THE ROYAL CANADIAN NAVY

INSTRUCTION BOOK

AND

PARTS MANUAL

FOR THE

TYPE CM11A RADIO TRANSMITTING - RECEIVING EQUIPMENT

THE ROYAL CANADIAN NAVY

The 28th day of January, 1960

This publication, which is entitled "RCN Instruction Book and Parts Manual for the Type CM11A Radio Transmitting-Receiving Equipment - BRCN 2769," is issued under the authority of the Chief of the Naval Staff within his power under the National Defence Act, 1950.

2. Suggestions for improving the text or illustrations should be forwarded to the Naval Secretary through the usual channels.

3. This publication supersedes BRCN 2769 bearing title "Installation and Operating Instructions for CM11A - Folder No. 122-104A".

NAVAL SECRETARY

To all Flag Officers,
Officers Commanding
Her Majesty's Canadian
Ships and Establishments,
and to all other concerned.

RECORD OF CORRECTIONS

Identification of Correction or Amendment List No.	Date Entered	By Whom Entered (Signature; Rank; Name of Command)

WARNING

1. Personnel engaged in the installation, operation and maintenance of this equipment are urged to become familiar with the following rules both in theory and the practical application thereof. It is the duty of every person connected with electronic equipment to be prepared to give adequate first aid and thereby prevent avoidable loss of life. Your own life may depend on this.

2. Operation of this equipment involves the use of high voltages which are dangerous to life. Operating personnel must observe all safety regulations at all times. Do not change tubes or make adjustments inside the equipment with the high voltage supply on. Do not depend upon door switches or interlocks for protection but always shut down motor generators or other associated power equipment and open main switch in the power supply circuit. Under certain conditions, dangerous potentials may exist in circuits with the power control in the "off" position owing to charges retained by capacitors, etc. To avoid casualties, always discharge and ground circuits prior to touching them. Keep them away from live circuits. Do not service or adjust alone. Do not tamper with interlocks.

HOLGER-NIELSEN METHOD OF ARTIFICIAL RESPIRATION

If breathing stops because of electrocution, drowning, sedative poisoning, gas poisoning, suffocation, or poliomyolitis, start artificial respiration immediately. Don't delay - seconds count. As soon as possible, send someone for a physician.

THE STANDARD TECHNIQUE FOR THE BACK PRESSURE-ARM LIFT METHOD IS AS FOLLOWS:

PLACE THE PATIENT FACE DOWN, ELBOWS BENT, ONE HAND ON THE OTHER WITH THE FACE TURNED TO ONE SIDE.

PLACE YOUR HANDS, THUMBS TOUCHING, JUST BELOW A LINE RUNNING BETWEEN THE ARMPITS.

ROCK FORWARD SLOWLY, ELBOWS STRAIGHT, UNTIL ARMS ARE VERTICAL.

ROCK BACKWARD, SLIDING YOUR HANDS TO THE PATIENT'S ARMS, JUST ABOVE THE ELBOWS.

RAISE THE ARMS UNTIL RESISTANCE AND TENSION ARE FELT AT THE PATIENT'S SHOULDERS.

REPEAT THE CYCLE 12 TIMES PER MINUTE

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INSTALLING AND OPERATING INSTRUCTIONS FOR TYPE CM11A TRANSMITTING-RECEIVING EQUIPMENT

SECTION 1 - GENERAL

1.1 PURPOSE AND FUNDAMENTAL CHARACTERISTICS OF EQUIPMENT

The Radio Transmitting-Receiving equipment type CM11A has been designed to provide a compact, medium power, transmitter-receiver for ship or shore installations. The transmitter frequency range is 375-515 Kc/s and 1.5 to 13.5 Mc/s with a nominal power output of 100 watts on C.W., 70 watts on M.C.W., 30 watts on voice. The receiver is a superheterodyne with a frequency range of 79 to 518 Kc/s and 1.5 to 30 Mc/s.

1.2 POWER REQUIREMENTS

The CM11A may be operated from 115 Volts, 60 cycle single phase or from 24 Volts DC by the addition of an automatic starter Marconi #122-147 or a dynamotor Marconi #122-103.

1.3 EQUIPMENT DIMENSIONS

Unit	Height	Width	Depth	Weight
CM11A Transmitter-Receiver Unit, Marconi #110-981A, consisting of: cabinet, antenna tuning unit, transmitter unit, receiver shockmounts, handset, handset holder, three inter-unit cables.	37"	24"	18-1/2"	240 lbs
ZM11A Power Unit, Marconi #110-982A, complete with shockmounts	15"	25"	20"	227 lbs

Following items supplied only as installation dictates:

Unit	Height	Width	Depth
SM-11 Remote Control, Marconi #110-827	20"	9"	6-1/2"
Dynamotor, Marconi #122-103	14-1/2"	10-1/2"	17-3/4"
Automatic Starter, Marconi #122-147	16-1/2"	14"	10-1/2"
CM11 Junctions Box, RCN Ref. No. 3F/1108. RCN Stock No. 451-0210	8-1/4"	14-1/2"	3-1/2"

