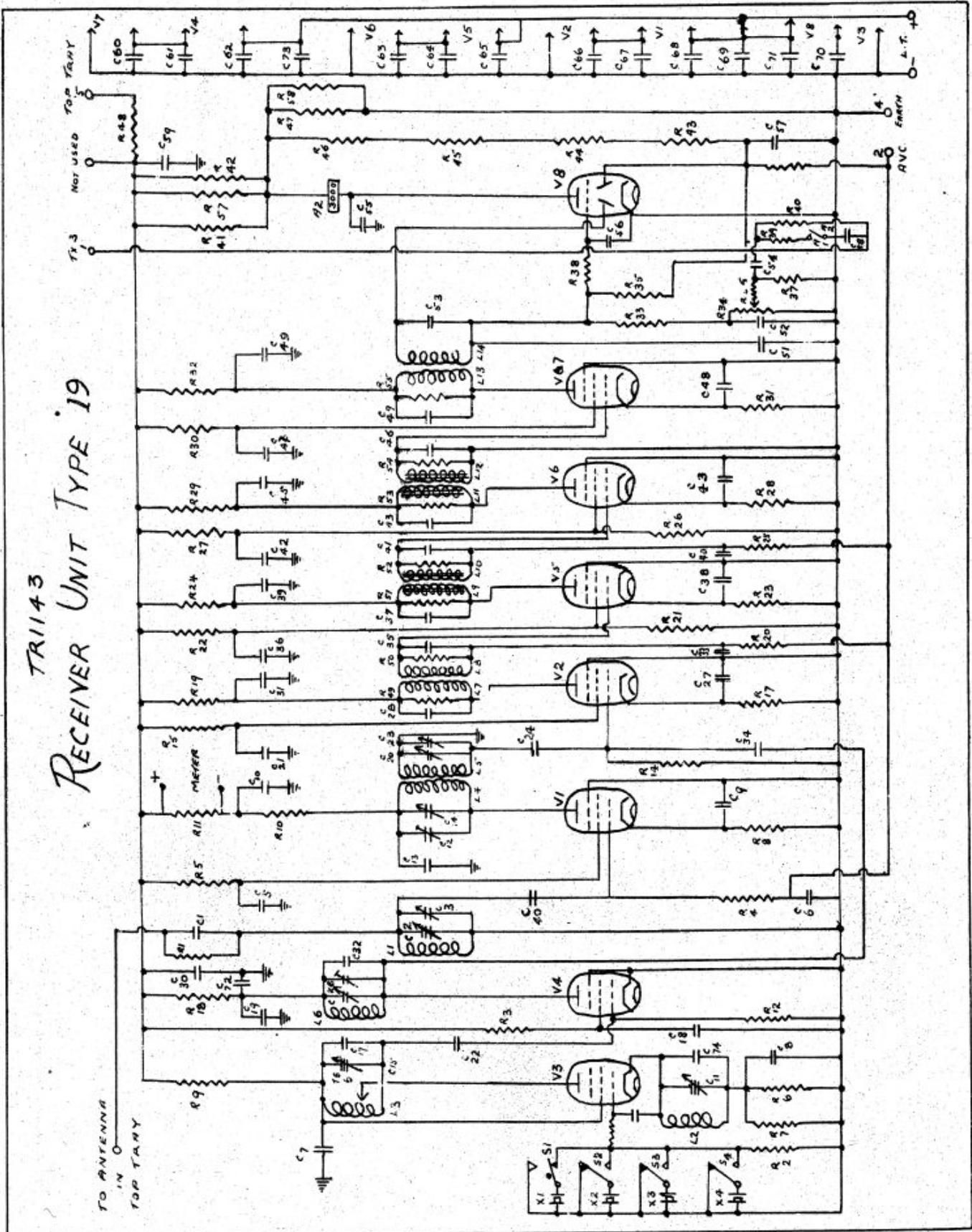
86. At no time should this compression screw be moved through more than 10 degrees of its rotation for each check. Lock the adjustments between each check as vibration may tend to shift the compression screw. If the above check and adjustment fails to obtain correct regulation and stability, or if the regulator has been maladjusted far from the correct settings, the following procedure should be used:-

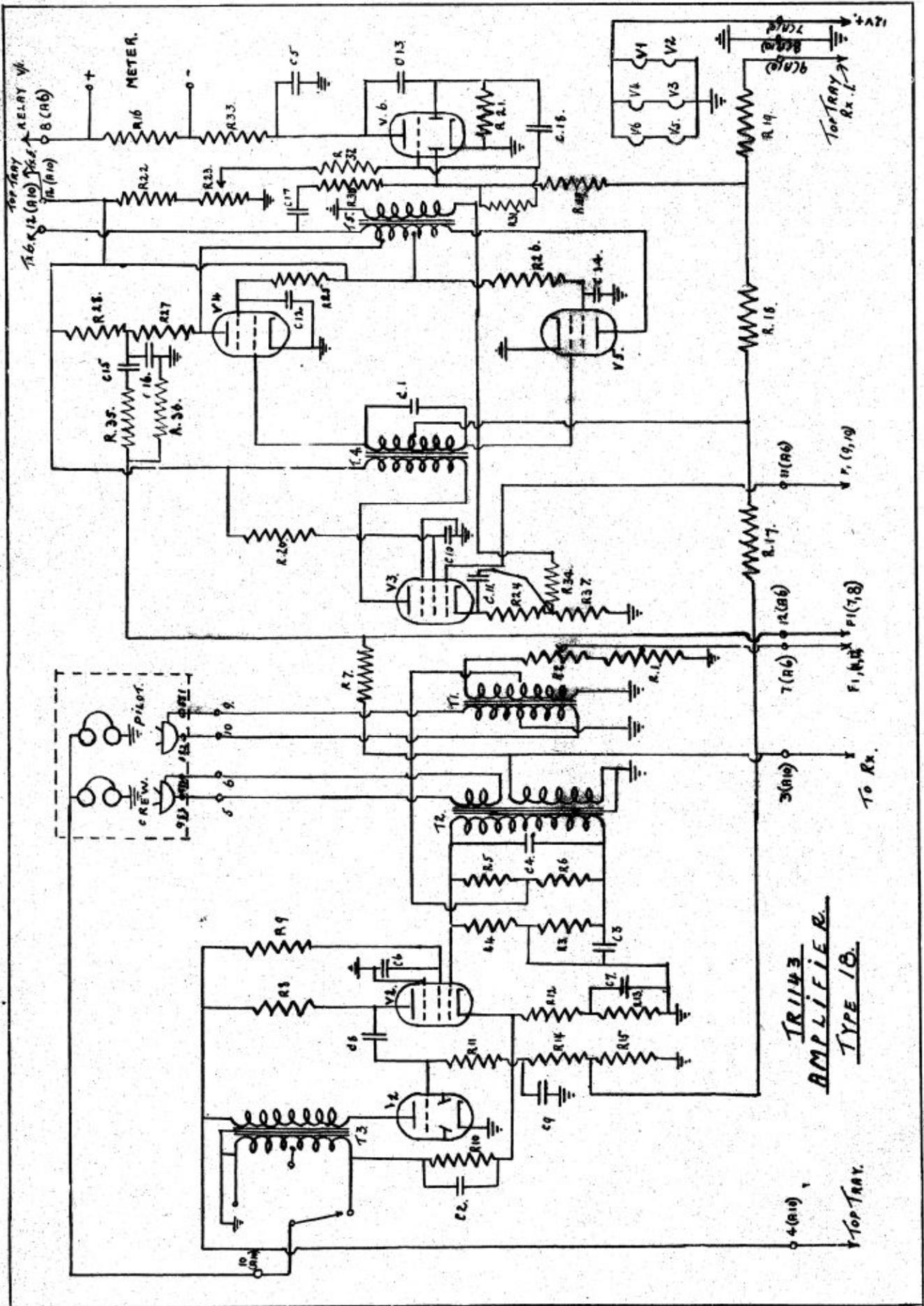
- (a) Isolate the ballast resistance and regulator coil from rest of circuit by disconnecting black lead from terminal marked L.T. Pos. on top of output filter can. Connect LOW reading ohm-meter or Avo type D on 1000 ohm range, very carefully set to zero between this black lead and chassis note reading, which should not be less than 12 ohms.
- (b) Adjust tap on ballast resistance for 13 ohms. This is made of regulator coil resistance of approximately 5 ohms plus tapped ballast resistance of 7 to 8 ohms. Replace black lead to L.T. pos. terminal.
- (c) Unlock and unscrew large adjusting screw (air gap) in bottom of power unit several turns.
- (d) Remove blue lead of regulator from starting relay terminal (nearest terminal to regulator). Connect low reading ohm-meter or Avo type D on 1000 ohm range with accurate zero to the end of blue lead and the other side to white lead which is connected to regulator compression screw housing.
- (e) Unlock and now adjust very carefully compression screw till lowest reading is obtained (0.1 to 0.3 ohms). Very carefully until pile begins to take up full compression, the condition required is lowest reading with lightest pressure. If too great a pressure is applied it will damage the pile carbon washers.

- (f) Reconnect the leads to original positions and connect up supply and TR. 1143 load as per para. 77 using accurate volt meters in positions indicated, i.e. across both input and output L.T. terminals.
- (g) Switch on the equipment by selecting appropriate channel on controller electric. With an input voltage of 26 to 28 volts for the 24 volt unit (type 16) and 13 to 14 volts for the 12 volt unit (type 15), check output L.T. voltage. If the output voltage does not read between 13 to 13.2 volts, an adjustment of the air gap screw will achieve this. Proceed as follows:-
- (h) The air gap screw has been unscrewed several turns (c). This screw should now be turned clockwise (viewed from the bottom of the power unit) slowly. As it is screwed in (reducing air gap) it will be observed that the output L.T. voltage will be reduced from a fairly high reading, through a minimum position as turning continues, to another maximum. This position indicates that the air gap has closed and compression of the carbon pile is being achieved by pressure of the air gap pole. Slowly turn anti-clockwise again and after the minimum position is passed, stop further adjustment as soon as an indication is obtained of 13 volts output.
- (i) The unit is now roughly adjusted to the correct regulating point, and further minute adjustments may be made to obtain the final correct position, remembering that small adjustments of no more than a degree or two only of the air gap must be made to alter the output voltage and adjustments of the carbon pile compression screw only must be made to obtain the compromise and regulation. During these adjustments the input voltage must be varied up and down the ranges indicated in (g) as readings taken of the output L.T. voltage under load.

NOTE:- All the above adjustments must be made bearing in mind that force must not be used and that all adjustments are inter-dependant. Lock compression and air gap screws before putting into use.

TR1143
RECEIVER UNIT TYPE 19





RELAY V.
B (A6)
METER.
+
-
R16
R33
C15
V.6
R.21
C.15
R.19
V1
V2
V3
V4
V5
V6
R.14
R.15
R.16
R.17
R.18
R.19
R.20
R.21
R.22
R.23
R.24
R.25
R.26
R.27
R.28
R.29
R.30
R.31
R.32
R.33
R.34
R.35
R.36
R.37
C.1
C.2
C.3
C.4
C.5
C.6
C.7
C.8
C.9
C.10
C.11
C.12
C.13
C.14
C.15
T.1
T.2
T.3
V.1
V.2
V.3
V.4
V.5
V.6
V.7
V.8
V.9
V.10
V.11
V.12
V.13
V.14
V.15
V.16
V.17
V.18
V.19
V.20
V.21
V.22
V.23
V.24
V.25
V.26
V.27
V.28
V.29
V.30
V.31
V.32
V.33
V.34
V.35
V.36
V.37
V.38
V.39
V.40
V.41
V.42
V.43
V.44
V.45
V.46
V.47
V.48
V.49
V.50

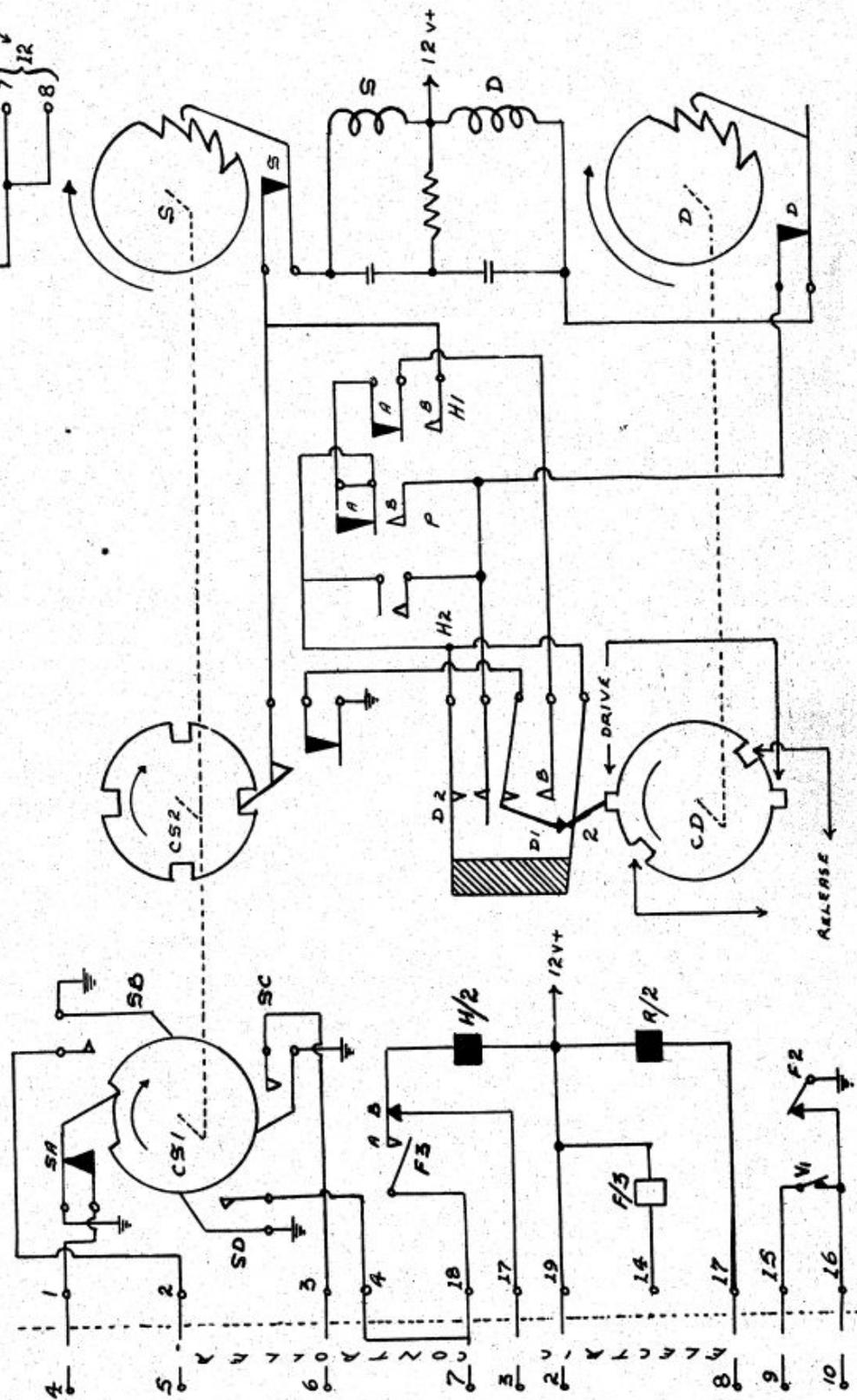
**TRILITE R.
TYPE 10.**

TOP TRAY
4 (A10)

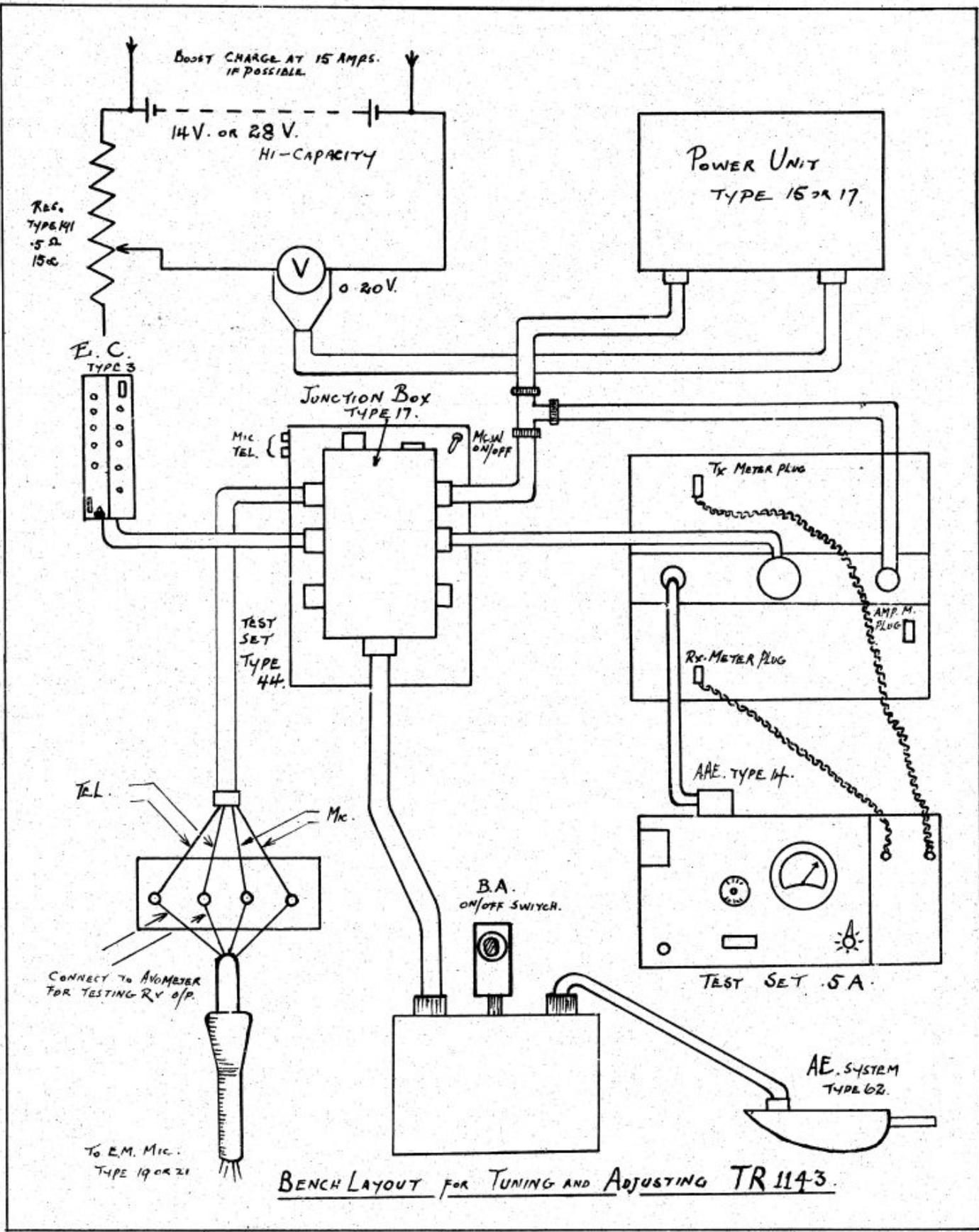
TO RX

TR1143

TUNING MECHANISM



NOTE:- RELAYS IN TUNING MECHANISM AND POWER UNIT SHOWN BLOCKED IN OFF ENERGISED BY ACTION OF PBI AND OFF CONTACTS.



BENCH LAYOUT FOR TUNING AND ADJUSTING TR 1143.

TR 5043 - SCR 522 - BENDIX.

VHF airborne set, crystal controlled with four crystal channels in both transmitter and receiver, together with necessary supply and control equipment.

Functions:

1. Plane to ground communication.
2. Plane to plane communication.
3. I/C system for pilot and crew.
4. Facilities for automatic transmission (MCW) of a signal for D.F. Ranges 1, 2 and 3 for R/T only, range 4 for R/T and MCW and the latter is only available for D/F purposes.

Characteristics:

1. Line of sight transmission only for statute miles where "H" equals sum of the heights.
2. Freedom from static.
3. Freedom from fading.
4. Good strength at maximum range.
5. Extreme accuracy for D.F. purposes and freedom from bending by either atmospheric conditions or the magnetic field of the earth.
6. Freedom from skip effect but affected by "shadows" due to obstructions.
7. Small but efficient antennae.
8. Severe ignition noises.
9. Improved secrecy.
10. Less crowded communication channels. (VHF rarely used and only local in effect).