1.4 ELECTRON TUBES

1.4.1 The following tubes are employed in the transmitter section:

V1 Master Oscillator	JAN 1619
V2 1st Buffer	JAN 1619
V3 2nd Buffer	JAN 1619
V4 Voltage Regulator	JAN OD3W
V5 Power Amplifier	JAN 813
V6 Modulator	JAN 1619

1.4.2 The following tubes are employed in the power supply unit:

V1 - JAN 816	V4 - JAN 816
V2 - JAN 816	V5 - JAN 5Y4G
V3 - JAN 816	V6 - JAN 5Y4G

1.4.3 The following tubes are employed in the receiver unit:

V1 - JAN 6SK7 - 1st R.F. amplifier
V2 - JAN 6SG7 - 2nd R.F. amplifier
V3 - JAN 6K8 - Mixer and Crystal Controlled Oscillator
V4 - JAN 6SG7 - 1st I.F. amplifier
V5 - JAN 6SK7 - 2nd I.F. amplifier
V6 - JAN 6B8 - Diode Detector
V7 - JAN 6H6 - Noise limiter rectifier - AVC rectifier
V8 - JAN 9002 - H.F. conversion oscillator
V9 - JAN 6SK7 - Beat frequency oscillator
V10 - JAN OD3W - Voltage regulator
V11 - JAN 6F6 - Pentode power output

1.5 GENERAL DISCUSSION

(1) The transmitter-receiver unit consists of a cabinet in which the Antenna Tuning Unit, transmitter unit and receiver are fitted. These units are withdrawn from the front on slide rails.

(2) All controls are on the front. The antenna connection is at the top and inter-unit cables from the power supply are connected on the left side.

(3) The ZM11 power supply consists of a cabinet in which the High Voltage, Low Voltage and Receiver power units are fitted. These units are withdrawn from the front. The external cable connections are on the left side of the cabinet.

(4) The SM11 remote control units were designed to provide one or two remote control positions for the CM11 when required in installations that are not fitted with the RCN Shipborne Radio Remote Control System. When two SM11 units are use, the CM11 Junction Box is required.

(5) For 24V DC Operation a Dynamotor Marconi #122-103 and Automatic Starter Marconi #122-147 are required. The change-over switches for either 115V AC or 24DC operation are located in the ZM11 Power Supply Unit.

1.6 FREQUENCY RANGE - POWER OUTPUT

1.6.1 The transmitter is capable of operating on any frequency in the ranges listed below. The frequency spectrum is divided into five bands on the transmitter tuning dial. Each band is coloured to match the colour of the scale of the window above the range switch.

Band No.	Colour	Range Kc/s
1	Blue	375-515
2	Yellow	1500-2600
3	Green	2600-4500
4	Mauve	4500-7800
5	Red	7800-13500

(2) The range switch in the antenna tuning unit covers the above frequencies in four positions:

Position of Range Switch	Range Kc/s
1	375 to 515
2	1500 to 3300
3	3300 to 6800
4	6800 to 13500

(3) In addition to the above range scale, a logging scale marked black with 23 divisions is provided on the transmitter tuning dial. A vernier dial with one hundred divisions, in conjunction with this scale, provides a logging scale 2300 divisions long. This permits a ready return of the pointer to any predetermined position.

1.6.2 Power Output:

The nominal power output of the transmitter when fed into an antenna whose characteristics fall within the limits listed in para. 1.8 is as follows:

Continuous wave	100 watts
Modulated continuous wave	70 watts
Radio Telephone	30 watts

1.7 RECEIVER

The receiver section is a type CSR5A modified to fit the CM11A cabinet. The modification consists of slide rails on the sides of the chassis and a terminal strip at the rear fitted with a male multicontact plug to permit the appropriate contacts to be made when in the CM11 cabinet. When used with remote control units, plug PC9 is inserted into J1 which is the 500 ohm output jack on the receiver. If PC9 is inserted into J2, the speaker, if used, will be silenced when a headset is inserted into the phone jack on the front panel. Refer to BRCN 2767 for further details of receiver type CSR5A.

1.8 ANTENNA

(1) The antenna impedance ranges for which the transmitter antenna circuit is designed are:

Kc	Resistance	Reactance
375	5-15 ohms	350-1000 ohms capacitive
515	5-15 ohms	450-1000 ohms capacitive
1500	15-750 ohms	0-1000 ohms capacitive or inductive
2500	15-750 ohms	0-1000 ohms capacitive or inductive
3500	15-750 ohms	0-1000 ohms capacitive or inductive
5000	15-750 ohms	0-1000 ohms capacitive or inductive
7500	15-750 ohms	0-1000 ohms capacitive or inductive
10000	15-750 ohms	0-1000 ohms inductive or 0-500 ohms capacitive
13500	15-300 ohms 15-75 ohms	0-500 ohms inductive or 0-100 ohms capacitive

(2) The operation of the transmitter into an antenna whose characteristics fall outside these limits may result in flashovers in the antenna tuning unit.

1.9 REMOTE CONTROL

1.9.1 RCN Shipborne Radio Remote Control System:

The CM11A may be controlled from a remote position when used with the RCN Shipborne Radio Remote Control Units. Refer to BRCN 2613 for details of the Remote Control System. Refer to para. 5.21 of this publication for a description of the CM11A control circuits.

1.9.2 Remote Control Unit Type SM11:

The SM11 Remote Control Unit is enclosed in a watertight metal box with a weatherproof loudspeaker. This unit contains: an indicating lamp to indicate when the equipment is ready for use or being used from another point, an on-off switch to control H.T. voltages, a speaker, volume control, headset jack and a handset. To control the transmitter-receiver from a remote position the appropriate controls must be preset at the transmitter-receiver for the following functions: frequency (both transmitter and receiver), power on-off, receiver volume, and the "control" switch to "OFF-REM" posi-

tion. When two SM11 Remote Control Units are required to provide two remote control positions for the CM11A, a CM11 Remote Control Connection Box RCN Ref. 3FJ/5, RCN Stock No. 451-0210 is required. The remote control unit provides only for telephone transmissions and it is recommended that the distance between this unit and the transmitter-receiver be not more than 100 feet.

1.10 POWER SUPPLY UNIT

The ZM11 Power Unit contains three separate rectifier units which supply the required voltages for the following: transmitter, receiver and the various relays. The input to the ZM11 is 115 Volts, 60 cycles, single phase. When the primary supply is 24V DC the 115 V AC for the transmitter is obtained from a separate dynamotor, and the 115V AC for the receiver is obtained from a small dynamotor in the receiver rectifier unit. The voltage for the various relays is also obtained from this primary 24V DC source. Change-over switches for either 115V AC or 24V DC operation are located in the ZM11.

1.11 BATTERY SUPPLY

When the CM11A is to be operated from a 24V DC source, a dynamotor Marconi #122-103, RCN Stock No. 416-0060, and an automatic starter Marconi #122-147, RCN Stock No. 5820-040-5896, is required. The voltage limits are 22 to 23.5 V DC at the terminals of the starter, when on load. The cables from the starter to the dynamotor should not exceed 3 ft. for #8 cable or 6 ft. for #6 cable.

1.12 POWER DEMANDS

Power requirement from an AC source is approximately 660 watts at 85% power factor; and the maximum input voltage and current under this condition is 120V at 5.4 amps. The power requirements from a 24V DC source, for the dynamotor and ZM11, is 24V DC at 48.5 amperes maximum or a total of 1164 watts.

Volt-Amperes at Line Voltage of 115V AC

Key Up	Key Down	Remarks	
480	770	CW)	
480	830	MCW)	High Power
480	590	Phone)	
390	515	CW)	
390	520	MCW)	Low Power
390	430	Phone)	

Amperes at Line Voltage of 22.5 V DC

Key Up	Key Down	Remarks	
33.5	48.5	CW)	
33.5	48.5	MCW)	High Power
33.5	40.0	Phone)	

Amperes at Line Voltage of 22.5V DC (Cont'd)

Key Up	Key Down	Remarks	
31.0	36.2	CW)	
31.0	36.2	MCW)	Low Power
31.0	33	Phone)	

SECTION 2 - INSTALLATION

2.1 GENERAL

The larger and heavier units that make up the component parts are packed in separate containers for shipping purposes.

2.2 UNPACKING

Unpack all the units and examine them for damage in transit. Check all wiring connections within the units and examine all nuts, bolts and screws and tighten any that appear to have worked loose in transit. Remove all dust, dirt and packing material, then place the units in storage under a weatherproof cover or in such a place as is deemed to be safe from the weather or physical damage.

2.3 REASSEMBLING THE UNITS

(1) After unpacking the main cabinet, fit the shock mount assemblies Marconi type 110-597A, RCN Stock No. 448-0075, at the bottom and at the top rear.

(2) Fit the shock mount assemblies Marconi type 110-598, RCN Stock No. 488-0076, to the power supply unit. Secure the main cabinet to the desk or bench and also to the bulkhead. Sufficient clearance is to be left at the front of the cabinet for the insertion or removal of the units. Sufficient space, approx. 6 inches, is to be allowed for fitting the cables on the left side of the cabinet.

(3) The ZM11 power unit is to be mounted so that the inter-unit cables do not exceed 10 feet in length. Sufficient clearance is to be left at the front of the cabinet for the removal of the units. If the power unit is placed under a bench or desk, check that a leg or brace on the bench does not hinder the removal of the units from the power supply.

(4) If the installation provides for 24V D.C. operation it is desirable that the dynamotor and starter be located external to the radio office. The distance between the starter and dynamotor is governed by the length of the interconnecting cable which should not exceed 6 feet of #6 (or heavier) gauge.

(5) The handset and handset hanger is to be mounted on the left of the main cabinet.

2.4 CABLING

(1) After the transmitter-receiver cabinet and the power supply cabinet have been secured in position, proceed with the cabling.

(2) If the installation provides for 24V D.C. operation the cable size between the battery and the starter shall be such that the voltage at the starter is between 22 and 23.5 volts under load.