Power Consumption:-

1. SCR 522A - 28 volts - transmission 11.5 amps.
reception 11.1 amps.
2. SCR 542A - 14 volts - transmission 23 amps.
reception 22.2 amps.

Frequency Ranges:-

1. Transmission and reception - 100 - 156 Mcs.

Power Output:-

1. In normal service 8 - 9 watts, but may be tuned to maximum output of 12.5 watts.

Sensitivity:-

1. 3 - 4 uV for 10 db signal-to-noise ratio.

Components:-

1. Radio receiver BC-624-A, type R5019
2. Radio transmitter BC-625-A, type T5017.
3. Rack FT-244-A, type 5009.
4. Case CS-80-A.
5. Radio Control Box BC-602-A, type 5003.
6. Junction Box JB-29-A, type 5017.
7. Dynamotor unit PE-94-A, type 5016.
8. Antenna AN-73 or AN-74 (See Wireless Orders).
9. Contactor unit BC-608-A.

<u>HEIGHT</u>	—————	<u>DISTANCE</u>
1,000 feet		30 Miles
3,000 "		70 "
5,000 "		80 "

<u>HEIGHT</u>	<u>DISTANCE</u>
10,000 feet	120 Miles
15,000 "	150 "
20,000 "	180 "

RECEIVER BC-624-A, R 5019

The receiver section of the SCR 522 consists of a superheterodyne with 4 pre-set crystal-controlled channels covering the range from 100 - 156 Mcs. with an I.F. of 12 Mcs.

Channel selection is by remote control only. Selecting a channel on the control box supplies L.T. to all circuits and operates frequency shifter slides, which, by means of a cam and shaft arrangement, rotates and locks condensers to predetermined settings and selects the correct crystal.

Tuning is carried out in -

R.F. grid circuit	(216A)	(36PF)	
R.F. plate circuit	(216B)	"	ganged
Mixer grid circuit	(216C)	"	
H.A. plate circuit	(217A)	"	
H.G. plate circuit	(217B)	"	ganged
Crystal oscillator plate circuit			Screwdriver adjustment.

Metering in R.F. anode circuit only.
Delayed A.V.C. to R.F., 1st and 2nd I.F. stages only.
Screwdriver adjustment for AUDIO volume and squelch control RELAY.

DETAILED DESCRIPTION OF CIRCUITS.

(a) Radio Receiver BC-624-A.

1. The radio-frequency amplifier - One stage of amplification at the signal frequency is provided, employing a VT-203 (commercial type 9003) super-control r-f pentode in a

high-gain, tuned-plate circuit. The antenna is coupled through coil 221 (1 turn) to grid coil 222 (2 turns), which is tuned by split-stator capacitor 216A (36 PF). Capacitor 218-1 (10 PF) is the r-f grid coil trimmer. Plate coil 223 (2 turns) is tuned by capacitor 216B (36PF). Capacitor 218-2 (10 PF) is the plate coil trimmer. Cathode bias for the stage is provided by resistor 253-1 (330 ohm). Resistor 202-2 (.00068 mF) comprise the a.v.c. decoupling filter. Capacitor 201 (10PF) prevents shorting of the a.v.c. voltage by the grid control. Resistor 267-8 (.1 meg) is the screen dropping resistor. Resistor 254-1 (6800 ohm), together with capacitor 202-4 (.00068 m.f.) form the plate circuit decoupling filter. Capacitors 202-1, 202-3 and 202-5 (.00068 m.f.) are the cathode, screen and plate by-passes respectively. Resistor 259 (10 ohm) is a built-in shunt for the tuning meter.

2. The mixer stage - The mixer stage, also employing a VT-203 (9003), is inductively coupled to the r-f stage. Grid coil 224 (2 turns) is tuned by split-stator capacitor 216c (36 P.F.) and trimmed by capacitor 218-3 (10 PF) Resistor 255-1 (1.8 meg) and capacitor 203-1 (47 P.F.) are the grid-leak and grid-condenser respectively. Injection of the output of the harmonic amplifier into the mixer is accomplished inductively by coil 225 (1 turn plus distributed inductance), thus providing control-grid injection. Cathode bias for this stage is provided by resistor 256 (1000 ohms). Resistor 257 (.33 meg) is the screen dropping resistor. Resistor 263-1 (4700 ohms) and capacitor 206-3 (.0006 m.F.) and 202-7 (.00068 m.F.) are the cathode and screen by-passes respectively. The plate circuit is tuned to the i-f frequency by the primary of i.f. transformer 291. The i-f transformers in the set are permeability-tuned; the capacitors across the windings are fixed and temperature-compensating.

3. The intermediate frequency amplifier stages - the three i-f amplifier stages, employing VT-209 (commercial type 12SG7) super-control sig-ended metal r-f pentodes, operate at a frequency of 12 mcs. Aside from the high frequency employed, the wide band-pass used and the special i-f transformers, the i-f circuits are conventional. A.V.C. voltage is supplied to the first two i-f stages, but the third i-f stage is operated on cathode bias alone in order to prevent modulation rise on signals with a high percentage of

modulation, also screen is series Fed. Band with approx. 80 kc/s at 2:1 ratio, 150 at 10:1 ratio.

4. The oscillator - the oscillator stage uses one section of the VT-207 (commercial type 12AH7GT) twin triode in a simple crystal oscillator circuit. Crystal-switching is effected by switch 286, which shorts out the three crystals not in use and connects the proper plate coil 227 (23 turns) into the circuit. The plate coils 227 (23 turns) are permeability-tuned. The necessary capacitance for resonance is supplied by capacitor 204 (15 P.F.), actually in the grid circuit of the following stage. Cathode bias is furnished by resistor 265 (2700 ohm).

Resistor 266-1 (.27 meg) is the grid-leak. Resistor 264 (10,000 ohm) and capacitor 206-1 (.006 m.F.) form the plate circuit decoupling filter. Capacitors 206-2 (.006 m.F.) and 202-27 are the cathode and plate by-passes respectively. The oscillator is capacity-coupled to the following stage through capacitor 205 (220 P.F.) 8 - 8.72 mc/s.

5. The harmonic generator - The harmonic generator stage employs a VT-202 (commercial type 9002) triode in a circuit designed to be rich in harmonic output. The plate coil 226 (2 turns) is tuned by split-stator capacitor 217B (39.6 M.F.) and trimmed by capacitor 218-5 (10 m.F.). Cathode bias for this stage is provided by resistor 261 (1200 ohms), while grid-leak bias is provided by resistor 262-1 (.56 meg). Resistor 260 (27,000 ohms) and capacitor 202-14 form the plate circuit decoupling filter. Capacitors 202-15 and 202-13 are the cathode and plate circuit by-passes respectively. The harmonic generator is capacity-coupled to the following stage through capacitor 203-2 (47 P.F.).

6. The harmonic amplifier - The harmonic amplifier uses a VT-203 (9003) in an r-f voltage amplifier circuit designed to be rich in harmonic output. The plate circuit of this stage is tuned by coil 225 (1 turn), the injection coil and split-stator capacitor 217A (36 P.F.) and is trimmed by capacitor 218-4 (10 P.F.). Cathode bias is provided by resistor 253-2 (330 ohm) and grid-leak bias is provided by resistor 255-2 (1.8 meg). Resistor 267-7 (.1 meg) is the screen dropping resistor. The plate circuit decoupling filter is composed of resistor 254-2 (6,800 ohm) and capacitor 202-10. Capacitors 202-12, 202-11 and 202-9

are the screen, cathode and plate circuit by-passes respectively. The harmonic generator and harmonic amplifier circuits are used to select and amplify from the eleventh to the eighteenth harmonics of selected crystals to provide a heterodyne frequency 12 mc/s lower than the incoming signal frequency.

<u>Signal Frequency</u>	<u>Harmonic</u>
100 - 108 Mc/s.	11th
108 - 116 "	12th
116 - 124 "	13th
124 - 132 "	14th
132 - 140 "	15th
140 - 148 "	16th
148 - 156 "	17th
156 - "	18th

Heterodyne frequency = Signal frequency -
12 Mcs.

Correct crystal frequency in Kcs.

$$F(xtl) = \frac{Fr - 12}{H} \times 1,000$$

where:-

Fr = Incoming signal frequency in mc/s.

F(xtl) = Required crystal frequency in kc/s.

H = Harmonic of crystal to be used.

7. The detector, automatic volume control, first audio-frequency stage - The detector - a.v.c. - first a-f stage employs a VT-169 (commercial type 1208) duplex diode pentode in a more or less conventional circuit. One diode, which is directly connected to the top of the i-f transformer secondary, is the rectifier for both detection and squelch voltage. This diode is connected in a series rectifier/^{control}the volume control 236 (.15 meg) and resistor 281 (.15 meg) form its load resistance. Resistor 281 (.15 meg) and capacitors 210 (330 P.F.) and 209 (100 P.F.) form a pi-section filter to remove the radio frequency component from the rectifier output. Resistor 274-1 (2.2 meg) and capacitor 206.16 remove the a-f component from the rectified signal voltage supplied to the grid of

the audio-squelch circuit. The second diode is coupled to the top of the i-f transformer secondary through capacitor 203-3 (47 P.F.), the reactance of which is low to radio frequencies but extremely high to audio frequencies. This diode is a shunt-connected rectifier and supplies the a.v.c. voltage requirements of the set. Resistor 275-1 (.47 meg) is the load resistance of this diode and resistor 266-2 (.27 meg) and capacitor 211C (.1 m.F.) remove the r-f component of the rectified output and provide a suitable time constant for the a.v.c. action. The cathode bias voltage applied by resistors 276 (18,000 ohm) and 277 (1800 ohm) gives a delay action to the diode circuits.

Until the signal level at the secondary of the i-f transformer exceeds this voltage, the diodes will not conduct. Therefore we have a delayed a.v.c. circuit. The a-f voltage from the volume control 236 (.15 meg) passes through coupling condenser 206-17 and resistor 272 (.12 meg) through the primary of transformer 295 (920 ohm). The secondary of transformer 295 (920 ohm) is connected to the grid circuit of the pentode section of the VT-169 (12C8). The plate of the pentode section is resistance-capacity coupled to the grid of the second audio stage through resistor 266-3 (.27 meg) and capacitor 206-18. Resistor 274-2 (2.2 meg) is the screen voltage dropping resistor. Capacitors 211B (.1 m.F.), 212C (5 m.F.) and 212A (10 m.F.) are the screen, cathode and plate circuit by-passes respectively. Choke B in transformer shield 296 (10 m.F.) together with capacitors 212A (10 m.F.) and 212B (20 m.F.) form the decoupling circuit and additional filter for the audio stages. Capacitor 203-4 (47 P.F.) reduces the high-frequency response of the audio amplifier.

8. The second audio frequency amplifier stage - The second a-f amplifier stage employs the VT-135 (commercial type 12J5GT) triode in a conventional circuit. Cathode bias is supplied by resistor 278 (1500 ohm), while 258 (.68 meg) is the grid resistor. Section A in transformer shield can 296 (10 m.F.) is the output transformer and is connected to the head sets of the pilot and any crew members. Capacitor 212D (5 m.F.) is the cathode by-pass. Output impedances 4000, 300 and 50 ohms. Power 425 mw. with 15% distortion.

9. The audio squelch circuit - The squelch circuit employs

one section of the VT-207 (commercial type 12AH7GT) twin triode, arranged in a simple vacuum tube control circuit. The variable source of fixed cathode bias is provided by potentiometer 237 (2000 ohm), part of the voltage divider made up of resistors 282 (3300 ohm), 237 (2000 ohm), 279-1 (47000 ohm) and 279-2 (47000 ohm), connected from positive high voltage to ground. In practice, potentiometer 237 (2000 ohm) is adjusted so that relay 246 will just close when no signal is being received. The contacts of relay 246 are connected to ground and resistor 273 (5600 ohm) which shunts the audio voltage from the volume control 236 (.15 meg). When a signal is being received, the negative rectified signal voltage from the detector diode applied to the squelch tube reduces the plate current flowing through relay 246, opening the relay contacts and removing the shunt from the audio circuit. Relay to close on 4 M/A, to operate on a change of .2 M/a. Contact spacing .0015" to .003".

(b) Radio Transmitter BC-625-A.

1. The oscillator stage - The oscillator stage employs a VT-198-A (commercial type 6G6G) in a crystal-controlled harmonic oscillator circuit. Four crystals are provided in the crystal compartment. Crystal-switching is effected by switch 156, which shorts out the crystals not in use. Grid-leak bias for the oscillator is provided by 50,000 ohm resistor 151-1 (50,000 ohm) in series with r-f choke 128-1 (2.5 m.H.). A small amount of feed back is introduced by capacitor 101. Capacitors 102-1 (.006 m.F.) and 102-2 (.006 m.F.) by-pass the screen and plate circuits respectively. Capacitor 103 (50 m.m.f.), in conjunction with choke 128-2 (2.5 M.H.) provides the regeneration which increases the efficiency of the circuit as a harmonic oscillator. The plate circuit is tuned to the second harmonic of the crystal frequency by coil 118 and variable capacitor 114, the two sections of which are in parallel. Resistor 152-1 (50,000 ohm) is the screen voltage-dropping resistor. The oscillator is coupled to the following stage through capacitor 104 (100 m.m.f.). Modified Pierce, approx. 5.5 mc/s to 8.7 mc/s for crystal, anode tuned to approx. 11 to 17.5 mc/s.

2. The first harmonic amplifier - The first harmonic

amplifier stage employs a VT-134 (commercial type 12A6) beam tetrode in a tripler circuit. Resistor 150 of 50 ohms is a parasitic suppressor. Resistor 151-2 (50,000 ohms) provides grid-leak bias for the stage and is by-passed to ground by capacitor 102-3 (.006 m.F.). Fixed bias for this stage is provided from the power supply and reduced to the proper value by the voltage divider composed of resistors 146 (6000 ohm) and 147 (18,000 ohms). Cathode bias for this stage is provided by resistor 153-1 (2000 ohm). The screen voltage dropping resistor is 154-1 (5000 ohm). Capacitors 102-6 (.006 m.F.), 102-5 and 102-7 are the cathode, screen and plate circuit by-passes respectively. The plate circuit is tuned by coil 119 and split-stator capacitor 115 to the third harmonic of the oscillator output frequency. It is therefore tuned to the sixth harmonic of the crystal frequency. Coil 119 is center-tapped in order to provide equal voltage 180° out of phase for the excitation of the following push-pull stage. Capacitor 100, indicated by dotted lines on fig. 1 (complete schematic circuit diagram) was included in the original design to compensate for the plate-to-cathode inter-electrode capacity of the VT-134, but in practice it has been found that its inclusion gives rise to a self-oscillation in the vicinity of 130 mcs. In all cases where a set is encountered which includes this capacitor the removal of the capacitor is recommended. The plate circuit is capacity-coupled to the grid of the following stage through capacitors 109-3 (20 m.m.F.) and 109-4 (20 m.m.f.). Frequency range approx. 33.3 to 52 mcs. Class C operation.

3. The second harmonic amplifier - The second harmonic amplifier employs a VT-118 (commercial type 832) push-pull beam tetrode in a push-pull balanced tripler circuit. The grid return is provided by resistors 132-1 (25,000 ohm) and 132-2 (25,000 ohm) in series with r-f chokes 127-1 and 127-2. Fixed bias is provided from the power supply through the same voltage divider which supplies the bias requirements of the first harmonic amplifier. Individual by-pass capacitors 102-8 (.006 m.F.) and 102-9 are connected directly to the lower ends of r-f chokes 127-1 and 127-2. It must be remembered that in circuits operating on frequencies in the VHF band a length of wire of one or two inches has appreciable inductance, comparable to a coil of many turns in a circuit operating on lower

frequencies. Consequently, in this circuit it is necessary to use individual grid resistors and grid capacitors in order to avoid this lead inductance; a single resistor and capacitor would not function at all. The plate circuit is tuned to the third harmonic of the output frequency of the first harmonic amplifier or the eighteenth harmonic of the crystal frequency by center-tapped coil 120 and split-stator capacitor 116. Resistor 152-2 (50,000 ohm) is the screen voltage dropping resistor. No screen by-pass is required, as the tube has an internal screen-to-cathode capacitor incorporated in its design. Capacitor 105-4 (.001 m.m.f.) is the plate circuit by-pass. The second harmonic amplifier is capacity-coupled to the following stage through capacitors 109-1 (20 mmF) and 109-2 (20 mmF). Class C operation, screen grid modulated, frequency 100 to 156 mcs.

4. The power amplifier - The final amplifier employs a VT-118 in a straight class B2 amplifier circuit. Fixed grid bias is supplied from the same source as for the preceding two stages. Plate inductance 121 is tuned by split-stator capacitor 106 (.002 m.F.) from the decoupling circuit for this stage. Resistors 133-1 (40,000 ohm) and 133-2 (40,000 ohm) in parallel form the screen voltage dropping resistor. Plate and screen modulated.

5. The R-F indicator circuit - The r-f indicator circuit employs a VT-199 (commercial type 6S67) connected as a diode. It rectifies a small portion of the output voltage picked up by a half-turn coil adjacent to the final amplifier plate inductance. Resistors 154-3 (5000 ohm) and 153-2 (2000 ohm) in series form the diode load resistor for this shunt-connected circuit. Capacitor 105-2 (.001 mF) removed the r-f component from the rectified signal output of the diode.

6. The meter switch - The meter switching circuit provides facilities for using an external 0-1 millimeter ^{am-}meter for all the tuning requirements of the transmitter. Switch 157 connects the meter terminals across resistors 134 (1.53 ohm) in the plate circuit of the first harmonic amplifier, 135-1 (0.76 ohm) in the plate circuit of the second harmonic amplifier, 135-2 (0.76 ohm) in the plate circuit of the power amplifier, 153-2 (2000 ohm) shunted across the output of the r-f indicator diode and 148 (75 ohm) in the grid

circuit of the power amplifier. These resistors are accurately wound shunts which convert the 0-1 millimeter to a meter of the necessary range for each switch position.

7. The speech amplifier - The speech amplifier stage employs a VT-199 (commercial type 6SS7) pentode in a high-gain voltage amplifier circuit. Plate voltage is supplied through inductance 126, while resistor 138-3 is the screen voltage dropping resistor. Cathode bias is supplied by resistor 153-3 (2000 ohm). Capacitors 110 (1.0 m.F.) and 107-1 (0.1 mF) are the cathode and screen by-passes respectively. The stage is inductance-capacity-transformer coupled to the modulator stage through parts 126, 113 (.003 m.F.) and 159. As this stage serves another function in the set, its special characteristics and components in its circuit which have not been discussed in this paragraph will be taken up under SPECIAL CIRCUITS.

8. The modulator stage - The modulator stage employs two VT-134 (commercial type 12A6) beam tetrodes in a push-pull class AB circuit. Fixed bias for this stage is provided from the power supply and reduced to the proper value by the voltage divider composed of resistors 152-3 (50,000 ohms) 152-4 (50,000 ohms) and 145 (15,000 ohms). Capacitor 109-5 (20 mmF) reduces the high-frequency response of the circuit and tends to suppress high-frequency parasitic oscillations. The screen voltage is reduced to the proper value through resistor 154-2 (5000 ohm). Capacitor 111 (0.5 m.F.) is the screen by-pass. The modulation transformer 160 matches the output impedance of the modulator and the plate-screen impedance of the modulated r-f stages. The secondary of this transformer is connected in series with the high voltage supplied to the plate and screen circuit of the power amplifier stage and the screen circuit of the second harmonic amplifier stage. The manufacturers state that it was necessary to modulate the screen of the second harmonic amplifier in addition to complete modulation of the power amplifier in order to achieve 100% carrier modulation.

CONTROL CIRCUITS.

(a) General - The control circuits of the radio set SCR-522 (5043) provide the following functions:-

- (i) Complete remote control of the set through radio box BC-602-A (type 5003).
- (ii) A clock contactor unit BC-608-A provides automatic switching to set up a 1000 cycles tone modulated transmitter on the proper frequency for use with direction finding equipment.
- (iii) Special plugs are provided for gun switches and variable length antenna.