(3) Refer to Figure 21 for connections for AC operation, SM11 remote control, speaker, handset. Refer to BRCN 2613 for connection to the RCN Radio Remote Control System.

(4) The cables between the ZM11A power unit and the main cabinet are supplied with the equipment and are fitted with "AN" type connectors. The cable runs are to be secured by clips or cable hangers. The coupling rings on the "AN" connectors are to screwed up tight on the chassis receptacles.

2.5 REPLACING THE UNITS

(1) When the cabling has been completely installed and has been checked, examine the units and fit the necessary electron tubes, then fit the units in the cabinet.

(2) The three units of the transmitter-receiver are arranged with sliding rails so that they can be partially withdrawn for maintenance. To replace these units, lift the unit up to the height of the associated rails in the interior of the cabinet and gently slide the unit into place until it stops against the catches. Now lift the catches, which are on the side of the unit, and slide the unit along the rails until almost mating with the connectors in the cabinet, then release the catches and press the unit firmly "home".

(3) When the antenna tuning unit has been inserted, check that the safety switch closes properly when the unit is pushed to the "home" position. When all the units are in place, close the locking catches on the front of the cabinet.

(4) The three units in the ZM11 power supply are secured by bolts, two bolts at the front of each unit. Insert the rectifier tubes; attach the plate caps to the 816 tubes. Check that for AC operation the three switches marked AC-DC are in the AC position. Check that the safety switches operate on the high voltage rectifier unit.

2.6 INSTALLATION OF THE REMOTE CONTROL

(1) When the SM11 remote control unit is required, only one run of type MCOS7 cable is required between the SM11 and SC7 of the transmitter-receiver unit. If two SM11 remote control units are required to operate off a CM11A, then a CM11 Junction Box, RCN Stock No. 451-0210, is required. Install a run of MCOS7 from SC7 of the transmitter-receiver unit to the CM11 Junction Box, then a run of MCOS7 from each SM11 to the CM11 Junction Box.

(2) When the CM11A is required to operate with the RCN Shipboard Radio Remote Control System, install one run of MCOS7 from SC7 of the transmitter-receiver unit to the Channel Amplifier Unit.

2.7 GENERAL NOTES

During the installation, care is to be taken to ensure that all cable connections make good electrical contact, that all terminal lugs are either soldered with rosin flux or properly secured by crimping, and that the antenna is properly connected and the ground connection is properly made to the cabinet.

SECTION 3 - ADJUSTMENTS

3.1 CAUTION

Dangerous voltages exist within the unit. To avoid the possibility of fatal injury, do not rely on the gate switches. Switch off the power at the office distribution panel if servicing is to be carried out inside the equipment.

3.2 PRELIMINARY

(1) The frequency of the transmitter is controlled by either:

(a) a calibrated master oscillator covering 375-515 kc/s and 1.5 to 13.5 mc/s; or

(b) a crystal control covering 1.5 to 13.5 mc/s.

(2) The adjustment procedure is slightly different for the two methods of control and is slightly modified when the transmitter is being used in 375-515 kc/s.

(3) The following procedure is to be followed to bring the transmitter section into operation. (For the receiver controls refer to BRCN 2767.)

3.3 CONTROL SETTINGS - RANGE I

For Range I, 375-515 kc/s, set the controls as follows:

(a) "Crystal" switch to "MO"
(b) "Range" switch to "1" (375-515 kc/s)
(c) "Tune" dial to the required frequency (375-515 kc/s)
(d) "Meter" switch to "P. A. GRID"
(e) "Anode Tune" to mid-scale
(f) "Range" switch in antenna Tuning Unit to "1" (375-515 kc/s)
(g) "Coupling" set to "0".

3.4 ADJUSTMENTS FOR RANGE I (375-515 kc/s)

(1) With controls set as in 3.3 adjust the controls as follows:

(a) Turn "Control" switch to "CW". This applies power to the transmitter and half the dial lamps will light. After 15 seconds a time delay relay will operate and the remainder of the dial lamps will light.

(b) Set "Power" switch to "Low".

(c) Press handset button or hand key and note that P. A. Grid current on the meter is 5 to 10 ma. Release Key.

(d) Turn "Meter" switch to P. A. Cathode". Press key and tune "Anode Tune" for minimum current. Release key.

(e) Turn "Power" switch to "High". Press key and again adjust "Anode Tune" for minimum current. Release key.

(f) Press key. Turn "Coupling" at approximately 5 divisions, adjust "Antenna L. F. Tune" for a maximum in P. A. cathode current.

(g) Increase "coupling" and readjust the "Antenna L. F. Tune" once more. Continue this process until P. A. Cathode Current is 200 ma. Release key.

(h) Turn "Meter" switch to "Antenna". Press key and note the reading on the meter. Release key. The meter reading will vary widely depending on the characteristics of the antenna.

(2) The final readings of the transmitter when all adjustments are completed should be as follows:

P. A. Cathode Current	- Not more than 210 ma.
P. A. Grid Current	- 5-7 ma.
H. T. Volts	- 1250-1300 Volts
Antenna Current	- Some reading depending on the antenna.

3.5 CONTROL SETTINGS - RANGES 2, 3, 4, 5

For frequencies 1.5 to 13.5 mc/s using Master Oscillator, for controlling the transmitter, set controls as follows:

(a) "Crystal" switch to "MO".
(b) "Range" switch to desired range.
(c) "Tune" dial to required frequency.
(d) "Meter" switch to "P. A. Grid".
(e) "Anode Tune" to approximately "50".
(f) "Range" switch in Antenna Tuning Unit to required range, (1.5 - 13.5 mc/s) Range 2, 3 or 4.
(g) "Coupling" set to "0".
(h) "H/F Tune 1" to "0".
(j) "H/F Tune 2" to "100".
(k) "Antenna Circuit" switch to "PAR".

3.5.1 Adjustments for Ranges 2, 3, 4, 5 (1.5 to 13.5 mc/s) for master oscillator control of the transmitter. With controls set as in para. 3.5, adjust the controls as follows:

(a) Turn "Control" switch to "CW". This applies power to the filaments and half the dial lamps will light. After 15 seconds a time delay relay will operate and the remainder of the dial lamps will light.

(b) Turn "Power" switch to "Low". Press key. Meter reading should be between 5 and 10 ma. Release key.

(c) Turn meter switch to "P. A. Cathode". Press key. Adjust "Anode Tune" for minimum P. A. Cathode current. Release key.

(d) Turn "Power" switch to "High". Press key and again adjust "Anode Tune" for minimum current. Release key.

(e) Press key. Turn "Coupling" to "5" divisions and rotate "Antenna H/F 1" for an approximate maximum meter reading. If no maximum is indicated,

increase coupling 5 more divisions and rotate "Antenna H/F 1" for an approximate maximum meter reading. If still no maximum, increase coupling and "Antenna H/F 1" and repeat until maximum reading is indicated. Release key.

NOTE

If no maximum reading is obtained, set "coupling" at "0", "HF 1" to "0", "HF Tune 2" to 0, "Antenna Circuit " to "Ser", then proceed as in (e).

(f) Press key. Adjust "H/F Tune 2" for an exact maximum meter reading.

(g) Increase "coupling" until P.A. Cathode Current is 200 ma. Release key.

(h) Switch meter to "Antenna". Press key. Adjust "coupling" and "H/F Tune 2" for maximum reading. Release key.

NOTE

On some frequencies no noticeable indication of antenna current will be shown. In that case, turn meter switch to "P.A. Cathode" and adjust "Coupling" and "H/F Tune 2" until meter reads not over 200 ma.

(j) Switch meter to "P.A. Cathode" and check that P.A. Cathode is not over 200 ma.

NOTE

1. When "Antenna Circuit" switch is in "Ser" position, "Antenna H/F Tune 2" control is to be as near as possible to "0".

2. When "Antenna Circuit" switch is in "Par" position, "Antenna H/F Tune 2" control is to be as near as possible to "100".

3.6 CRYSTAL CONTROL - RANGES 2, 3, 4, 5

For frequencies 1.5 to 13.5 mc/s using Crystal Oscillator for controlling the transmitter. The required crystals are to be placed in the crystal holders (six in number) in the transmitter Unit. Set the controls as follows:

(a) "Crystal" switch to required crystal position
(b) "Range" switch to desired range
(c) "Tune" to required frequency
(d) "Meter" switch to "P.A. Grid"
(e) "Anode Tune" to approximately 50
(f) "Range" switch in antenna Tuning Unit to required range (1.5 - 13.5 mc/s) Range 2, 3 or 4
(g) "Coupling" set to "0"
(h) "H/F Tune 1" to "0"
(j) "H/F Tune 2" to "100"
(k) "Antenna Circuit" switch to "PAR"

3.6.1 Adjustments for Ranges 2, 3, 4, 5 (1.5 to 13.5 mc/s) for Crystal Control of the Transmitter:

With controls set as in para. 3.5, adjust the controls as follows:

(a) Turn "Control" switch to "CW". This applies power to the filaments and half the dial lamps will light. After 15 seconds a time delay relay will operate and the remainder of the dial lamps will light.

(b) Turn "Power" switch to "Low". Press key. Adjust "Tune" dial for maximum P.A. grid current. Release key.

(c) Turn meter switch to "PA Cathode". Press key. Adjust "Anode Tune" for minimum P.A. Cathode current. Release key.

(d) Turn "Power" switch to "High". Press key and again adjust "Anode Tune" for minimum current. Release key.

(e) Press key. Turn "coupling" to "5" divisions and rotate "Antenna H/F 1" for an approximate maximum meter reading. If no maximum is indicated, increase coupling 5 more divisions and rotate "Antenna H/F 1" for an approximate maximum meter reading. If still no maximum, increase coupling and "Antenna H/F 1" and repeat until maximum reading is indicated. Release key.

NOTE

If no maximum reading is obtained, set "coupling" at "0", "H/F Tune 1" to "0", "H/F Tune 2" to "0", "Antenna Circuit" to "Ser", then proceed as in (e).

(f) Press key. Adjust "H/F Tune 2" for an exact maximum meter reading.