(b) Radio control box BC-602-A (type 5003) - The radio control box is located in the pilot's cockpit and provides ON/OFF transmit/receive and channel-change switching. The control box is equipped with five (5) push-buttons, usually mounted in a vertical row. The top button 611E is the ON/OFF switch, while the other four buttons, 611A, B, C, D provide for frequency-channel selection. A three-position key switch 612, marked T-R-REM, located below the row of push-buttons, provides transmit, receive and remoted, or press-to-transmit operation respectively. Channel indicator lamps 601 (1, 2, 3 and 4) are provided to indicate which channel is in operation. Lamp 601-5 is illuminated when the receiver is in operation.

(c) Rack FT-244-A (type 5009)- The rack FT-244-A, besides being the mounting rack for the receiver BC-624-A and transmitter BC-625-A, also contains the tuning motor 406 that operates the channel selector slides and tunes both the transmitter and receiver at the same time. The tuning motor 406 is a ratchet wheel pulser arrangement that drives a set of cams. These cams operate through a system of levers to drive the proper channel slide and positioning contact.

(d) The tuning control circuit -

(1) The OFF button is depressed when the set is off and is mechanically interlocked to the other four push-buttons. When any one of the channel-selector buttons is depressed the OFF button is released by the mechanical interlock. This allows the OFF button contacts to close, completing the battery circuit through

several plugs and cables and energises the master power relay 321 in dynamotor unit PE-94-A, thus turning on the unit.

(ii) The channel-selector circuit is as follows:-
 Depressing channel A selector switch completes a circuit from ground, through the D-channel relay 130, through the channel A button contacts, through cam-operated motor positioning contacts 427-A, to energise the ratchet motor control relay 411-2. As long as the ratchet motor control relay 411-2 is energised, its contacts will complete the ratchet motor circuit to ground and the ratchet motor will operate. The channel-tuning cams are so positioned on the same shaft with the ratchet wheel that all four channels are tuned, A, B, C and D, successively for each revolution of the ratchet wheel. These timed positions are operated by cams arranged at 90° positions around the ratchet wheel, so that by stopping the ratchet wheel on the proper tooth the cam for channel A will have the slide for channel A completely engaged, thus tuning the transmitter and receiver to channel A. In the same position, the cam for channel C is exactly the cam for channel A. Switch contacts 427 are located so that the channel C cam will open the 427A contacts. Opening the 427A contacts releases the motor relay. This in turn opens the ground circuit to the motor so that the motor stops on the proper tooth of the ratchet wheel. The cams are so positioned that moving the ratchet wheel one more tooth will release the channel A tuning slides. In this position the switch contacts 427A should remain open. The other three channels work exactly like channel A. Therefore, one tooth position past any channel position will release all of the channel tuning slides. A channel release button, 426, located in the receiver section of the rack, is provided to give the ratchet wheel a one-tooth forward movement. The ratchet wheel can also be moved one tooth forward by pressing the motor armature. If no power is available to operate the set. **DAMAGE TO EQUIPMENT WILL RESULT IF CHANNEL SLIDES ARE NOT ALL RELEASED BEFORE REMOVING EITHER RADIO RECEIVER BC-624-A OR RADIO TRANSMITTER BC-625-A FROM RACK FT-244-A.**

The ratchet wheel of the motor has 100 teeth. On the 24th contact the positioning contacts of the

appropriate channel open, the channel is fully selected; on the 25th tooth the slide drops back; on the 26th the positioning contacts close and a new cycle commences.

(iii) A channel indicator lamp is provided for each channel-selector button. One side of each lamp is connected directly to the positive side of the battery. The other lamp terminal is connected to the negative battery, or ground, through the control button contacts 611 and the pip-squeak relay 130 contacts.

(iv) The T-R-REM key on the lower part of radio control box BC-602-A is the transmit-receive-remote switch. Normally the switch lever is in the R position, and if thrown in the T position it must be held in place or else it will spring back to R and it is impossible to switch the REM position. This is with the switch locking lever, which is a small lever located directly above the T-R-REM switch, in the down position. With the switch-locking lever in the up position it is possible to place the T-R-REM switch in either the T, the R or the REM position. There is no spring-back on any position. In the REM position the receiver is normally in operation. To talk, it is necessary to press the press-to-talk switch, which is usually located on the microphone handle.

(v) The circuits for this T-R-REM switching are as follows:-

(a) The R position is the normal position. In this position the antennae change-over relay 412 is energised. One side of relay 412 is connected directly to the positive side of the battery and the other side of relay 412 returns to ground through contacts on the T-R-REM switch and contacts on contactor relay 131, which is the "pip-squeak" changeover relay. The antenna relay 412 is also energised through contacts on relay 411-1 when the channel-change mechanism is operating.

(b) In the T position, contacts in the T-R-REM switch are opened, removing the ground (negative terminal) lead from antenna change-over relay 412, allowing it to de-energise and connect the antenna to the transmitter.

(c) In the REM position, antenna change-over

relay 412 is normally energised through the T-R-REM switch key and contacts on relay 161 and relay 131 to ground. When the press-to-talk switch is depressed, it completes the relay 616 circuit to ground, energising the relay 161. This opens a pair of normally closed contacts on relay 161, thus opening the ground (negative terminal) circuit of the antenna change-over relay 412, allowing it to de-energise and connect the antenna to the transmitter.

(vi) An indicator lamp is located opposite the T-R-REM switch. This lamp glows when the switch is in the R position and is out when the switch is in the T position. With the switch in the REM position the lamp will glow when the receiver is in use and will go out when the transmitter is in use. For night operation it is necessary that all of the indicator lights be dimmed to prevent glare. Therefore a dimmer mask is provided. To lower the dimmer mask, lower the dimmer mask lever, which is a little lever similar to the T-R-REM switch locking lever, located just above the A-channel indicator lamp.

(vii) The D Channel is arranged for automatic pip-squeak transmissions for a period of time out of every minute. These transmissions are timed by contactor unit BC-608-A. During the proper period the contactor unit BC-608-A completes the circuit through relay 131 to ground. Relay 131 is thus energised, and its operation provides the following functions:-

(a) In the transmitter speech amplifier, the control grid circuit of the VT-199 is removed from the microphone input circuit and connected to a resistor-capacitor feedback network consisting of resistors 140-2, 140-3, 140-4 (50,000 ohms) and 142 (5000 ohm) and capacitors 105-3 (.001 m.F.) and 108-2 (.001 m.F.). Feed back is obtained from the plate of one of the modulator stage tubes VT-134 (commercial type 12A6). The values of the resistors and capacitors used are selected so that the network will give the proper phase shift and R.C. time constant to make the speech amplifier a 1000 cycle oscillator, thus providing a 1000 cycle tone to modulate the transmitter.

(b) A normally closed contact on relay 131 opens and removes the ground (negative terminal) from the control switch or relay 161. This releases the antenna changeover relay 412, and connects the antenna to the transmitter.

(c) Another normally closed contact on relay 131 opens and removes the ground (negative terminal) from the D-channel relay 130. This removes the ground return from all channel button switches, and ties the D-channel circuit to ground. This operates the tuning motor and sets up the D-channel, even though the A-channel button on the control box is depressed and the D-channel button is not. The D-channel indicator lamp is lit when the D-channel is on.

(d) As soon as the time period is over, the contactor circuit is opened, releasing relay 131 and the normal circuits of the set are automatically restored. For example, if the set had been receiving on A-channel before the pip-squeak started, then when the pip-squeak transmission is finished, the set will automatically return to receiving on A-channel.

SPECIAL CIRCUITS.

On aircraft with a crew of one or more the radio set SCR-522-A is also used for interphone purposes between the pilot and members of the crew. The interphone system operates as follows:-

(a) The pilot and crew all have headsets connected to the receiver output. Therefore, everyone on the aircraft will hear any speech that comes through the audio system of the receiver, thus providing the receiving end of the interphone system.

(b) The crew microphones are magnetic microphones which require no operating voltage. They are connected in parallel through hacks provided in jack boxes BC-630-A and BC-631-A through the necessary plugs and cables to terminals 3 and 4 of this transformer connect to a balanced winding (see figure 6). A balanced winding is used here so that any ignition or electrical noise on the aircraft which might be picked up by the various crew microphone leads will be balanced out. The output from the receiver detector stage feeds into terminals 1 and 2 of the transformer 295. A special adaptor to permit carbon microphones to be used is available.

(c) The pilot's microphone, which is a magnetic microphone, feeds into a balanced winding, terminals 1 and 3 of transformer 158 in the radio transmitter BC-625-A speech amplifier circuit. This balanced winding arrangement is used so that any electrical noise on the aircraft that might be picked up by the pilot's microphone leads will be balanced out and will not go through the transmitter speech amplifier. The secondary of transformer 158 connects directly across the speech amplifier GAIN control 125 and the speech thus goes out to the transmitter speech amplifier. In order to get speech from the pilot's microphone through the interphone system, a bridge circuit consisting of four 1-megohm resistors 141-1, 141-2, 141-3 and 141-4, is connected across the terminals 4 and 5 of transformer 158 with connections from the center points of the bridge going out through the two .01 mfd bridge blocking capacitors 102-14 and 102-15 (.006 m.F.D.). Therefore a signal with half the amplitude of the signal appearing across the terminals 4 and 5 of transformer 158 will appear between the center points of the bridge circuit and ground.

The connections from the center points of the bridge go directly across the two 470,000 ohm bridge balancing resistors 275-2 and 275-3 in the receiver, which are connected directly across the output of transformer 295. Therefore, half the amplitude of the signal appearing across terminals 4 and 5 of transformer 158 will appear across resistor 275-3. Since the center tap between resistors 275-2 and 275-3 (.47 meg) is connected to ground through a part of the first audio stage cathode bias resistor 276, and the other side of resistor 275-3 is connected directly to the grid of the first audio stage, the output from the pilot's microphone will appear in the grid circuit of the first audio stage of the receiver, thus connecting the pilot into the interphone system. Approximately one third of the audio frequency voltage induced in the secondary terminals no. 5 and 6 of the transformer 295 from either of the two primaries will appear at the grid of the first audio amplifier stage VT-169 and the result will be an audible signal in the headsets. An audio frequency voltage from the secondary of transformer 295 will appear at the junction point of resistors 141-1 and 141-4 (1 meg) and will be of equal amplitude, but in phase opposition to the voltage appearing at the junction point of resistors 141-2 and 141-3 (1 meg.). Since these four resistors are all of the same voltage the two out-of-phase voltages will cancel each other and no voltage will appear across potentiometer 125 (1 meg). This arrangement makes interphone communication

from the pilot and crew stations possible at all times, but no modulation of the transmitter by the crew stations or the receiver can result at any time.

TUNING PROCEDURE

TRANSMITTER.

Equipment required:-

Field Intensity Meter 1 - 95 - A) or test set
 Test Set (meter 0-1 ma 75 ohm) 1 - 139 - A) 98
 Control box adaptor

Tuning Procedure Ranges A, B, C and D.

After reconnecting for use of the 5043 test all points for normal operation. Tuning is to be carried with the TR 5043 in its case. If tuning is carried out in the aircraft, engines should be running and battery voltage should be normal. Switch on and allow time to warm up. Plug in meter.

Tune transmitter as below, always noting frequency indicated by tuning dials.

Meter Pos'n.	Stage Tuned	Tune for	Meter Circuit	Full Scale	Approx. Indication.
1	Oscillator Anode	Peak	1st H.A. Anode	50Ma.	.5 -.7
2	1st H. Amp.	"	2nd " "	100 "	.5 -.7
3	2nd H. Amp.	"	P.A. Anode	" "	.6-.65 (x)
3	Power Amp.	Dip	P.A. Anode	" "	.6-.65 (x)
4	All stages	Peak	R.F. Indicator	1 "	.5 -.8
5	2nd H.A., 1st H.A. and Osc.	"	P.A. Grids.	2 "	Above 1.0

(x) Maximum P.A. Anode must not exceed .75.

When tuning 2nd H.A. Amp., if meter swings beyond full scale deflection, tune power amplifier for approximate dip. Lightly lock tuning dials. If necessary, adjust aerial coupling for maximum indication of .60. Power amplifier tuning must be altered on all ranges when aerial coupling is altered. After tuning is completed on all channels, release slides and lock tuning dials firmly. Switch meter to position 4 on ranges A, B, D; check tuning of each stage by rotating dials against spring tension. Meter indication should drop.

Field Intensity Meter

This meter may be used for comparative readings only. Modulation may be checked, and approximate frequency is indicated. Meter must be set to zero if readings are to be compared with previous results.

DO NOT shut off equipment with tuning slides disengaged, otherwise previously selected channel will not operate when associated button is depressed.

Frequencies of transmitter

Crystal frequency	5.56	- 8.72	mc/s.
Anode of crystal oscillator	11.12	-17.54	"
Anode of 1st H. Amp.	33.3	-52.00	"
Anode of 2nd H. Amp.	100.0	-156.0	"
Anode of power amplifier	100.0	-156.0	"

RECEIVER

Apparatus required:-

Signal generator	1 - 130 - A) or test
Test Set (meter 0-1 ma 75 ohm)	1 - 139 - A) set 5A.
Phones		

Proceed as on page 11, "Operation and Serviceability of the TR 5043 in Aircraft".

The receiver may be tuned without the use of the signal generator by listening for maximum noise input.

A buzzer is ideal for generating the required static noise.

Test set type A 20 incorporates a buzzer for receiver tuning. By plugging the A 20 into the 5043 18 pin receptacle, the transmitter and receiver may be tuned, contactor and "press to talk" may be checked, either carbon or magnetic mikes may be used.

Volume

The pre-set volume control on the receiver chassis should be set to the highest permissible value, so that the manual controls on the junction boxes may be used over the full range of volume.

Relay

Adjustment of this control is the last operation in the receiver tuning. If possible, this adjustment should be carried out in the aircraft with the engine running and the normal aerial connected. Any channel may be used for the adjustment, subject to no signal conditions. Turn screwdriver adjustment clockwise, then retard (anti-clockwise) until noise level drops 20 db. If engines are not running, retard still more, from half to three quarters of a turn. Check on all ranges. For bench testing, a buzzer input determined by experiment equivalent to engine noise, is useful.

An adaptor (type A 1) is available for single or double wire aircraft. Balanced circuit reduces noise. For single wire circuits (one side earthed) connect batt. neg., mic. neg., and earth together.

American adaptor type M-299-T1 is intended for single or earth return circuits only.

All mikes MUST BE OFF when not in actual use.

Dynamotor Unit - PE-94-A Type 5016

Dynamotor Unit - PE-94-A Type 5016Generator Output

14.5 volts	4.9 amps.
-150 "	.01 "
300 "	.26 "

MG-1-A

A carbon pile voltage regulator is provided to achieve constant output with varying input. Shunt and series fields act on both motor and generator armature windings. The regulator is on the motor winding only and is so constructed that its flux induces voltage in the motor winding which is in direct opposition to the counter E.M.F. A starting relay is provided, controlled by the OFF button on the Radio Control Box.

Hash filters (series chokes and shunt condensers) are provided in the input and output circuits. A ballast resistor (317) of .3 ohms drops the L.T. from 14.5 volts to 13 volts and resistor 316 (15 ohms) acts as regulator coil control.

Regulator

Both the carbon pile and the solenoid act against a common spring. With the solenoid unenergised, maximum pressure is exerted on the pile; energised, minimum pressure on the pile.

The spring consists of a six finger, three leaf assembly and rests on a bi-metal washer, which thermodynamically compensates for variations in ambient temperature.

The carbon pile is contained in a ceramic tube. The initial pile pressure adjusting screw is at the top and the air gap adjustment at the bottom. The pile pressure adjustment controls stability and the air gap adjustment the sensitivity of the regulator. Regulation is achieved by varying the speed of the motor in the following manner:-

1. L.V. exceeds 13 volts increased solenoid current - spring applies less pressure to carbon pile - increased resistance of carbon-pile caused reduced regulator field winding current - less opposition to main motor field - increased flux - resulting in reduced motor speed.
2. L.V. less than 13 volts - spring applies added pressure (due to reduced solenoid current) - reduced resistance of pile causes increased current in regulator field - increasing flux in opposition to main motor flux - causing motor to increase speed.

NOTE:- The variations of field flux caused by the opposing regulator field only affects the motor field circuit.

Dynamotor Type DA - 3A

This dynamotor has an additional field, namely a demagnetiser. The motor winding is controlled by the shunt and series windings only. The three armature output windings are acted on by all the fields.

Regulation is a function of adjustable field strength on output windings of armature. The regulator field keeps the output constant by changing the intensity of the magnetic flux acting on the output windings. This process is aided by the demagnetiser field, which is in series with, and tends to oppose the action of, the shunt field. This dynamotor does not exhibit the tendency to instability inherent in the earlier model.

Reduced L.V. will cause reduced solenoid current, increased pressure on carbon, increased current in regulator field, increased output.

Dynamotor Unit - PE-98-A

This unit, operating on 14 volts, does not require resistor 317, since the low voltage output is 13 volts.

DYNAMOTOR MAINTENANCE.

DO NOT make internal adjustments until all other faults have been eliminated.

Check commutators and brushes; spring tension should be firm but not excessive, otherwise overheating and undue wear will be caused. Brushes should be free to move in their holders and be at the neutral electrical axis. Check by listening for minimum noise. Commutators should be cleaned with finest sandpaper only when absolutely necessary; a cloth or carbon tetrachloride will quite often suffice.

Three adjustments are associated with the carbon pile regulator:-

1. Variable resistor.
2. Air gap.
3. Initial pile pressure.

At all times endeavour to limit adjustments to initial pile pressure.

DO NOT ADJUST REGULATOR WHILE CONNECTED TO THE 5043. USE AN ARTIFICIAL LOAD. Lamps or resistors to give the required drain may be used. In addition a resistance of approximately 0.15 ohm should be placed in the L.T. input to simulate the resistance of the aircraft wiring.

With an input range of 21.8 to 29 volts the L.T. output should remain within 12.35 to 13.52 volts. Check for stability at intermediate voltages.

Adjustment of 3, initial pile pressure, should be attempted first; clockwise adjustment increases stability but reduces ability to regulate. Adjust in ten degree steps. Screw to be locked after each adjustment.

If adjustment 2 is to be made, 3 must be done also. The average position for the air gap screw is about one half turn out from the flush position.

It should NOT be about two or three turns in from the surface of the base; this position will cause instability.

An approximate setting may be found thus:-

Unscrew top and bottom screw fully, screw top adjustment (pile pressure) in until L.V. output is maximum (14.0 to 14.5) give the top screw about an extra one and a half turns, screw in bottom slug (air gap) to read minimum; MG-LA about 10-12 volts, DA-3A about 8-10 volts. Screw air gap slug counter-clockwise to read 13 volts. Check regulation from 21.8 to 29 volts, re-adjust if necessary.

NOTE:- Use 24 volts input and a dummy load. DO NOT USE the 5043 as a load while adjusting the regulator, otherwise valve failure will result.

If normal adjustment of the regulator fails to achieve the desired results (1) should be carried out thus:-

Remove the positive L.V. brush from the dynamotor, remove the six contact plug from output filter socket. An ohm-meter connected between L.V. positive terminal 4 on the output filter and chassis should read 13.1 ohms; adjust variable resistor if necessary. If satisfactory regulation cannot be achieved the resistance may be reduced but NOT less than 12 ohms.

RACK MAINTENANCE

With all relays limit maintenance as far as possible to cleaning contacts; use carbon tetrachloride on a thin piece of wood or stiff paper. DO NOT USE an abrasive, e.g. sand or emery paper or an ignition file; a burnishing tool may be used if available.

Do not bend the contacts; with telephone relays factory adjusters "iron" the springs to give them a "bow".

An anti-freeze grease may be sparingly applied to the ratchet motor and slide mechanism.

Ratchet Motor:- Centre of hinge should be .785" from centre of solenoid. Hinge should be adjusted to permit cores to rest together; armature should be parallel to frame. Armature stop screw should permit .058" to .060" movement, measured at screw. Armature spring tension should provide $6\frac{3}{4}$ lbs. load at the pawl spring perch on the armature or just sufficient to pull in on 1.1 amp. current.

The stop block is to prevent over-shooting. It should permit no more than a quarter of a tooth travel of the ratchet wheel. Interrupter contacts should open .006" in the fully energised position, contact spring tension 3-6 ozs. Motor arms should clear bakelite fingers by .010" to .015" after release of positioning contacts.

Frequency shifter slides should provide $21/32$ " movement, clearance should be $1/32$ ". Minimum clearance between slide head and motor arm after release .002" to .003". Distance from end of shifter slides to centre of earthed banana plugs should be 8.750".

Of the two interrupter contacts only the tungsten should be cleaned. Use a thin single faced contact file, polish with finest sandpaper. This should involve cleaning off deposits of silver only.