(g) Increase "coupling" until P.A. cathode current is 200 ma. Release key.

(h) Switch meter to "Antenna". Press key. Adjust "Coupling" and "H/F Tune 2" for maximum reading. Release key.

NOTE

On some frequencies no noticeable indication of antenna current will be shown. In that case, turn meter switch to "P.A. Cathode" and adjust "Coupling" and "H/F Tune 2" until meter reads not over 200 ma.

(j) Switch meter to "P.A. Cathode" and check that P.A. Cathode is not over 200 ma.

NOTE

When "Antenna Circuit" switch is in "Ser" position, "Antenna H/F Tune 2" Control is to be as near as possible to "0".

3.7 OPERATION ON MCW TRANSMISSION

(1) To operate the transmitter on MCW transmission, tune the transmitter as under 3.3, 3.4, 3.5, 3.5.1 or 3.6, 3.6.1 depending on the frequency, and switch "Control" to "M.C.W." The meter will give the same indication except on "Antenna", when the reading will be lower.

(2) On M. C. W. the carrier will be modulated by a 1000 cycle.

3.8 OPERATION ON TELEPHONE

(1) To operate the transmitter on voice transmission, tune the transmitter as under 3.3, 3.4, 3.5, 3.5.1 or 3.6, 3.6.1 depending on the frequency, and switch "Control" to "phone". The meter will give the same indication except on "Antenna", when the reading will be lower.

(2) On "phone" the transmitter of the handset should be held the same distance from the lips as an ordinary telephone. Do not raise the voice too much or the speech input circuit will be overloaded and distortion will occur. When transmitting on phone the button on the handset should be held down and released when the conversation is over or it is desired to receive.

3.9 OPERATION FROM REMOTE CONTROL

(1) To operate from a remote control unit the transmitter and receiver have to be tuned to the required frequency at the set. The volume and other controls on the receiver are required to be preset and the "control" switch on the Transmitter to be on "Off-Remote".

(2) From the remote position, control of the transmitter-receiver is limited to switching from "standby" to "ready" and transmitting.

3.9.1 RCN Shipboard Radio Remote Control System:

The CM11A may be operated from remote points utilizing the RCN Shipboard Radio Remote Control System. Reference is to be made to BRCN 2613, the "Instruction Book for the RCN Shipborne Radio Remote Control System", for details.

3.9.2 SM11 Remote Control Unit:

When it is required to operate the CM11A from only one or two remote points, Remote Control Units type SM11 may be used. When two SM11's are used, a junction box (RCN Stock No. 451-0210) is required. The SM11 Remote Control Unit contains: indicating lamp, standby-ready switch, handset, loudspeaker, volume control, headphone jack. The SM11 is housed in a weatherproof box with the weatherproof speaker on the exterior.

3.10 EMERGENCY OPERATION

If it is required to place the transmitter in operation without waiting for the 15 seconds time delay, turn the "Control" switch to "EMCY". The time delay will be cut to 4 seconds. This will not damage the equipment but will shorten the life of the 816 rectifier tubes.

SECTION 4 - FAULT TRACING

4.1 THE USE OF TEST INSTRUMENTS

Extreme care should be exercised in the use of test instruments. The absence of certain readings does not indicate that there is no voltage applied to that portion of the transmitter but it does indicate that there is a defect, and considerably more care than usual should be exercised. The following is a general guide for the symptoms indicated:

4.2 FILAMENTS AND PILOT LAMPS WILL NOT LIGHT

(a) Check that there is 115V A.C. at the power input to the ZM11.

(b) Check that the units are homed properly in the cabinet.

(c) Check the fuses in the power supply unit.

(d) Check that the connectors on the inter unit cables are properly mated.

(e) Check that when the "Control" switch is placed to one of "Phone", "MCW", "CW" that relay E2 closes in the power supply unit.

(f) Check that there is voltage at the connectors inside the cabinet at points which are designated as "24V" on Figure 22.

4.3 FILAMENTS AND PILOT LAMPS LIGHT BUT THERE IS NO OTHER SIGN OF OPERATION

(a) Check that the Antenna Tuning Unit is in place and the connectors on the unit are mating properly with the receptacle on the cabinet and the gate switches are making contact.

(b) Check that the cover is in place of the ZM11 power supply unit and the gate switch is making good contact. If the cover is off, that the lock switch is pulled forward.

(c) Check that the rectifier tubes are in the sockets and the anode caps are attached to them.

(d) Check that meter switch is in the correct position for the reading required and that the meter is operating.

(e) Check that the Keying relays and the antenna changeover relays operate when the Key or the handset button is pressed.

4.4 SET WILL OPERATE BUT THERE IS NO INDICATION OF LOADING INTO THE ANTENNA

(a) Check that the antenna is connected to the set.

(b) Check that the antenna is connected to the antenna insulator, and feeder cable to the set.

(c) Check that the "RANGE" switch on the antenna section of the transmitter is set to the proper frequency range.

(d) Check that the spring connections at the rear of the antenna section of the transmitter is making adequate contact with the stud at the rear of the antenna unit.