Contacts of plugs may be cleaned with carbon tetra-chloride (not an abrasive) and smeared with a very thin coating of vaseline.

VOLTAGE REGULATION.

Consideration of the factors affecting the speed of a motor and the output of a generator.

With care in design a compound motor maintains constant field strength for varying armature speeds within working limits of the machine.

In the case of a generator with field independently excited and load constant the generated E.M.F. will be governed by the armature speed.

To control generator volts it is necessary to control speed of armature without altering generator field and adjust the speed to compensate for variations of input voltage and output loads.

Referring to voltage regulation diagram, it will be seen that the control field is wound to oppose the main field, but acting only on the motor armature windings. Thus any variation of control field strength will affect the motor speed, but will not directly affect the generated E.M.Fs.

Since $\frac{\text{Volts Output} \times \text{Amps Output}}{\text{Volts Input} \times \text{Amps Input}} \times 100 = \% \text{ efficiency}$

and as efficiency can be considered as constant, then if output is to remain constant any variation of input voltage must be compensated by a variation in input current in order to keep the product of Volts in. x Amps in. at a constant value.

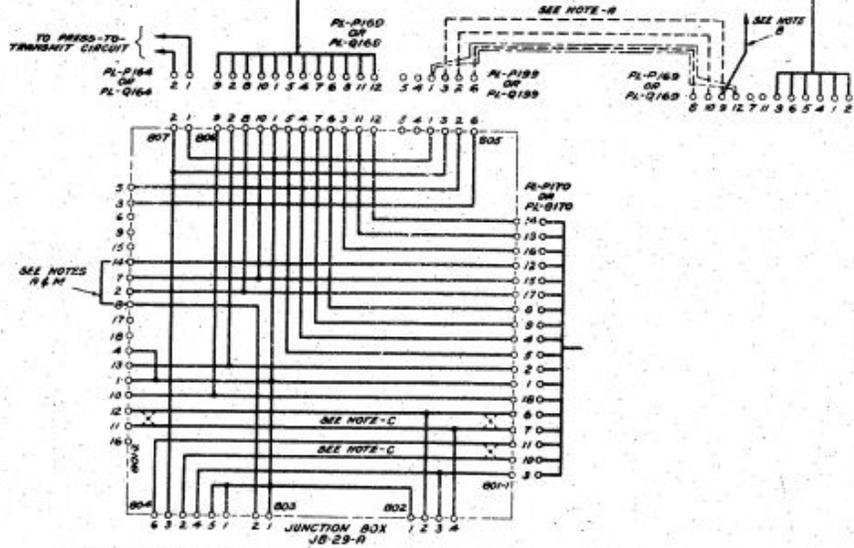
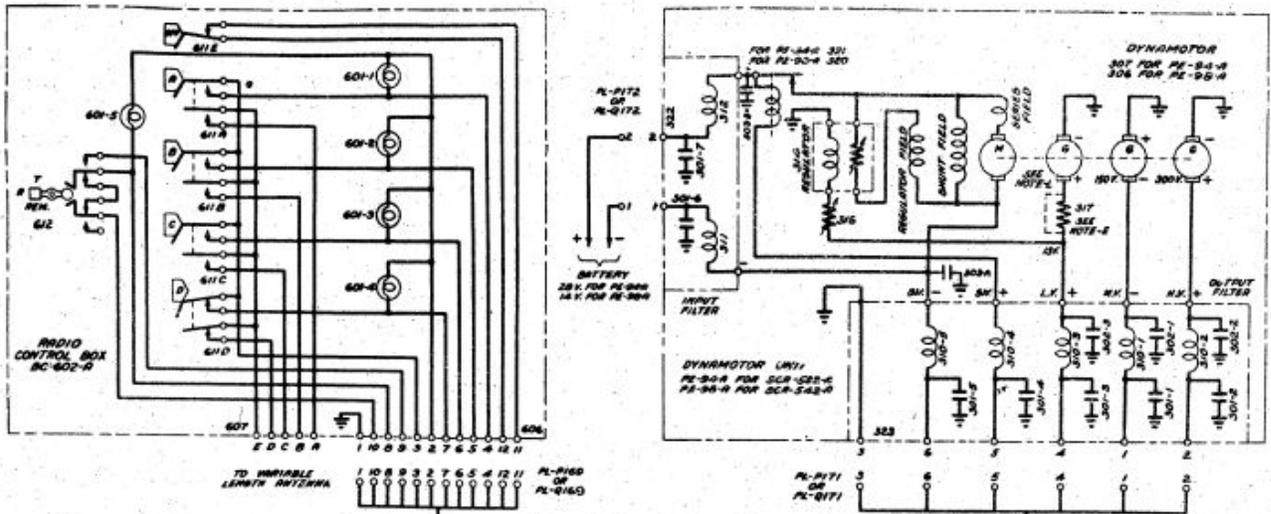
CARBON PILE REGULATION. (Ref. diagram)

Pressure is maintained on carbon pile by spring and varied by flux of solenoid acting on the spring armature. The solenoid is connected across the L.T. output and the carbon pile in series with the control field.

If input volts decrease output volts decrease, resistance of carbon pile decreases, control field strength increases, effective motor field decreases, decreasing back E.M.F., increasing armature input current and speed, tending to increase output volts.

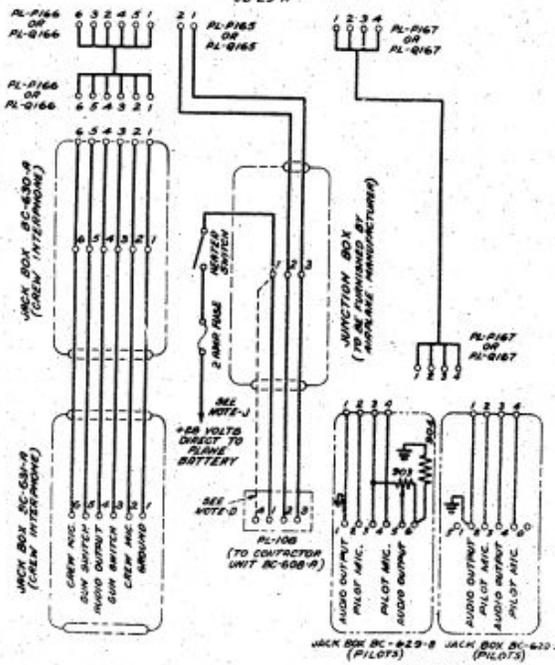
Again if load varies so that output volts increase, resistance of carbon pile will increase, control field will decrease, motor field increase, motor back E.M.F. increase, armature current and speed decrease and decrease output volts.

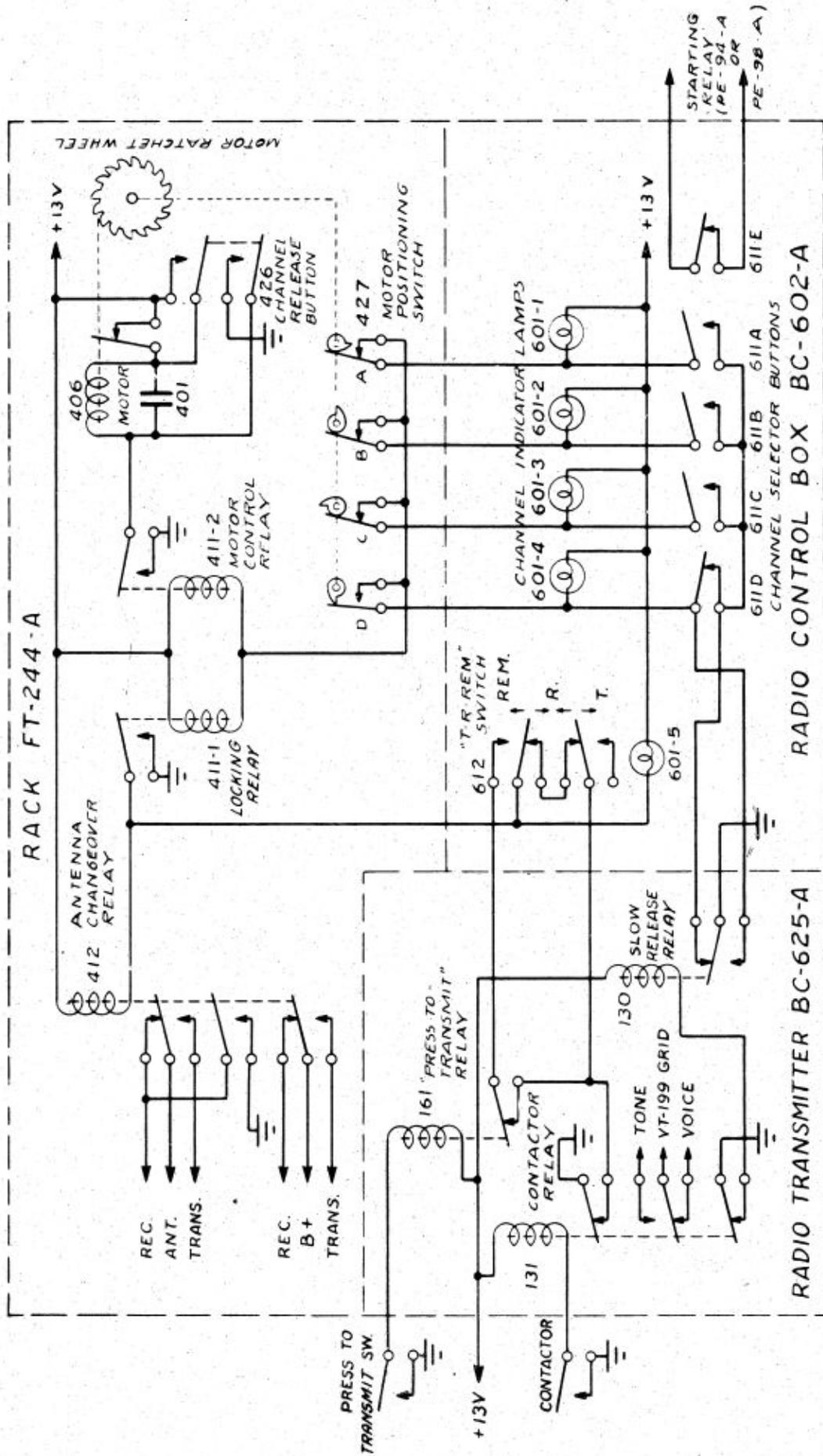
Thus with regulator correctly adjusted output will remain practically constant over variations of input voltage and output loads.



NOTES:

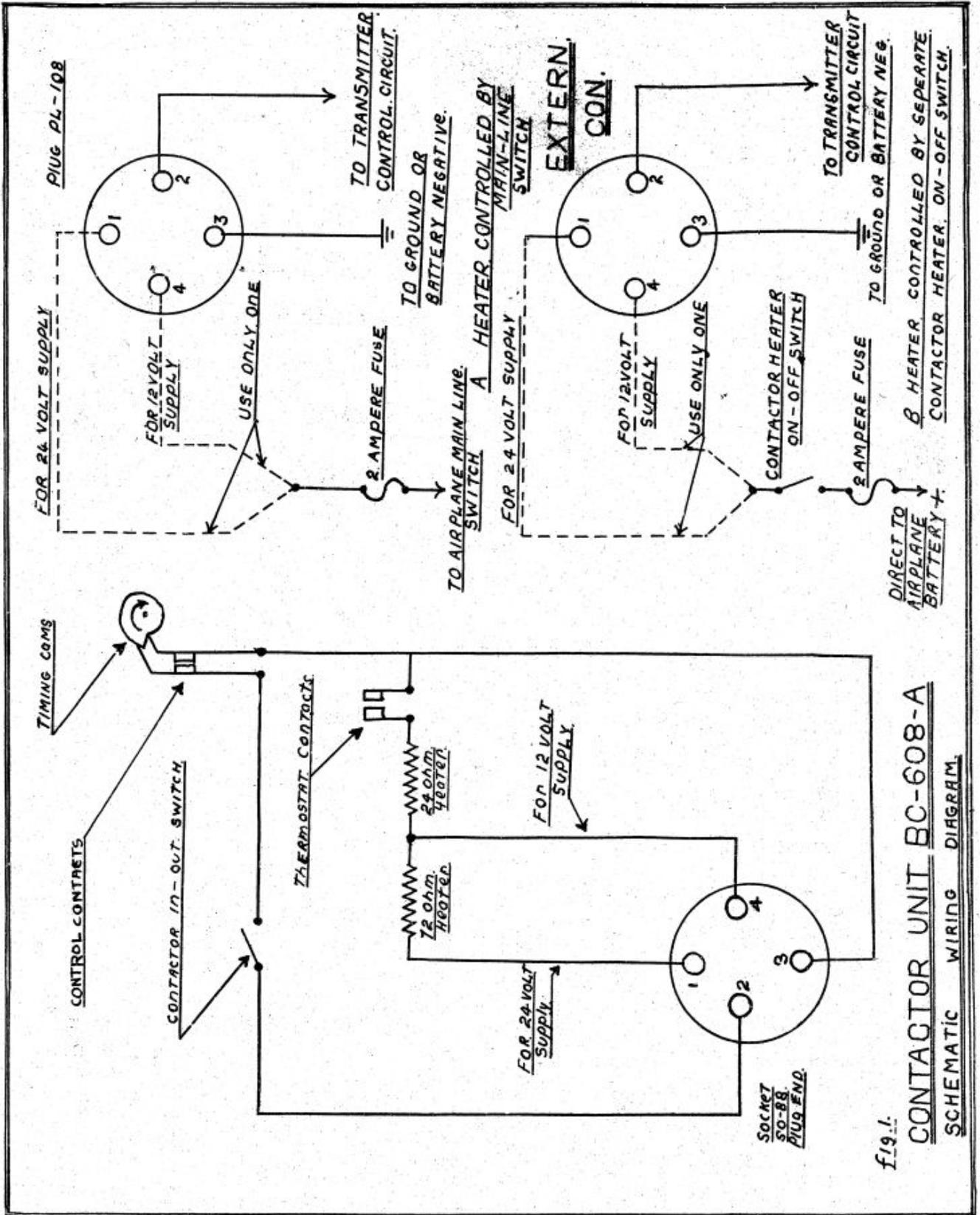
- A-WHEN MARKER BEACON RECEIVER IS USED IT IS NECESSARY TO USE THE CABLE SHOWN IN DOTTED LINE BETWEEN SOCKET 420 AND SOCKET 605. IT IS ALSO NECESSARY TO REMOVE THE JUMPER BETWEEN TERMINALS 8 AND 14 OF SOCKET 601-E.
- B-THIS LEAD IS USED IN U.S. INSTALLATIONS ONLY AND GOES DIRECTLY TO THE PRESS-TO-TALK SWITCH ON THE THROTTLE.
- C-THese LEADS MAY BE INTERCHANGED IN SOME EQUIPMENTS AND THIS IS UNIMPORTANT AS THESE LEADS ARE FOR A BALANCED MICROPHONE CIRCUIT.
- D-FOR 14 VOLT OPERATION REMOVE LEAD FROM PIN No. 1 OF PL-P168 AND CONNECT IT TO PIN No. 4 AS SHOWN BY DOTTED LINE.
- E-ON RC-604 ITEM 517 IS OMITTED AND CONNECTION IS MADE AS SHOWN BY DOTTED LINE.
- F-EQUIPMENT SHOWN IN THE RECEIPT POSITION ON BAND 'D' WITH SUFFICIENT INPUT TO THE RECEIVER TO OPEN THE SOLENOID RELAY 2-46.
- G-VACUUM TUBE NOS. IN PARENTHESES, SUCH AS (832), ARE U.S. COMMERCIAL TYPE NOS.
- H-A FEW EQUIPMENTS DO NOT HAVE ITEM 162.
- J-CONTACTOR UNIT SUITABLE FOR USE ONLY WITH PRIMARY POWER SYSTEMS HAVING A GROUND NEGATIVE.
- K-A FEW EQUIPMENTS HAVE ITEM 100, 105-4, 106
- L-14.5 LY OUTPUT FOR DYNAMOTOR 307 13 LY OUTPUT FOR DYNAMOTOR 306
- M-THIS JUMPER IS NOT REQUIRED IF CONTACTOR OPERATION IS NOT DESIRED.
- N-PL-P167 (OR PL-Q167) TO BE PLUGGED INTO WHATEVER JACK BOX IS USED (RC-629-A OR RC-629-B).





NOTE: EQUIPMENT SHOWN IN RECEIVE OPERATION ON BAND "D".

FIGURE 55 — CONTROL CIRCUITS, SIMPLIFIED SCHEMATIC DIAGRAM



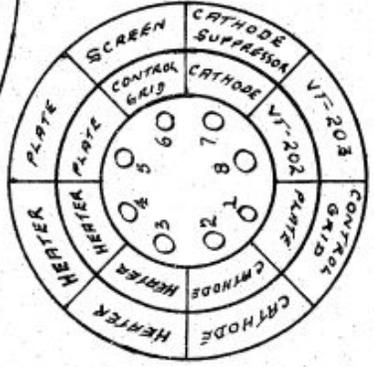
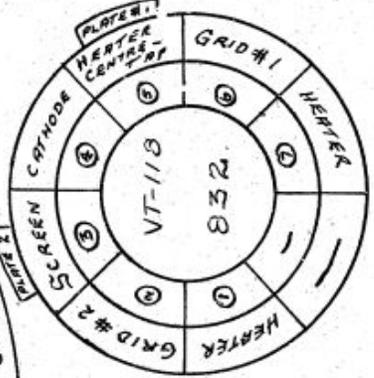
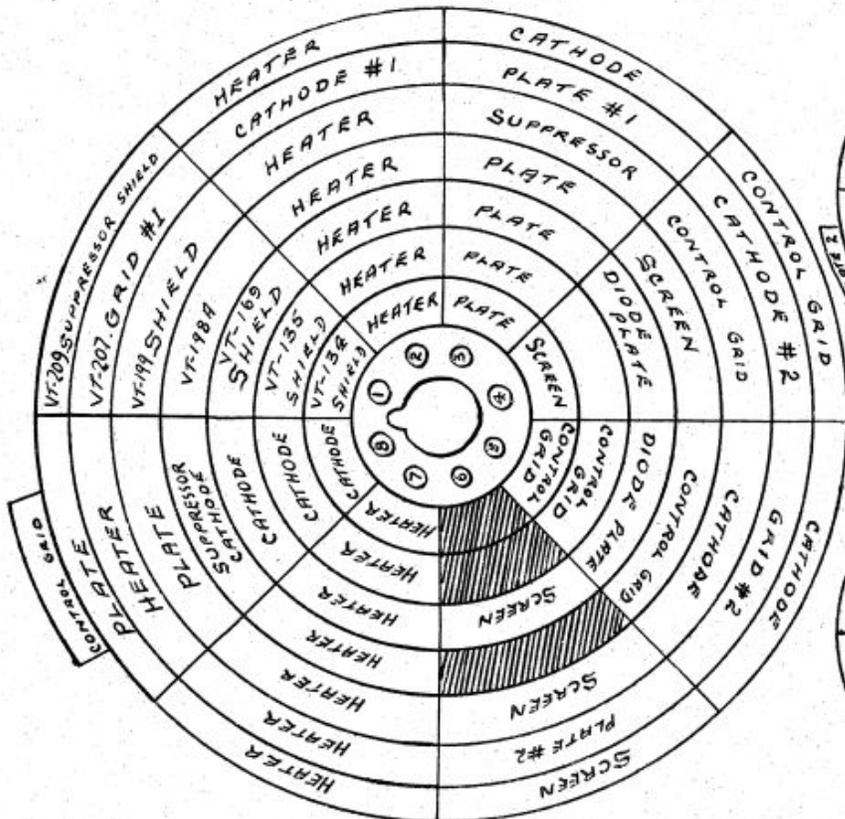
TRANS-MITTER BC-625-A T5017

TUBE SERVICE TYPE	TUBE COMMERCIAL TYPE	FUNCTION	PLATE	SCREEN		GRID		CATHODE	HEATER
				GI/1	GI/2	GI/1	GI/2		
VT-118	832	2 nd HAR. AMP	300	150	-57	-80	0	12.5	6.4
VT-118	832	POWER AMP	285	160	-52	-52	0	12.5	6.4
VT-198A	666G	OSCILLATOR	300	157	-29	-29	-	12.5	6.5 7.5
VT-134	12A6	1 st HAR. AMP	300	280	-40	-40	40	12.5	0
VT-199	6557	SPEECH AMP	288	40	VARIABLE	VARIABLE	2.2	6.5	0 22
VT-134	12A6	MODULATOR	290	265	-13.5	-13.5	0	12.5	0
VT-134	12A6	MODULATOR	290	265	-13.5	-13.5	0	12.5	0
VT-199	6557	A.F. MOD. DIODE	-2.4	-2.4	-2.4	-2.4	0	6.5	0 2.4

RECEIVER BC-624-A-R5019:

TUBE SERVICE TYPE	TUBE COMMERCIAL TYPE	FUNCTION	PLATE	SUPPR.	SCREEN	GRID	CATH.	HEAT.
VT-203	9003	MIXER	295	2.3	42	0	2.3	12.9 6.5
VT-203	9003	HAR. AMP	260	2.5	75	0	2.5	13. 6.8
VT-202	900R	HAR. GEN.	180	-	-	0	4.5	6.9 0
VT-209	12SG7	1 st I.F.	290	1.8	70	0	1.8	13. 0
VT-209	12SG7	2 nd I.F.	285	1.4	65	0	1.4	13. 0
VT-209	12SG7	3 rd I.F.	280	3	135	0	3	13. 0
VT-169	12CB	DETECTOR	75	8.5	20	4	8.5	13. 0
VT-135	12J5GT	2 nd A.F. AMP	295	-	-	0	10.5	13. 0
VT-207	12AH7GT	OSC. BR. SQUELCH	260	12	0	0	12	13 0

1000Ω PER VOLT METER.