4.5 FLASHOVERS OCCUR WHEN THE ANTENNA UNIT IS BEING ADJUSTED

(a) Turn the "Power" switch to "Low" and proceed with caution.

(b) Check that there is no foreign material in the plates of the variable condensers in the antenna unit.

(c) Tune the transmitter to some other frequency; and check if the condition still exists. If the flashovers still persist the trouble is not a function of frequency. If the flashovers do not occur on the new frequency, try a frequency near the frequency upon which the flashovers occur. This will demonstrate if the cause of the flashover is improper antenna length for the frequency upon which the transmitter is being worked. In such cases the antenna will usually be too short.

(d) Check that there is nothing intermittently fouling the antenna or lead-in.

4.6 MOTOR SECTION OF THE DYNAMOTOR RUNS BUT WILL NOT COME UP TO SPEED

(a) Check that the voltage across the starting coil of the starter relay is at least 20 volts and that the voltage across the delay relay coil is at least 10 volts. If less than these values, the battery voltage is insufficient to close the relays. If the voltages are correct and the relays do not close, the springs should be loosened. This condition will, if allowed to persist, damage the starter beyond repair due to burning out of the starter resistors which only have an intermittent rating.

SECTION 5 - TECHNICAL DESCRIPTION

5.1 INTRODUCTION

The following section is intended to outline the general paths of the transmitter circuits and the more salient features of the equipment. It is suggested that a careful study of this section be made in conjunction with the diagrams and illustrations in this folder, so that an accurate working knowledge of the paths of the circuits and the component parts that make them up, can be gained. An accurate knowledge of the functions and locations of the components of the transmitter section of the equipment will enable technical personnel to maintain the apparatus in first class condition at all times.

5.2 BREAK DOWN OF UNITS

The communication equipment consists of three basic units, the transmitter-receiver cabinet, the power supply and the dynamotor set. These three units are interconnected with lead covered cables, which are installed to meet the service conditions, and flexible plug terminated cables of fixed length. A remote control unit is fitted as optional equipment in cases where it is required that the transmitter-receiver be worked from a distant point for the transmission and reception of radio-telephone signals.

5.3 INPUT VOLTAGES

(1) The equipment is designed to operate from either an AC supply of 115 volts, 60 cycles (which should be commercially stable and whose voltage should not vary more than plus or minus 10% from the mean value) or, in cases where there is a possibility of the Alternating Current supply being interrrupted or where such supplies do not exist, may operate with a battery source of supply, the nominal value being 24 volts. To accommodate the effect of partially discharged batteries or long lead lengths from the storage battery location to the input of the dynamotor the equipment is designed to operate from a source of supply that will deliver a voltage of between 22 and 23.5 volts at the input to the starter. As the starter will not be placed more than the distances mentioned in Section 1.11 from the dynamotor, this will ensure that, in effect, the above mentioned voltage is delivered to the input to the machine.

(2) The starter employed when the equipment is operated from a battery source of supply is of the fully automatic type and incorporates within the unit the necessary delay action to allow the machine to become fully started in about three seconds, when the input voltage is within the limits quoted above.

5.4 TRANSMITTER-RECEIVER UNIT

(1) The transmitter-receiver unit contains three units mounted one above the other and secured to the cabinet by means of a locking device on the front panel. These units are, from top to bottom of the cabinet: output tuning unit, transmitter, and receiver units. These units are arranged so that they may be partially withdrawn from the body of the cabinet for examination, test or service work. If desired, they can be completely withdrawn from the cabinet and placed on a bench or table, but for all normal purposes such as the insertion of vacuum tubes, crystals, and routine maintainance work the position provided by the partial withdrawal is sufficient. When the unit has been with-

drawn to the normal service position,the sliding guide bars lock in position and hold the unit in this position until the unit is required to be replaced. A test cable is provided so that the transmitter unit or the receiver unit can be operated in this position or on an adjacent bench. On the transmitter chassis, the unit will of necessity only function on the low power stages as the anode circuit elements of the final power amplifier vacuum tube are contained in the antenna unit and are connected to it via a single connection which connects direct to the anode of the final vacuum tube. The inter-connections between the units that make up the transmitter-receiver and the rest of the apparatus are made by means of a system of multi-contact "snatch plugs" mounted on the rear of each unit and the matching counterparts mounted on the cabinet. The circuits of the units are so arranged that, when the transmitter-driver unit is required to work in the partially withdrawn position, the unit will only function with the test cable inserted in the correct plug which is marked "TEST PLUG HERE ONLY" on both the rear of the cabinet and the unit itself. Any attempt to operate with the test cable in any of the other plugs will render the apparatus totally inoperative, as the control circuits will be put out of action. Safety switches are provided on the output tuning unit to remove the high voltage when the unit is withdrawn so that those persons operating the apparatus are protected from the effects of accidental contact with dangerous voltages.

(2) The removal of the driver section of the transmitter effectually removes the high voltage from it as all the control circuits are disconnected, and it is therefore impossible to turn on the equipment unless the test cable is inserted in the plugs, when matters are so arranged that the high voltage section of the rectifier is rendered inoperative. As there are no dangerous voltages involved in the operation of the Receiver, the unit is not fitted with any gate switches but will also be rendered inoperative unless the test cable is inserted in the plugs at the rear.