VALVE BASE CONNECTIONS & VOLTAGES TR5043.

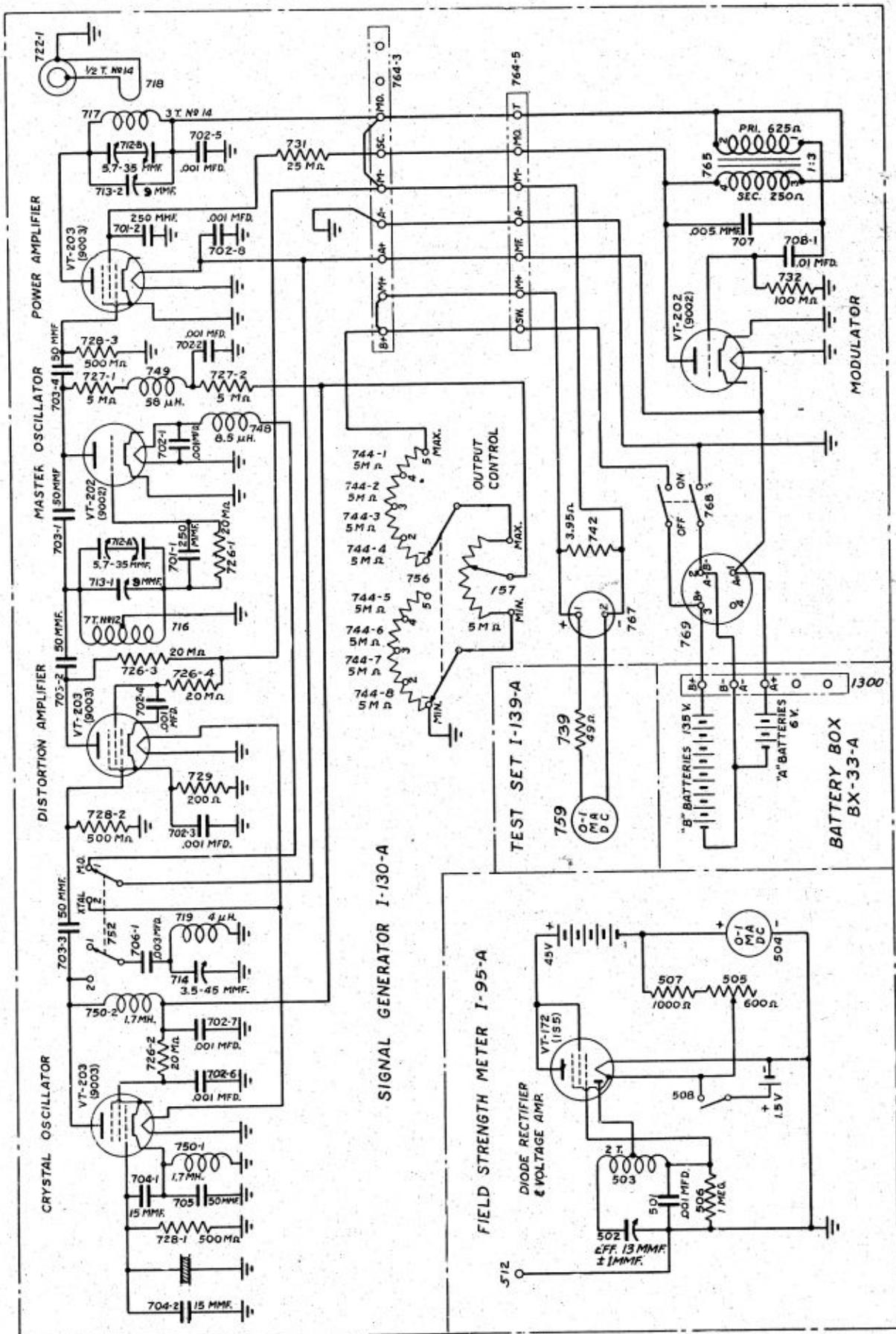


FIGURE 11—TEST EQUIPMENT IE-19-A, COMPLETE SCHEMATIC CIRCUIT DIAGRAM

TEST SET TYPE A. 20OPERATING INSTRUCTIONSINTRODUCTION.

1. The test set type A 20 is designed to provide a means of alignment and adjustment for Transmitter-Receiver type TR. 5043 (SCR. 522). It is intended that this test set will be used in conjunction with the test set type I-96-A or the test set type IE-19-A or their equivalent. The test set type A 20 may be used as an alternative to the IE-19-A for daily inspection but it is essential that the TR 5043 equipments be checked periodically - not less than once each week - with a test set type I-96-A or IE-19-A.

INSTRUCTIONS FOR USE.

2. The 18 pin plug type PL-P170 from the test set type A 20 is plugged into the 18 contact socket type SO-151 in lieu of the cable to the junction box. The test set has now full control of the TR 5043 equipment.

TRANSMITTER ALIGNMENTS.

3. (a) When being tuned the radio transmitter type T 5017 must be inside case CS-80-A with receiver type R 5019 connected.

(b) If the receiver and transmitter covers are closed, loosen the dzus fasteners pinning them to the center cover. Raise the covers slightly and slide them away from the tuning controls.

(c) Insert the crystals giving the desired frequencies into the transmitter crystal sockets and plug the test set meter cord into the two prong test milliammeter socket no. 171.

(d) Plug in the dummy aerial provided with the test set. This is located in the top right corner of the set and is removed by applying a light pressure to the left side of the securing bracket while extracting the dummy aerial.

(e) Ensure that the Rem/Trans/Rec switch is in the "Rec" position and that the contactor and signal generator switches are in the "OFF" position.

(f) Turn the equipment on by rotating the range switch to position "A". The dynamotor unit should start and the frequency shifter mechanism should operate, shifting the equipment to this channel. Release the frequency shifter mechanism by pressing the channel release button No. 426. Loosen the four transmitter tuning control lock nuts slightly by turning them counter clockwise. Select the lowest frequency channel by means of the range change switch and place the Rem/Trans/Rec switch in the "trans" position.

(g) Place the transmitter meter switch in position 1 and adjust the oscillator plate tuning control for maximum reading of the meter in the test set. Repeat, using meter switch positions 2 and 3 respectively and the second and third tuning controls respectively and in consecutive order.

(h) With the meter switch in position 3, tune the fourth control for minimum current. The test set reading must fall between 0.6 and 0.65. Final adjustment of the fourth tuning control and the aerial coupling must be made when the TR 5043 equipment is connected to the aircraft aerial.

(i) Adjustments of the aerial coupling and re-adjustment of the fourth tuning control for a dip in current may be necessary to obtain this reading. Do not consider a reading of more than 0.65 acceptable since such an adjustment will result in early valve failure. Following the adjustment of the antenna coupling control on the channel having the lowest frequency, record the meter readings obtained on the other channels with the meter switch in position 3 but do not make any further adjustments to the aerial coupling control. These meter readings will normally become progressively lower in switching to a lower channel. A meter reading as low as 0.50 on some channel is satisfactory providing the aerial coupling adjustment on the lowest frequency channel is correctly made.

(j) To tune the next channel rotate the range switch to the corresponding channel position and proceed in accordance with the normal procedure as laid down in the standard instruction manual.

CONTACTOR SET.

4. (a) With the channel range switch in position "A" and a headset connected to the Mic-Tel socket located on the test set, turn the contactor switch to the "ON" position and observe that the channel shifter mechanism operates and shifts the channel selected to "D". A 1000 cps. note will be heard in the headset.

(b) Return the contactor switch to the "OFF" position and observe that the channel shifter mechanism returns the frequency to channel "A".

RECEIVER ALIGNMENT.

5. (a) Insert the crystals to give the desired frequencies into the receiver crystal sockets and rotate the range switch to the channel selected for alignment. Connect a lead from the "aerial" terminal of the test set type A 20 to the aerial socket on the TR 5043 equipment.

(b) Place the signal generator "ON-OFF" switch to the "ON" position and ensure that the buzzer is operating. Adjustments for maximum output can be made by adjusting the two knobs on the front of the buzzer.

(c) Connect a headset to the Mic-Tel socket located on the test set and, using the local R/F generated by the buzzer, align the receiver in the manner laid down in the standard instruction manual.

CARBON/ELECTROMAGNETIC MICROPHONE OPERATION.

6. This switch enables a check to be made with either carbon or electromagnetic microphones.

OPERATION AND SERVICEABILITY OF TR 5043
IN AIRCRAFT

From general reports received concerning the serviceability of the TR 5043 in aircraft, it is felt that without probing into any radio technology much can be done to improve and maintain the highest standard of communication.

Records have proved beyond doubt that failures in aircraft can be divided into the following ratios: 95% due to faults that could, with systematic inspections and improved maintenance, be avoided and 5% due to faults outside the control of the personnel. This analysis of radio trouble is based on squadron mechanics' duties and the duties of the servicing echelon. Unless under an emergency the mixing of the above duties should not be encouraged. The following squadron set-up is known to be practical and is worth adopting;

RECORDS.

1. These are invaluable and can be kept without putting much extra work on the section. Every section possesses a man who perhaps is not a good radio man but who could do the seemingly unimportant work very well. It is necessary and most helpful to record:-

- (a) History of each TR 5043 as per attached specimen sheet.
- (b) History of each PE-94-A as per attached specimen sheet.
- (c) Pilot's report sheet.

2. Allocate the radio mechanics to a specific flight, such as A, B, C or D. It has been found that when men have their particular flight to maintain a self pride develops in them and a private struggle for the most efficient flight takes place.

3. The senior N.C.O. and remaining personnel are to be responsible for seeing that spare equipment is ready for immediate use on the flights.

FLIGHT MECHANIC'S DUTIES.

1. That an efficient daily inspection as laid down on the daily inspection sheet be carried out. On a day fighter squadron this should be done when the squadron is released at dusk and on a night fighter squadron when the squadron is released at dawn.
2. At all times when flying is taking place, mechanics must be out on the line and every ship met as it comes in. The pilot's report must then be filled in. Where the radio has been unsatisfactory, get as much information from the pilot as possible since it will help to locate the trouble more quickly. Remember that to a pilot the radio is "out" as soon as it ceases to be of use to him. Many pilots will help you a great deal and with a little tact the others can be encouraged to do the same, but learn your side of the work to avoid asking unnecessary questions. When the pilot reports radio "out", retain his microphone and check it, but make it your duty to see that it is returned to wherever he may need it. Don't content yourself with the worn-out theory of "cockpit trouble" This does exist, but is over-rated. Since the primary duty of a line mechanic is to keep the ships serviceable, it becomes a matter of replacing rather than repairing.
3. On a ship whose radio is reported "out", the following servicing routine should be carried out in this order, since it is based on the recording of the most common failures. Before removing anything from the aircraft, switch the radio on and note result.
 - (a) Failure to start. Check the fuse in the power supply, check battery voltage. Do not check the battery on no load as a practically discharged battery will read 22 to 24 volts, but on load may drop to 18 volts or lower.
 - (b) No side tone. Check the microphone telephone socket in the cockpit for a damaged cable by moving this cable freely and listening for any intermittent connections during the period you are testing. These sockets are a continual source of trouble if not

securely anchored in such a manner as to remove all strain from the cable assembly. They have been purposely left free to move so that a pilot on bailing out and forgetting to unplug his microphone and telephone will not be strangled, as the locking ring on the socket and plug is sufficient to maintain a firm connection but will release on sudden pull. Check microphone and telephone which were used by the pilot, making sure that the mike switch is in the "on" position.

- (c) Continuous howl. Usually due to inter-coupling between the microphone circuit in the form of dampness which gathers in the microphone socket. Use a piece of dry cloth to clean the inside of the socket. All mechanics should make themselves a suitable cleaning rod for this purpose and have it available while on line duty. Should the noise persist after cleaning the socket, replace with a new one since the insulation used on the cable assembly is often of a non-hygroscopic material and becomes sodden.
- (d) TR 5043 remains on channel D. Check that the contactor has not stopped on the first quadrant. Remove the plug 165 from the junction box assembly and if the set performs its normal operation, a short exists in the contactor wiring.
- (e) Excessive noise. Remove antenna connection from TR 5043 to ensure that the noise is not due to an external source. If the noise is still present, change the dynamotor unit.
- (f) Weak reception. Check volume control on pilot's jack box in case this has been accidentally left in a turned down position. Check the audio gain control in the receiver. This should be set at maximum. Check the squelch relay setting by having the engine

run up and set in the normal manner. The correct way in which to set the squelch relay is to turn the control fully clockwise and with the TR 5043 in the receive position and the engine of the ship running, turn the squelch relay control slowly counter-clockwise until a decrease in background noise is heard. Care must be taken that no incoming signal other than aircraft noise is being received. The maximum engine noise in terms of AC voltage measured at the phone terminals should not be in excess of 8 volts. Should the engine noise volts be in excess of this figure, the trouble must be remedied at the engine bondings, etc. Check the antenna system as per the 25-hour inspection sheet. If any of the above tests fail to reveal the source of the trouble, change the set and dynamotor.

Interference from Ignition Systems.

Interference from the ignition system as picked up on the TR 5043 can be cut down to such a low level as to cause little trouble with communications, but to attain this desired result, perfect co-operation must exist between the radio and the engineering sections.

The very maximum noise level which can be tolerated is 10 volts as measured at the telephone terminals with the audio gain at maximum and the squelch relay out.

To ascertain noise level, connect an AC volt meter across the telephone terminals, put the audio gain to maximum and set the squelch relay control to maximum.

Note the normal noise level due to the dynamotor and general hiss of the receiver. This is usually .5 to 1 volt, varying a little on the different channels. With the aircraft engine running, check the increase in noise level as registered on the AC volt meter on all channels.

Should this reading exceed 8 volts the bondings on the engine ignition system must be checked.

Here are the main points that give trouble:-

1. Loose gland nuts at the point where the main ignition conduits enter the distribution block.
2. Loose gland nuts at the point where the grounding wires enter the magnetoes.
3. Loose gland nuts at the point where the cannon plugs are situated in the various fire-walls and bulk heads.
4. Dirty and loose connections on the general ignition harness, particularly where the harness joins the spark plugs.
5. Dry soldered joints in the harness assembly. (These are difficult to locate, since they appear to be quite sound, but the twisting of the conduits around the ferrul they enter will reveal them).

Certain aircraft have been distributed that call for certain modification before the noise interference can be cleared. On the P-47's the distributor housing must be taken apart and the individual faces of the sections lapped. A bending clamp must be fitted at the point where the ignition conduit enters the distributor. This clamp must bond the conduit to the distributor in the most efficient manner since great trouble has arisen from this source. On many new aircraft the grounding wires have been found to be radiating into the ships' electrical system, but this trouble can be remedied on it by tracing the grounding wires back to the instrument panel to where the magneto switches are fixed and removing any excess of wire which may be looped and touching the electrical wire.

On the P-40's there should be a battery switch separate from the ignition switch and if this modification has not been done it should be carried out immediately.

25-HOUR INSPECTION AS CARRIED OUT ON AIRCRAFT BY THE RADIO MECHANICS.

When an aircraft is due for a 25-hour inspection, the following practice is thought to be the most practical both for speed and efficiency.

1. Remove the TR 5043, PE-94-A dynamotor and the radio controller. Where a servicing echelon or sub-depot exists, return this equipment and in exchange draw a replacement of equipment already serviced.
2. Examine for mechanical damage and general security all radio wiring in the aircraft.
3. Carry out an insulation test on the microphone telephone wiring since this is the most vulnerable part of the installation, as any intercoupling such as low insulation results in a continual howl in the telephone. A permissible test is:-

(a) Telephone positive to ground	2 megs
(b) Telephone negative to ground	0 ohms
(c) Microphone positive to ground	2 megs
(d) Microphone negative to ground	2 megs
(e) Telephone positive to microphone positive	2 megs
(f) Microphone positive to microphone negative	2 megs
4. Check all microphone and telephone sockets for correct anchorage and any possible wear of the cable assembly which connects the socket to the jack box. Where volume controls are fitted, check these for correct operation.
5. Check antenna system. Disconnect the coaxial cable from the antenna mast and make an insulation test of the cable. This should be around 20 megohms. By making a continuity test, check that the external screenings of the coaxial cable are efficiently bonded to the connectors type PL-P 173 and PL-Q 173. Make an insulation test between the antenna mast and the aircraft frame. Since the mast insulation is not entirely non-hygroscopic coupled with surface leakage which varies with climatic conditions the insulation value will alter con-

siderably, but a minimum reading of 100000 ohms should be sought. Make a continuity test between the center connection of the mast socket and the mast itself to ensure that the internal connection of the mast is correct. Make a continuity test between the outside of the mast socket and the external earthing terminal which is approximately seven inches higher up the mast. Many masts of the AN-74 type have been found to be broken internally, resulting in a range of about ten miles, so the above tests are of the utmost importance. Check the TR 5043 fuse visually for signs of fatigue which may exist due to the number of starting periods of the PE-94-A dynamotor. Install the serviced TR 5043, dynamotor and controller, and carry out a normal daily inspection.

25-HOUR INSPECTION FOR THE TR 5043 TO BE CARRIED OUT BY THE SERVICING ECHELON.

1. Remove the TR 5043 from its case.
2. Remove the transmitter and receiver from the rack.
3. Check the rack:-
 - (a) Remove the cover which surrounds the 18 pin, 12 pin and the antenna socket.
 - (b) Clean and blow out with air all dirt which has collected in the rack assembly, taking extreme precautions against damage to the contacts on the relays 411-1, 411-2, 412 and the selector motor.
 - (c) Check visually all the wires for any chafing which may have occurred from previous misplacement, particularly on the transmitter side where the dzus fasteners pass through.
 - (d) Check for any corrosion in the base of the 18 pin, 12 pin and antenna socket; if present, remove with tetra-chloride. Clean the pins with tetra-chloride and smear sparingly with petroleum jelly. Do not clean any contact pins with abrasive

materials since the pins are tin plated to retard corrosion or oxidisation.

- (e) Using tetra-chloride, clean the contacts on the relays 411-2, 412 and 411-1, and the selector motor; then, by operating the relays manually, check that the contacts are making correctly. Check that the armatures on these relays do not foul the back guide and stop.
 - (f) On the under side of the rack clean with tetra-chloride the Jones plug socket, also the antenna plugs for the transmitter and receiver.
4. Check the transmitter:-
- (a) Remove the plate which gives access to the compartment containing the final VT-118 tube.
 - (b) Clean and blow out with air all dirt in the transmitter.
 - (c) Remove all the tubes and clean their contact pins with tetra-chloride.
 - (d) Check visually all the wiring.
 - (e) Clean with tetra-chloride the contacts on relays 131, 161, 130; then by operating the relays manually check that the contacts are working correctly.
 - (f) Clean with tetra-chloride the Jones plugs.
 - (g) Actuate by hand the selector slides and check for free operation, then oil very sparingly using an anti-freezing oil.
 - (h) Clean with tetra-chloride the crystal switch contacts 156 and the meter switch contacts 157.
 - (i) Replace all the tubes and, where anchoring

devices are employed, check for security.

- (j) Check that the antenna coil coupling adjustment is satisfactory by moving it from the maximum to the minimum positions. Check that the moving coil does not short the fixed coil, or that the individual turns of the moving coil do not short themselves.

5. Check the receiver:-

- (a) Clean and blow out with air all dirt in the receiver.
- (b) Remove all tubes and clean their contact pins with tetra-chloride.
- (c) Check visually all the wiring.
- (d) With extreme caution clean with tetra-chloride the squelch relay 246 contacts; this relay, being very delicate, calls for great care.
- (e) Clean with tetra-chloride the crystal switch contacts 286.
- (f) Clean with tetra-chloride the Jones plugs.
- (g) Actuate by hand the selector slides and check for free operation, then oil very sparingly, using anti-freezing oil.
- (h) Replace all tubes and, where anchoring devices are employed, check for security.

6. Assemble the transmitter and receiver to the rack and replace the unit in its case.

7. Carry out a normal tuning procedure and bench check in the following manner:-

- (a) Check channel selection, A to B, B to C, C to D and D to A, by operating the push buttons on the controller.

- (b) Check the transmit position first by using the controller, then by using the "press to transmit" feature. Check the receive position by using the controller.
- (c) Check the contactor system selection of channel D. When the contactor circuit is completed the TR 5043 must select channel D in the transmit position, irrespective of which channel was selected prior to the contactor operating. Check that channel D is selected from A, B and C positions but that the set turns to its previous setting when the contactor set is open. At the same time that channel D is selected during the above check, a 1000 cycle note of low strength must be heard in the telephone, also the TR 5043 must be on transmit.
- (d) Check for side tone, i.e. hear yourself speak.
- (e) Check the audio control on the receiver section using the dynamotor background for the signal.
- (f) Check the squelch relay, using the dynamotor background for the receiver.
- (g) Insert the appropriate crystals in the transmitter and receiver and proceed to tune as per the normal tuning instructions.

25-HOUR INSPECTION FOR THE PE-94-A DYNAMOTOR.

Remove the dynamotor from its chassis:-

1. Check all the brushes for excessive wear.
2. Check the brush springs for correct positioning; the springs must not foul the sides of the brush box and must sit in a square and central position on the brushes.

3. Check that the brushes show no tendency to stick in their boxes.

4. Check the spring tension - 12 ounces of tension on the 24 volt and 13 volt springs and 4 ounces on the 300 volt and 150 volt springs.

5. Commutators:- The less work done on these the better; a healthy commutator is of a dull straw colour and no benefit is gained by removing this natural burnish. If, however, any particular commutator does have excessive blackening, check for a soft brush. Drop test the 300 volt and 150 volt armatures for open and closed circuits, i.e. test bar to bar with an ohm meter. This test is necessary since many armatures have been found with open circuits, presumably due to centrifugal force lifting any coils that have been insufficiently secured during the dynamotor construction. On the ordinary performance of the dynamotor under these conditions, this fault does not reveal itself too plainly but usually excessive sparking and an increase in the noise level as heard in the telephones occur. Check that all leads are free from rubbing and remove any carbon or copper dust which may have accumulated on the brush rings. Thoroughly clean the whole dynamotor and replace its chassis. Check the switching relay and if arcing has occurred across the contacts, reface same.

6. With an input of 28 volts, check the dynamotor output voltages, namely 300 volts, 150 volts and 13 volts. Should the readings obtained fall wide of the above check the resistance setting for the voltage regulator solenoid. This operation requires the lifting of 13 volt brushes and the removal of the 6 pin plug from the dynamotor. With an ohm meter check between the 13 volt positive lead and the chassis; this should be 13.1 ohms. Adjust by means of a sliding contact on resistance 316, if necessary making sure that the sliding contact is tightened up again. If with the correct input voltage the 13 volts is still not obtained, adjust the air gap of the voltage regulator. This is done through the hole provided in the chassis base. A very slight running of this adjustment gives a considerable voltage variation so great care must be taken. Should the 13 volt output

appear to be unstable, remove the regulator cover and turn the adjustment slightly clockwise to stabilise. A compromise will have to be reached since increased stability gives decreased regulation. Replace the 13 volt brushes and the 6 pin plug and run the dynamotor on load, i.e. using the TR 5043 as a load.

7. Check for sparkless running at the brushes by listening to the noise level in the telephones. Should this noise be excessive after making sure that there is sparkless commutation, check the AC component of the 150 volt output. The maximum permissible is .4 volts and if the reading is in excess there is nothing that can be done locally to cure the trouble. Give an all-round check for loose connections and security of the cooling fan. On completion of the inspection enter the power unit number and case number with any necessary remarks in the book furnished for this purpose.

NOTE:- If the bearings appear to give smooth running, it is only necessary to repack with grease as per instruction for sealed bearings.

BEWARE OF THE FAN WHEN THE COVER OF THE DYNAMOTOR IS REMOVED.

TUNING PROCEDURE OF THE TR 5043

By using a suitable dummy loading for the transmitter, the TR 5043 can be pre-tuned on the test bench and later installed into an aircraft with no further adjustment than the squelch relay setting.

The advantages of such tuning are:-

1. No transmitter need be switched on, so avoiding any interference with operations which may be taking place. In operational zones no transmitters must be switched on other than those actually engaged in operations since heterodyning takes place and makes any communication impossible. This point must be impressed upon all personnel.

2. An aircraft whose radio fails can be put back into commission in the shortest possible time by replacing units.

3. The TR 5043 is more efficiently tuned due to applying the correct input voltage to the dynamotor as against a supply from a possible indifferent aircraft battery. Even when the aircraft battery is in a good state of charge voltage drop along the aircraft wiring cannot be compensated and seldom is the required voltage available within the limits of the dynamotor voltage control. The extreme minimum voltage measured at the dynamotor terminals when on load should not be less than 22 volts. Only in an emergency should tuning be carried out in the aircraft. Due to the location of the radio set in many aircraft accurate tuning is very difficult, so that an occasional check of the transmitter antenna circuit should be carried out.

To check the transmitter antenna tuning use the 0-1 milliammeter and note whether the minimum reading is being obtained when the tuning switch is in position three. It will be found on certain frequencies that a further "dip" could be obtained of perhaps five milliamps but this slight gain will not increase the transmitter range to any extent, so it need not be retuned. A careful check has been made on the following aircraft - P-70s, A-20s, P-40s, P-38s, P-47s, P-39s, B-24s, B-25s, B-18s and in each case it has been possible to install a bench tuned radio into these ships with no further tuning of the antenna circuits necessary.

TUNING PROCEDURE FOR THE TR 5043.

The following sequence of tuning operation must be carried out so that failure to check any individual requirement will be eliminated.

1. Check channel selection, A to B, B to C, C to D, D to A, by operating the push buttons on the controller.
2. Check the transmit position by using the controller, also the "press to transmit" feature.
3. Check the receive position by using the controller.
4. Check the contactor system selection of channel D by using the push button on test rig. When

the push button is pressed the TR 5043 will select channel D irrespective of what channel was selected prior to the push button being operated. Check that D is selected from A, B and C positions, but that the set returns to its previous setting when the push button is released. At the same time that channel D is selected during the above check, a 1000 cycle note of low strength should be heard in the telephone, also the TR 5043 should be on transmit.

5. Check for side tone, the functioning of the audio gain and squelch relay, also the gain control in the modulator circuit of the transmitter. Check the side tone from both the pilot and crew position.

TRANSMITTER TUNING.

Select channel D and then press channel release. Unlock the tuning, control thumb screw. Press channel A and with the meter plug into the transmitter carry out the following operation:-

1. Tune the first control for the maximum reading with the meter switch in position one.
2. Put switch in position two and tune the second control for maximum reading.
3. Put switch in position three and tune the third control for maximum reading.
4. Leaving the switch in position three, tune the fourth control for a minimum reading.
5. Adjust the antenna coupling so that not more than 45 mils is shown in the tuning meter. After any adjustment of the antenna coupling the fourth tuning control must be readjusted for minimum reading. The remaining channels are tuned in the same manner, but there is no need to alter the position of the antenna coupling. (See notes on dummy transmitter loading).
6. Press channel release and lock the tuning controls tightly. The pressure which can be obtained by the fingers is found sufficient.

7. Select the four channels in turn and note that the meter readings after the controls have been locked are the same as those indicated during the tuning.

RECEIVER TUNING.

1. Place transmitter crystal for the band you are tuning into the crystal socket of the signal generator.
2. Turn the signal generator on.
3. Connect meter to signal generator.
4. Connect antenna to signal generator.
5. Set signal generator MO/crystal switch to crystal.
6. Place output control on maximum.
7. Place output steps on -5.
8. Adjust crystal tuning control for "dip" in meter. This dip should be at the frequency to be tuned.
9. Adjust megacycles dial control for additional dip; this dip should also be obtained at the frequency to be tuned.
10. Place T/R-remote switch in R position.
11. Press channel D.
12. Press channel release button.
13. Unlock receiver tuning control thumb screws.
14. Press channel A.
15. Place meter in socket of receiver.
16. Adjust both receiver tuning controls to approximately the frequency to be tuned.

17. Tune A band oscillator screw down clockwise.
18. Place phones on head.
19. With one hand adjust receiver tuning controls and with a screwdriver start to unscrew (counter-clockwise) the oscillator plate coil tuning screw until the signal is heard in the phones. When signal is heard, turn the screw down again (clockwise) until there is no signal.
20. Slowly unscrew (counter-clockwise) the oscillator plate tuning screw until you bring signal back, give the screw an extra half turn after you have brought the signal back.
21. Adjust receiver tuning controls for maximum "dip". The remaining B, C and D channels are tuned in the same manner. Ensure that the audio gain is at maximum and the squelch relay "out" during the receiver tuning operations.
22. Press the channel release and lock the tuning controls tightly.
23. Where volume controls are fitted in the aircraft leave the audio control in the TR 5043 at maximum (clockwise). Where no volume controls are fitted in the aircraft turn the audio control in the TR 5043 counter-clockwise for about sixty degrees.

NOTE:- In the average TR 5043 a satisfactory setting of the gain control on the transmitter is 45 degrees back from the maximum setting.

A correctly tuned TR 5043 apart from internal failures will not need retuning other than at the 25-hour inspection.

CONSTRUCTION OF A DUMMY TRANSMITTER LOADING.

This dummy loading is made up from components that are easily obtained on any squadron and will do good service until a correct design properly manufactured

111.
becomes available. At the end of a short piece of coaxial cable connect from the centre core to the outside screening a 20 ohm resistance in series with a 24 volt 2/4 watt lamp. It will be found that an antenna circuit tuned to this loading will be correct for any aircraft fitted with a quarter wave antenna such as the AN-74 mast. But the actual aircraft antenna will load up much better. To avoid overloading the output tube, keep the current in the final stage down to 45 milliamps when tuning to the dummy loading.

When the set is installed in the aircraft, the antenna circuit will be in resonance without retuning and the antenna will load up to the permissible 60 milliamps. Always use this loading when bench tuning the TR 5043 transmitter. The glowing lamp gives a quick check of R.F. An increased glow when testing for modulation will be seen.

TEST RIG FOR BENCH TUNING TR 5043.

This rig is not elaborate but extremely useful and can be constructed by the squadron personnel with no further call for equipment outside those that are usually available. Construct the test rig so that it is mobile. Rig a TR 5043 harness up including a single pole switch or push button connected across the socket of the junction box assembly which receives the plug PL-P 165, i.e. the contactor circuit, for testing contactor operations and a single pole switch or push button set in the cable connecting the dynamotor to the TR 5043 for checking the push to transmit feature. Push buttons are advisable since they cannot be left on. Make provision that the microphone telephone jack box for the connecting of an output meter (A.C. volts 0-60) for checking the audio output or noise levels of the dynamotors. Use a battery bank of good capacity, preferably 90 ampere hour and whatever form of battery charger may be available. During tuning operations it is desirable to keep the battery floating across the charger but should the capacity of the available charging unit not be sufficient to deliver 15 amperes the battery will supply the difference. In such cases leave the battery charger on after any tuning has been completed, regulating the charging note to that required.

CARE AND MAINTENANCE OF MICROPHONES AND TELEPHONES.

A system should be established on all squadrons whereby it is a pilot's responsibility to ensure that his microphone and telephone be checked in the communication section once per week. On this equipment being brought to the section, it should be checked in the following manner:-

1. Inspect all cords for general wear and tear, such as fraying of the outside braidings or slackness of the anchoring cords in the telephone pieces.
2. Check all connections for security.
3. Examine the receiver diaphragms for corrosion.
4. Carry out a continuity test and insulation test on the telephone and microphone cords, carefully checking for any intermittent breaks.
5. Where the T-34 cord assemblies are used, tape the microphone telephone plug completely over the plastic housing with either adhesive or rubber tape since these plugs are easily broken by the pilots getting in and out of the aircraft. There is a great deal of utter carelessness being displayed by pilots and air crews and this should be discouraged.
6. Test the microphone and telephone for actual performance.
7. Where communal microphones and telephones are in use owing to scarcity of supplies, wash and disinfect the microphone masks. Where such equipment is assigned to an individual pilot, he should be told of this practice in his own interests.

OPERATION OF TR 5043 BY PILOTS OR AIR CREW.

It is of great benefit to the satisfactory working of the TR 5043 to see that pilots and aircrew are made familiar with its usefulness and limits of its range.

Let **it** be the communication section's liability that these people are fully acquainted with the purpose of each channel, contactor procedure and that the radio range is similar to the optical range. This will prevent pilots trying to get extreme ranges at low altitudes.

TRANSMITTER TYPE A.T. 17INTRODUCTION.

The A.T. 17 is a mobile ground transmitter covering the V.H.F. frequency range of 100-150 m/cs. per second. Transmission is available on C.W., M.C.W. or R/T. either frequency or amplitude modulated. A transmitter using these frequencies is most suitable when secrecy of transmission is desired, as the signal radiated does not return to earth as in the case of the sky wave and any wave radiated parallel with the earth's surface does not follow the curvature of the earth and therefore becomes a sky wave at approximately the horizon.

The transmitter is specially designed to prevent the entry of dust. The two cabinets forming the complete unit are each provided with a fan and filtering system, using copper gauze.

The A.T. 17 may be operated from a single phase 40-60 cycle 110 volt supply or from 200, 220, 240 and 260 volt supply, having a power output slightly in excess of 150 watts on all frequencies for both F.M. and C. On M.C.W. or A.M. the power output varies between 50 and 100 watts, depending on the percentage of modulation. Provision has been made to key the transmitter either locally or remotely up to 200 w.p.m. over 20 loop miles of land lines, using lines of 170 ohms per land mile.

CIRCUIT DESCRIPTION.

The transmitter comprises the following units:-

1. Mounting base.
2. R/F cabinet.
3. Cabinet - power supply and modulator.
4. Power supply unit.
5. Modulator unit.
6. Exciter unit.
7. Power amplifier unit.
8. Inter-cabinet connecting leads.

Total Weight - 1166 lbs.

1. MOUNTING BASE.

The mounting base is used when the two cabinets are mounted side by side and care must be taken so that the power supply and modulator unit are placed on the left hand side of the R/F cabinet in order to provide easy access to the mains and line input terminal panel. Spare valves and equipment may be stowed in lockers provided in the mounting base.

2. R/F. CABINET.

The R/F. cabinet consists of:-

- (i) Exciter unit.
- (ii) Power amplifier.
- (iii) Aerial circuit.

(i) The Exciter unit type A. 17 contains the following components:-

(a) Crystal Oscillator - a crystal connected in the grid-anode circuit. The crystals should be ground to operate on frequencies between 2.083 - 3.125 m/cs. Four crystals may be plugged into sockets in the exciter unit chassis and selected by means of a selector switch on the front panel. Care should be taken to ensure that the crystals used are for operation between the above limits as the ratio of the transmitted frequency to crystal frequency is 48 to 1, and anything outside the above limits would not come within the range of the following tuning circuits. The amount of feed back in the oscillator is controlled by the size of condensers C.1, C.2 and R.2 forming a grid leak condenser combination. The D.C. voltage on the crystal holders is equalised by a voltage applied through the isolating resistor R.1 to prevent break down and strain of the crystal due to high D.C. voltages. C.3 is a screen by-pass and RFC. 1 allows the H.T. to be applied to the plate of V.1 without loading the circuit which will assist to improve the frequency stability. R.4 is part of a voltage divider network.

(b) Balanced Modulator:- The crystal oscillator is capacitively coupled to the grids of a pair of 7A8's (octode convs.) balanced modulator tubes via a

resistance capacity phase shifting network, the constants of which are arranged to produce phase shift in the output circuit when an audio frequency of suitable amplitude is applied to the No. 4 grids of the 7A8's. C.10 and C.11 are blocking condensers and R.12 and R.13 are grid leaks. Phase shift is brought about by a network consisting of resistors R.6, R.8 and R.11 and condensers C.9.

Cathode bias is provided by R.14, C.12 by passes the cathode for R.F., C.13 and C.14 bypass grids G.2 and G.3 of V.2 and V.3. Voltages for these grids are obtained through R.15, R.16.

(c) Quadrupler:- The output of the balanced modulator is fed to the grid of V.4, the plate circuit of which is tuned to the fourth harmonic of the grid circuit, the output of V.4 being four times the crystal frequency. Keying takes place at this stage. C.18 is a grid coupling condenser, R.21 a parasitic suppressor, R.19 grid leak, R.20 metering resistor, the voltage drop across which is a measure of grid current flowing in R.19. The screen voltage supply for V.4 is tapped off a voltage divider across exciter H.T. supply, C.22 is a screen bypass and C.23 a suppressor bypass. The anode circuit of V.4 is tuned by C.24 and L.2. R.28 and C.25 form the plate decoupling circuit. The valve employed is a 7W7 pentode valve.

(d) 1st Frequency Doubler:- The anode circuit of V.5 is tuned to 8 times the crystal frequency, this stage acting as a doubler. This stage is capacitively coupled to V.4. A parasitic suppressor is included in the grid circuit made up of RFC 6 and R.46. The voltage drop across R.32 provides cathode bias and C.27 is a bypass. The plate circuit of this valve is tuned by variable condenser C.30 and inductance L.5. This stage employs a 7C5 (a beam power tetrode).

(e) 2nd Frequency Doubler and Amplifier:- An 807 is now used as a frequency doubler, the output of which is 16 times the crystal frequency. The output of this stage is applied to the grid of the 813 (beam power tetrode) and amplification takes place in order that the exciter will drive the subsequent stages in the P.A. chassis. The resistor R.42 and choke RFC. 2 again

form a parasitic suppressor in the grid of the 807. RFC.4 prevents the grid leak R.40 and metering resistor R.41 from loading the plate circuit of the 807 excessively. The plate tuned circuit of the 807 is made up of C.42 and L.4. This stage is capacitively coupled to the 813 amp. valve. The cathode voltage of the 813 valve is obtained from a voltage drop across R.36. The filaments are bypassed for R.F. by C.35 and C.36. The resistors R.33 and R.39 are metering resistors for the cathode and grid currents of the 813. Range switches are unnecessary in any stage of the exciter as the frequency range of any stage may be covered with a variable condenser and fixed coil, having values chosen to suit the frequency band in which they operate. Every stage except the crystal is provided with both grid leak and cathode bias, which ensures that the plate dissipation of any stage is not exceeded during tuning. The circuit values are chosen in such a manner that the total plate current of the exciter remains approximately constant for either Key Up or Key Down conditions. This is most desirable because the voltage drop due to the exciter current is used to bias other stages in the transmitter.

The final frequency of the exciter is tunable over a range of 33 - 50 m/cs. and is coupled by means of an open wire transmission line to the input of the P.A. All traces of amplitude modulation are removed by operating the multiplier stages under class "C" conditions with heavy drive, which also ensures high efficiency in each stage.

(ii) Power Amplifier Unit:- The P.A. is included in the R/F Cabinet directly above the exciter unit and is designed to deliver 150 watts carrier into a 75 - 100 ohm coaxial cable (max.150 watts).

This unit incorporates five valves, the first two being type 100 TH used as push-pull triplers, the grid ~~circuit~~ ^{circuit} being tuned by coil L.2 and the split stator condenser C.2 to frequencies between 33 and 50 m/cs. The anode circuit of these valves is tuned by a Lecher rod and split stator condenser to the final frequency of the transmitter, which is 100 - 150 m/cs.

P.A. Valves:- The output of the frequency tripler is inductively coupled to L. 4, which again is in the form of a lecher rod and tuned by a split stator condenser and applied to the grids of two type 100 TH valves, which constitute the final amplifier stage, the anode circuit of which is tuned by another lecher rod and split stator condenser. As the P.A. valves are H.F. triodes, it is necessary to neutralise the inter-electrode capacity in order to prevent oscillations. This is accomplished by adjusting coils L.5 and L.6 until they are in parallel resonance with the internal grid to plate capacity of the valves at operating frequency.

Neutralising the P.A.:- The inductance of L.5 and L.6 is varied simultaneously by means of a control on the front panel. It is not possible to completely neutralise the stage for all frequencies over which it is desired to work with a single coil in L.5 and L.6 and for this reason two coils are provided with the transmitter, each covering approximately 25 mc/s.

Neutralising the Filaments:- Because of the physical size of the 100 TH valves used in the P.A., the filament leads within the valves possess inductive values which would cause considerable degeneration at the operating frequency. The effects of this inductance have been minimised by adjusting C.22 to such a value that it is in series resonance ^{with} the filament lead inductance. It will be noted that the lecher rods L.4 (grid ~~current~~ P.A.) are provided with an adjustable shorting bar in order that the complete range may be covered.

Aerial Coupling:- The aerial circuit consisting of a concentric line is inductively coupled by a lecher rod L.8 and tuned by C.27 to the P.A. output circuit L.7 and C.25. The angle between L.7 and L.8 is adjustable from the front panel in order that the output stage may be correctly coupled to the antenna.

Power Supply:- The power supply consists of the following:-

- (a) Auto transformer to convert mains voltage from 110, 200, 220, 240 and 260 to 240 volts.

- (b) 1500 volt H.T. supply delivers 1500 volts D.C. at .5 amp.
- (c) 750 volt H.T. supply delivers 750 volts D.C. at .5 amp.
- (d) Fuses, contactors and switches.

1500 volt supply employs two 866As working into a choke input filter system and protected by overload relay No. 1 and associated fuses. The overload relays may be adjusted to trip at the desired current value by means of a variable resistance shunted across the windings of the relay solenoid. Following are correct tripping currents:-

No. 1 H.T. O.L. .75 - .9 amps.
 No. 2 H.T. O.L. .7 - .85 amps.
 No. 3 Exc. O.L. .225- .250 amps.

This unit supplies power to the P.A.

750 Volt Supply employs a pair of 866As in a full wave rectifier circuit working into a choke input filter system. This rectifier unit supplies power to the exciter and modulator units ~~and amplifier 813~~. The minor supply is protected by relays Nos. 2, 3.

1500 Volt Supply:- The primary of the H.T. transformer in the major power supply is returned to neutral by the Tune/Transmit switch and the M/M change-over relay. In the "Tune" position, the primary is returned to the 110 volt tap of the auto transformer, thus reducing the output voltage to half the normal value. In the "Transmit" position the primary is returned to neutral via the FM/M relay. On A.M. it is necessary to reduce the plate voltage of the P.A. to about 1100 volts, which is accomplished by returning the primary of T.3 to a tap on the auto transformer. The FM/AM change-over relay has a coil resistance of 500 ohms and must trip at 22 - 25 M.as.

The Modulator Unit consists of two pre-amplifier stages, resistance coupled, both type 6J7G

pentode valves, two 807s in parallel as sub-modulators, two 809s in push-pull class AB2 operation. Negative feedback in the secondary of the input push-pull transformers to the cathode of the second pre-amplifier valve is used. Power supply is obtained from the 750 volt supply via series resistors and a voltage divider.

The output of the 809s is transformer coupled to give high level cathode modulation of the P.A. valves. As V.1 should be inoperative on C.W. and M.C.W., in order to prevent any incoming signal from modulating the transmitter, one section of the emission switch S.1 shorts the screen to ground on C.W. and M.C.W. emission. On R/T position the same switch shorts to ground the point where the tone oscillator voltage is injected into V (6J7G), thus preventing the tone oscillator from being heard on R/T. C.18 governs the proper function of negative feed-back; too small a value of this condenser results in positive feed-back, while too large a value attenuates the higher audio frequencies. Parasitic suppressors are included in the grids of the two 807s. The overload relay REL 1 opens the H.T. circuit in the event of a plate cathode short. The push-pull input transformer has two secondaries - one is used to feed the speech rectifier valve V.7 (5V4G) whose function will be explained under V.O.C. and A.G.C. The other secondary is used to feed the grid of the 809 and in addition two leads are taken from this secondary through a resistance network to the grids of the two balanced modulator valves in the exciter unit for F.M. The gain of the modulator amplifier is approximately 76 DB. The output impedance of the modulator is 600 ohms.

Diode Plates on the 6B6G are used to eliminate hum which may originate from the full wave rectifier supplying H.T. to the keying valve. This ripple is of large enough amplitude or percentage will effectively modulate the carrier. When the key is down, current ceases through 6B6G (cathode-anode) and diode plates are at earth potential or same potential as the suppressor. From this, it follows that any variation in potential on the suppressor will cause varying current changes through diodes via R.30 and R.31 to the cathode of 6B6G. **drop** thus produced would effectively oppose the changes in potential of the suppressor.

KEYING APPARATUS.

The transmitter is keyed in the exciter unit by biasing the suppressor grid of V.4 to 110 volts neg. in key up position. The Tone Oscillator is also keyed by tapping off 45 volts neg. from this 110 volts and applying to the control grid of the tone oscillator.

On "A1" emission, the secondary of the audio oscillator transformer T.5 is earthed. On "A2" the tone oscillator may be switched on to either a 700 or 1150 cycle note, which is grid injected into V.2 (6J7G). On "A.3" emission the output of the tone oscillator is shorted to earth in a similar manner.

KEYING.

A source of voltage approximately 300 volts is connected in series with a resistance of 50,000 ohms and the plate-cathode path of the 6B6G. When the grid of the valve is at cathode potential (key up) the valve draws current and acts as a resistor. The VD across the valve is approximately 190 volts so that across R.30 there is a VD of 110 volts neg. and is used to bias the exciter tubes beyond cut-off. On closing the key, the grid of the 6B6G receives a negative bias of sufficient value to cause this valve to be biased beyond cut-off, thus preventing current flow through the 50,000 ohm resistor. There is now no VD across this resistance and therefore the exciter and tone oscillator grid returns are at ground potential and the transmitter becomes operative. This method of keying allows high speed operation over a cable up to 20 miles in length.

VOICE OPERATED CONTROL.

This device switches on the carrier when the microphone is spoken in to. Switching is instantaneous so that there is no clipping of the first syllable, while the ^{Decay} ~~Decay~~ time is such that the carrier does not go off between words or breathing spaces. As has been explained under "keying" the transmitter can be made operative or inoperative by means of a bias on the grid of the 6B6G valve. The voice operated carrier control

equipment can provide this bias. The push-pull transformer T. 3 of the modulator has two secondaries, one of which feeds a full wave rectifier circuit, the output of which is taken to the resistors R.67 and R.68, 69.

Portion of this rectified voltage, which may be adjusted by means of a VOC gain control R.68, is used as bias for the 6B6G. When the microphone is spoken in to the output voltage will be rectified and appear as negative bias on the grid of the 6B6G. If this bias is 5 volts or over, the valve will cease passing current from the 300 volt supply, there will be no VD across R.30 (the 50,000 ohm resistor) and the transmitter will operate. As the control on R.68 (threshold sensitivity) is moved towards R.67, the output voltage from the voice rectifier, to operate the 6B6G is decreased; therefore the transmitter could be switched on by a lower input level to the microphone. Thus, if the microphone was situated in a noisy room, the noise might produce enough voltage to bias the 6B6G valve sufficiently to operate the transmitter, therefore by adjusting R. 68 and increasing the voice level at the microphone, it is possible to override the noise. It must be understood that the setting of R. 68 would only be correct for one setting of the main gain control. It has been previously stated that the V.O.C. equipment should act instantly and ~~slowly~~ slowly. *Decay*

The rectifier circuit used provides this automatically. On the positive half cycle, the internal resistance of the diodes is low and the condensers across the diode load charge up quickly, when the signal ceases, these condensers discharge slowly due to the high resistance of the diode load.

The value of this capacity may be altered to one of three different values, namely .25, .5 and .75 ufd. so that the discharge time may be increased or decreased by adjusting a three position switch. As the large condensers are switched in the period the transmitter remains on the air after speech is increased.

AUTOMATIC GAIN CONTROL.

A portion of the voltage drop across the diode load resistor of the speech rectifier is applied

back to the grid of the 6J7G (VI) for the purpose of controlling automatically the gain of the modulator and therefore the output of the modulator to the modulation transformer, thus preventing over-modulation in the transmitter. This AGC voltage operates in a similar manner to AVC commonly found on receivers.

MODULATION PERCENTAGE.

In position 1 the Test Meter is used to measure the percentage of modulation. As the diode load current of the speech rectifier is proportional to the output of the modulator and the output of the modulator proportional to the percentage of modulation, by measuring the voltage drop across the diode load resistor we have a measure of percentage of modulation.

TEST MIC. JACK ON MODULATOR PANEL.

The transmitter can be tested by inserting a microphone in the jack provided. The microphone voltage is derived from the drop in R. 45 and filtered by means of R.20 and C.1. For correct modulation with normal voice levels, the gain control must be set about 5 - 10. By inserting the test mic., all incoming signals are interrupted and the key closed.

LINE CHECK.

By inserting a pair of headphones in this jack, incoming signals can be monitored. The jack is in parallel with the "IN" terminal of the main gain control.

LOCAL AND REMOTE CONNECTIONS.

Lines should be connected to the terminals marked "LOCAL" and "REMOTE" on the line input panel which is situated on the side of the transmitter. The Local/Remote switch S selects either line and connects it to the input transformer whose secondary connects via the main attenuator to the input transformer of the modulator amplifier. Examination of the current shows that the FM/AM switch is only operative if the Local/Remote switch is in the "Local" position. In the "Remote" position, earthing terminal No. 5 energises the FM/AM switch relay REL.3. The control pair which enables the remote operator to change from AM to FM and vice

versa, connects to terminal 5 and 8. In short, switching from AM to FM can be carried out when on the "Remote" position without using the Remote Control Switch.

Should there not be a control pair available the AM/FM switch can be made operative in both the LOCAL and REMOTE positions of the line switch by connecting terminals R and S. These terminals are located on top of the built-in 5012A transformer.

KEY CONNECTIONS.

A morse key may be connected to the terminals marked "Key" on the line input panel. One side of the key terminals is earthed.

TIME DELAY SYSTEM.

A time delay mechanism is mounted on the P.A. chassis consisting of a 5V4G connected as a half-wave rectifier, the two anodes being connected together and being returned to one side of the filament transformer primary via the coil of REL 2 (time delay relay) and R.18 (limiting resistor). The cathode is connected to one side of the filament primary and the primary is connected to its secondary at the opposite end to which the anodes are connected. The 5V4G, being an indirectly heated type of valve, will take a considerable time for its cathode to reach operating temperature. Until the cathode reaches operating temperature which is determined by R 7 (a variable resistance in series with filament circuit) no current will flow via cathode-anode path of the valve, REL. 2 will be inoperative and as one set of contacts of REL 2 are in series with the coil of the two main contactors which are connected in parallel, there will be no H.T. available.

The second pair of contacts, when closed, short out the time delay resistance. This allows the filament of the time delay valve to reach its normal operating value (voltage) once the transmitter is operating.

SWITCH S.1 - EMISSION SWITCH.

Bank 1. Makes V.1 (6J7G) inoperative on A1 and A2 emission by shorting screen grid to earth on A1 and A2 position. The same bank when on A3 position shorts to earth the point where the tone oscillator voltage is injected into V2, thus preventing the tone oscillator from being heard on R/T.

Bank 2. When on C.W. (A1) this bank shorts the tone oscillator secondary output to earth, thus preventing the transmitter from emitting an M.C.W. note when on C.W.

On position A.3 a similar action takes place to prevent M.C.W. when on R/T.

Two other positions (A2 - 700 and A2 - 1150) are used to change the M.C.W. note frequency by placing additional capacity across the tone oscillator secondary to give a lower frequency.

Bank 3. (a) S.4 on P/T. - This part of S.1 controls the operation of the keying valve V.9 (6B6G) with switch S4 (P/T - V.O.C.) on P/T and S1 on A1, A2 or A3 a negative voltage will be applied between grid and filament of V9 when key is pressed, thereby operating the transmitter.

If switch S1 is turned to A3 position, a negative bias will be applied to the grid of V.9 as long as a microphone plug is inserted in the mic. jack J.1.

(b) S.4 on V.O.C. - With the P/T. V.O.C. switch in the V.O.C. position the emission switch (S1) in the A3 position, it is possible to control the carrier by speaking into the mic. bias being applied to the grid of the keying valve V9 from a voltage drop across the diode load resistance of the speech rectifier, thus switching on the carrier and modulating at the same instant.

Bank 4. Not used on A.T. 17 but used on A.T. 15A and is not shown on roneced diagram.

Bank 5. In order that the full H.T. voltage may be obtained on C.W. the FM/AM change over relay in the P S. unit must not be energised. This is accomplished by earthing its supply voltage when switch S1 is in A1 position.

SWITCH S.2 - LOCAL/REMOTE SWITCH

Bank 1 Local Position. When on "Local" the common side is connected via FM/AM change-over relay to a positive voltage source. Contact "Local" goes to AM position of the FM/AM switch which, if made, will complete a circuit to earth for REL. 2, thus switching transmitter circuits to AM.

Remote Position. When on "Remote" the FM/AM relay may be controlled by a line connected to terminals 5 and 8 on the modulator unit. The action here is to complete a circuit to earth for energising current of REL. 2 when the remote terminals of this line are connected.

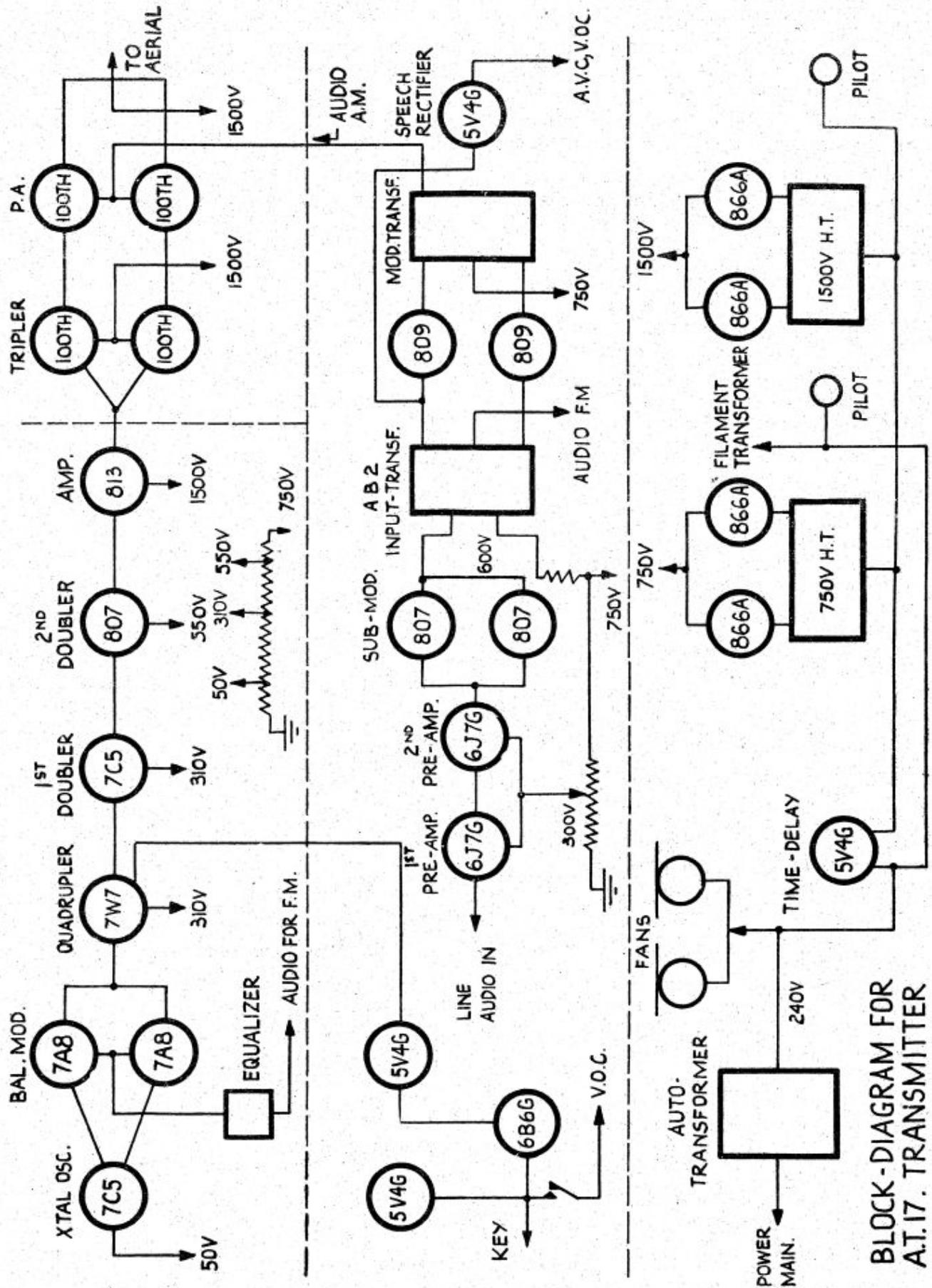


Figure 12.

BLOCK-DIAGRAM FOR A.T.17. TRANSMITTER

TUNING PROCEDURE FOR AT.17

Power supply has been adjusted at the factory to operate on 250 volts and 50 cycles. Should the line voltage be other than 240 volts, adjust the line auto transformer in accordance with the following table:-

MAINS VOLTS	110v	200v	220v	240v	260v
SELECTOR MAINS VOLTS	110v	200v	220v	240v	260v
PLUS OR MINUS 5V SELECTOR	-5v	-5v	plus 5v	plus 5v	plus 5v

Close main power switch to transmitter and press filament "ON" button. Main contactor should close fil., pilot lamp together with all fila. in equipment. If this does not occur, check power line gate switches and fuses.

NOTE:- Reading on AC line meter should be within 10% of 240 volts and if not, re-adjust auto transformer taps.

After approximately 30 seconds, time delay relay should close with a click; this indicates circuit is operating correctly.

Allow the transmitter to stay in this condition for a period of 15 to 30 minutes, during which time rectifier valves will become heated and the excess mercury which may have become deposited on the films. will evaporate. This applies to initial operation only.

Check to see that fans in rear of equipment are operating. Set tune transmit-switch in "tune" position, FM/AM switch in AM position and emission switch in A1 position. Press H.T. "ON" button. The H.T. voltage should appear on all valves and H.T. pilot lamp should light.

Proceed to tune transmitter as indicated in Section 4.

SECTION 4.

1. Having carried out previous instructions

the R/F circuits may be lined up.

2. Check that crystals are suitable for final operating frequency required; this will be 48 times crystal frequency. Next place exciter test meter switch in position "0" and a reading of approximately .2 to .3 m.a. should be obtained. No reading indicates that crystal is not functioning.

3. Rotate switch to position "ONE". adjust first tuning to give maximum reading on meter. This reading should be obtained at a point on the calibrated scale showing approximately the desired frequency (final).

4. Repeat this procedure for switch position and tuning controls Nos. 1, 2, 3 and 4.

5. Switch meter to position 5 - meter indicates cathode current of 813 amplifier valve and should be tuned to give minimum meter reading. This completes tuning of exciter unit.

6. Two sets of neutralising coils are supplied with P.A. The pair one inch diameter by six turns covering the frequency range of 125-150 m/cs, the pair $1\frac{1}{2}$ inches diameter by five turns from 100-125 m/cs. with a slight overlap. It will be found that a stop is turned in grid Lecher rods to act as a guide in setting shorting bar in the correct position, approximately half way along rods, allows operation on frequency 125-150 m/cs. while if placed at further end grid circuit will tune at from 100-125 m/cs.

7. Set neutralising control for desired operating frequency from neutralising chart.

8. Tune trebler grid for maximum in tripler grid meter. Tripler cathode current should rise to approximately 125 mils. Tune tripler plate for dip in tripler cathode meter.

9. Set P.A. fil tuning in accordance with chart.

10. Tune P.A. grid and tripler plate for maximum reading of P.A. grid current in meter. It will be found that these circuits interact somewhat and the two controls should be adjusted alternatively until maximum P.A. grid current is obtained.

11. Turn aerial coupling to minimum, aerial tuning to zero. Tune P.A. for lowest cathode current minimum plate current should co-incide; if not, reneutralise in accordance with instructions in Para. 13.

12. Place tune transmit switch in transmit position and increase aerial coupling slightly at same time adjusting aerial tuning dial until P.A. cathode current rises.

Recheck P.A. tuning-increase-coupling, recheck tuning and recheck P.A. tuning until P.A. cathode meter reads approximately 125 mils in FM position and 100 mils in AM position (tune position 75 mils). Resonance at a different dial setting and inability to load amplifier indicates mismatch or fault in aerial system.

NEUTRALISING PROCEDURE AND FILAMENT TUNING.

13. In event of neutralising and filament tuning charts being lost, or even if it is desired to check them, the following procedure is to be adopted:-
Slide P.A. chassis from the cabinet and open the link on the side of the aerial coupling compartment, thus removing high tension from 100TH amplifier valves. Tune up transmitter as far as P.A. grid (previously described) with aerial coupling at minimum, tune P.A. plate to resonance and if amplifier is incorrectly neutralised the P.A. grid will drop to low value. Adjust neutralising control until it is restored to its former value. Retune the P.A. plate circuit carefully and adjust neutralising control until there is no reaction from the P.A. tuning (plate) on the P.A. grid current reading. Retune P.A. grid circuit and simultaneously adjust P.A. filament tuning until P.A. current is maximum. The amplifier should now be correctly neutralised and readings recorded.

NOTE:- Setting of filament tuning influences neutralising and the grid circuit of the P.A. Insufficient capacity in filament tuning circuit will result in inability to properly neutralise amplifier. Compare meter readings with representative meter readings chart of each circuit.

14. Check and see if transmitter will key from both local and remote position. Plug a standard microphone (carbon) in mike jack, turn emission switch to A3, advance gain control and see if transmitter is being modulated on speaking into microphone. Operate FM/AM switch and see that FM/AM relay is operating.

NOTE: Readings on modulation percentage meter, if it appears to be operating correctly set gain control to percentage desired. Check operation of tone oscillator by turning emission switch to position 1 and 2. Turn emission switch to A3 and check VOC operation.

EXCITER AT. 17

Condition of Operation	Ball Mod. Grid m.a. V2 & V3 K.U.K.D.	Quadrupler Grid ma. V4 K.U.K.D.	1st Doubler Grid ma. V5 K.U.K.D.	2nd Doubler Grid ma. V6 K.U.K.D.	Amplifier Grid ma. V7 K.U.K.D.	Amplifier Cathode ma. V7 K.U.K.D.
F.M. TUNE	0.2 0.2	0.3 0.3	NIL 0.5	NIL 1.2	NIL 4-8	40 100
A.M. TUNE	0.2 0.2	0.3 0.3	NIL 0.5	NIL 1.2	NIL 4-8	40 100
F.M. XMIT	0.2 0.2	0.3 0.3	NIL 0.5	NIL 1.2	NIL 4-8	60 160
A.M. XMIT	0.2 0.2	0.3 0.3	NIL 0.5	NIL 1.2.	NIL 4-8	60 130

POWER AMPLIFIER AT 17

Condition of Operation	Tripler Grid ma V 1&2 K.U.K.D.	Tripler Cathode V1&2 K.U.K.D.	P.A. GRID ma V 3&4 K.U.K.D.	P.A. Cathode ma V3 K.U.K.D.	P.A. Cathode ma V4 K.U.K.D.
F.M. TUNE	NIL 10	40 120	NIL 20	25 80	25 80
A.M. TUNE	NIL 10	40 100	NIL 20	25 80	25 80
F.M. XMIT	NIL 20	60 150	NIL 40	50 125	50 125
A.M. XMIT	NIL 15	50 125	NIL 30	30 100	30 100

NOTE: DO NOT TUNE P.A. TO LOAD UP OVER 100 MIL ON A.M.

MODULATOR A. 14

Condition of Operation	Line Volts	Pre Amp Plate ma VI	Pre Amp Plate Ma V2	Sub Mod Cathode Ma V3V4	Modulator Ma V5V6	Tone Osc. V8	Mod %
F.M.	240	0.5-1	1.2	55	50-240	1.2	0-100
A.M.	240	0.5-1	1.2	55	Nil	1.2	0-100

Reading of VI obtained only in A2 and A3 position of emission switch.

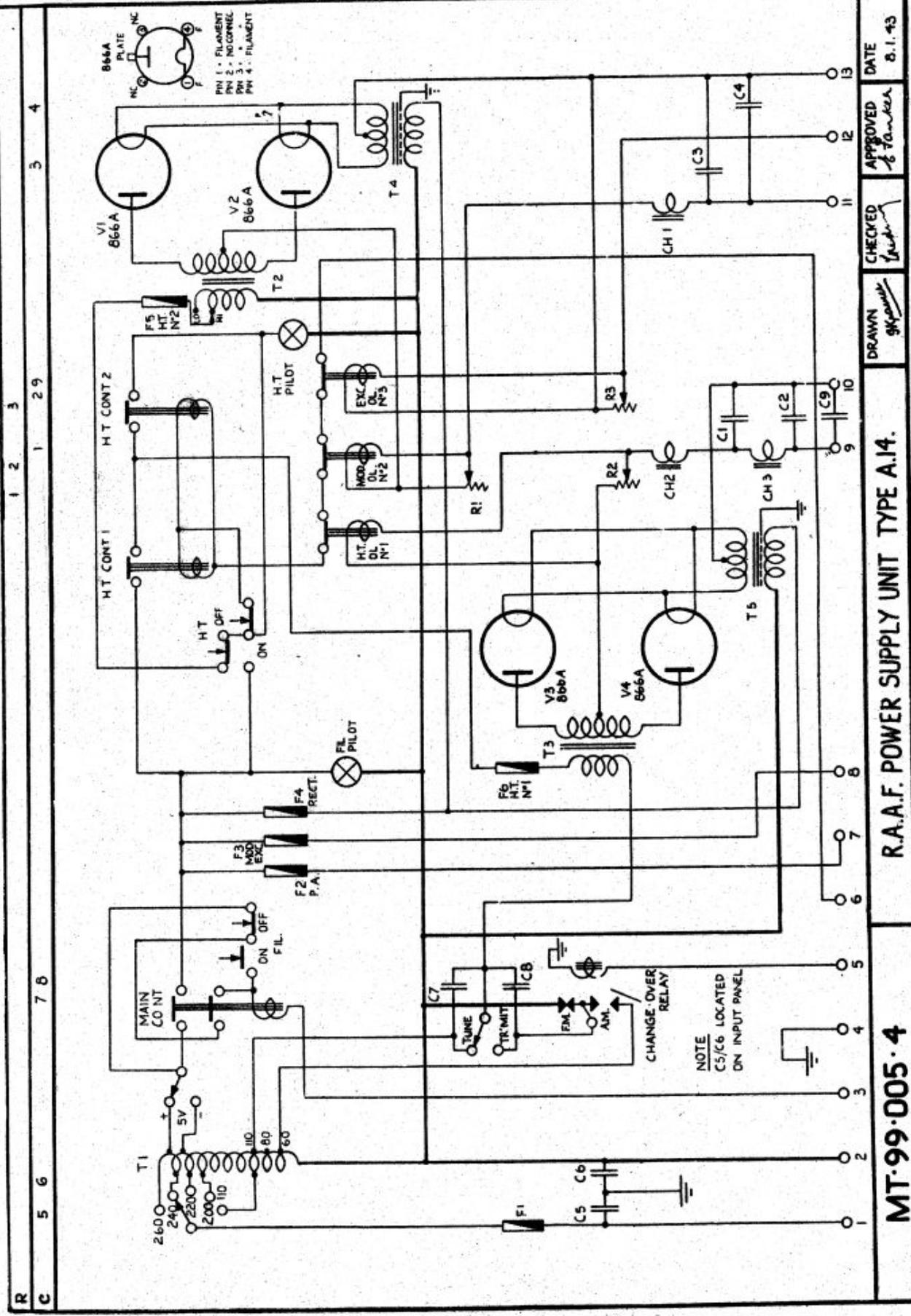
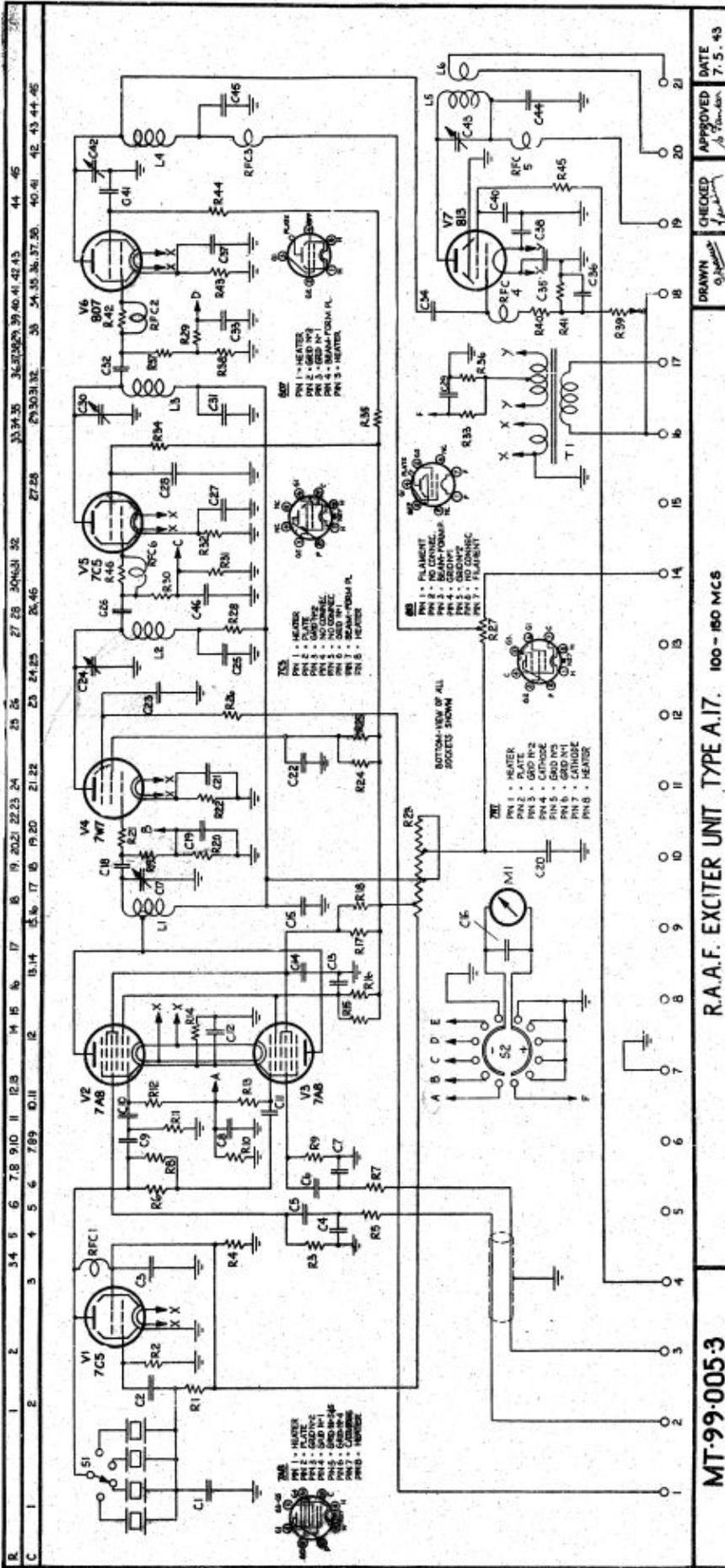
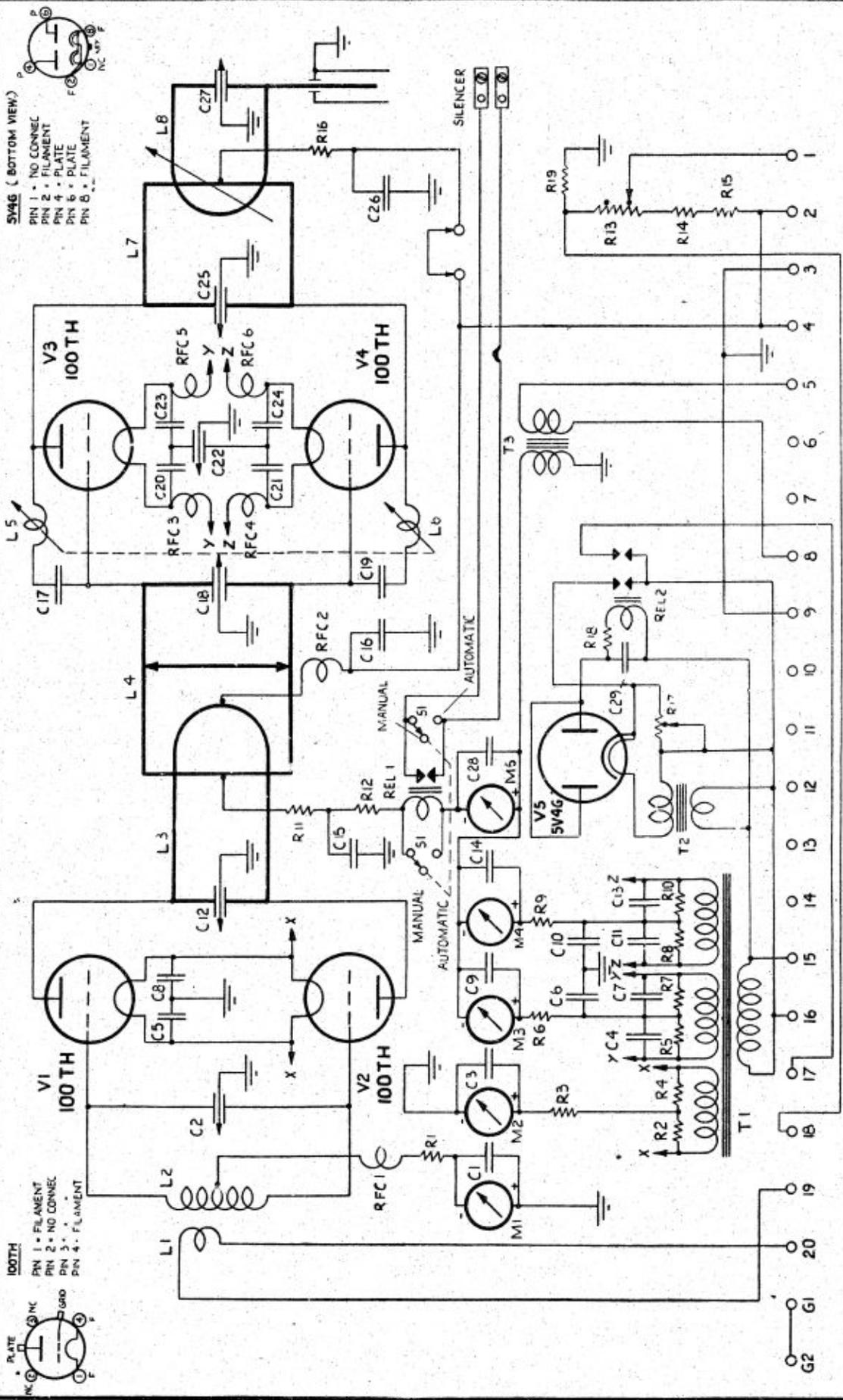


Figure 20.

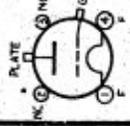


R 12 3.4 5.6 7 8 9.10 11 12 13 14.15 16 17 18 19 20 21 22 23 24 25 26 13.14 15 16 19 27

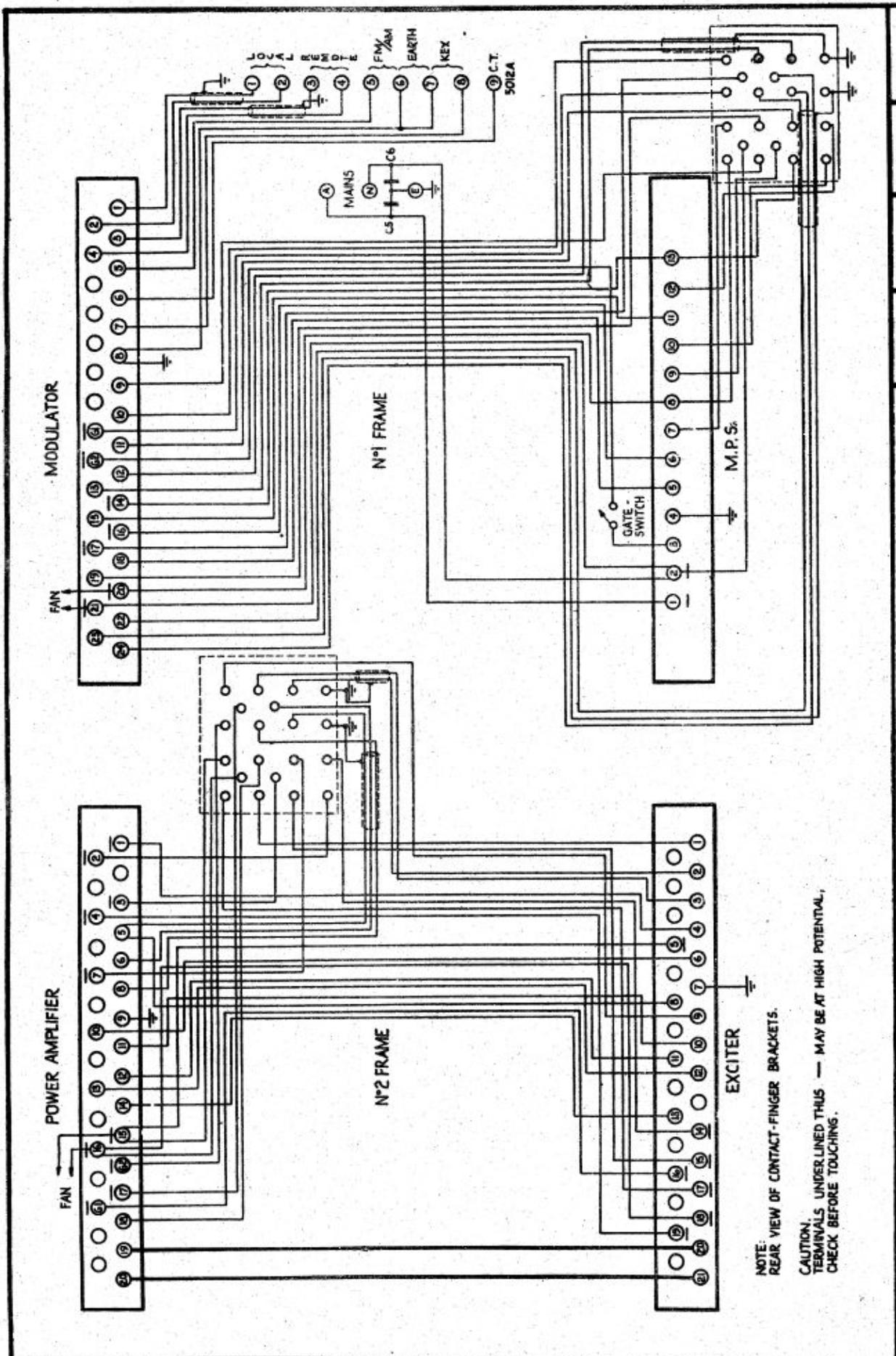


100TH
 PIN 1 - FILAMENT
 PIN 2 - NO CONN.
 PIN 3 - FILAMENT
 PIN 4 - FILAMENT

5W4G (BOTTOM VIEW)
 PIN 1 - NO CONN.
 PIN 2 - FILAMENT
 PIN 4 - PLATE
 PIN 6 - PLATE
 PIN 8 - FILAMENT



MT-99-005.2 **R.A.F. POWER AMPLIFIER UNIT TYPE A.17.100-150MCS** **DRAWN** **CHECKED** **APPROVED** **DATE**
 31.12.42



MT-99-005.9

INTER-WIRING, R.A.A.F. TRANSMITTER AT.14A, 15A & 17.

DRAWN
 CHECKED
 APPROVED

DATE
 23.3.45

FIGURE 11.