5.5 POWER UNIT ZM-11A 110-982A

The power supply unit which is contained in a separate metal cabinet is designed to be mounted under the bench or in some other convenient location near the transmitter-receiver unit. The connecting cables between this unit and the transmitter-receiver unit are 10 feet in length and the unit must therefore be placed not more than this distance away from the transmitter-receiver unit. The power supply unit contains three separate units which supply the various voltages required for the operation of the equipment. These units are arranged so that they supply the voltages required for the operation from either of the input voltages specified, the necessary switches for the changeover from one type of power supply to the other being incorporated in the units.

5.6 TRANSMITTER UNIT #112-912A

The transmitter unit contains the vacuum tubes and the associated circuits that make up the radio frequency generating multiplying and amplifying circuits of the transmitter. From an examination of the schematic diagrams it will be apparent that these circuits will consist of the following vacuum tube line-up: Master Oscillator, 1st Buffer, 2nd Buffer and Power Amplifier. All the circuit components for these vacuum tube circuits are contained in the chassis, except those that comprise the anode circuit of the power amplifier vacuum tube, which are contained in the output tuning unit. Also mounted on this chassis is the single vacuum tube used as a modulator when the transmitter is emitting on either phone or MCW transmission. The front panel of this unit carries the various switches and controls for the operation of the complete equipment.

5.7 MASTER OSCILLATOR CIRCUITS

The following detailed description of the transmitter circuits is intended to direct attention to the more noticeable features of the circuit arrangements employed in the apparatus. The first vacuum tube (V1-1619) performs the dual functions of a Master Oscillator or a crystal controlled oscillator. When operating as a crystal controlled oscillator, the circuit employed is that of the well known Pierce type oscillator especially adapted for service in this type of transmitter. The crystals are connected between the anode and grid of the vacuum tubes, with the element potentials being blocked off from the crystals by means of the condensers C20 and C21. When this vacuum tube is to function as a Master Oscillator, one of the tuned circuits consisting of the inductances L1, L2 and L3 together with the condensers C2, C3, C4, C5, C6 and C7 is connected in place of the crystal, the selection of the appropriate circuits being made by the switch S2. This circuit is resonated by the first two sections of the gang condenser C1-1 and -2 to provide the required frequency. The anode circuit of this vacuum tube is shunt fed through the voltage dividing resistors R3 and R4. The customary bypass condensers C17, C18, C19 and C46 are provided on the filament screen and anode of the vacuum tube, while R1 is used as a conventional grid leak to the stage.

5.8 1st BUFFER CIRCUIT

The output from the first vacuum tube is fed to the grid of the 1st buffer stage through the coupling condenser C22. This stage operates as an aperiodic amplifier when the transmitter is operating on the three lower frequency bands, i.e. 1, 2 and 3, and on the two higher frequency bands as a frequency multiplier. When operating as a tuned multiplier stage it will be noticed that the master oscillator stage has been switched back to bands 2 and 3 and that therefore the stage acts as a frequency multiplier. The frequency multiplication is achieved by inserting between the first and the second buffer stages, the tuned circuits consisting of the inductances L4 and L5 and the condensers C8 and C9 which are tuned by the third section of the gang condenser C-3, thus changing the stage from an untuned amplifier to a tuned frequency multiplier. The anode of this vacuum tube is shunt fed through the choke L70 while grid current is fed through the resistors R5 and R11. Bypass condensers C23, C24 and C25 are provided on the various elements. R7, R8 and L12 are switched into circuit on ranges 1, 2 and 3 to equalize drive conditions when this vacuum tube is working as an aperiodic amplifier.

5.9 2nd BUFFER STAGE

The second buffer stage is arranged to work as a tuned amplifier on all the five ranges of the transmitter and for this reason is fitted with five tuned circuits consisting of the inductances L6, L7, L8, L9 and L10, and the condensers C11, C12, C13, C14 and C15, which are tuned by the fourth section of the gang condenser C1-4. The anode circuit of this vacuum tube, (V3-1619) is, like all the other low power stages, shunt fed through the choke coil L13. R9 and R10 serve as a grid leak to the stage which is fitted with the customary bypass condensers which are designated C28, C29 and C30.

5.10 VOLTAGE REGULATOR CIRCUIT

To ensure that the frequency stability of the transmitter when operating with Master Oscillator control, is as high as possible, the anode and screen supplies of the Master Oscillator, 1st Buffer and the screen supply of the 2nd buffer vacuum tubes are taken through a voltage regulator circuit. This circuit employs one of the common types

of voltage regulator tubes - the VR 150-30(V4) to maintain the voltage at 150 volts. This type of circuit must be used in conjunction with a series resistor to limit the current through the gaseous tube and for this purpose the resistor R14 is employed in series with the tube. It will be noticed that the anode of the 2nd Buffer vacuum tube is fed direct from the low voltage supply at approximately 400V.

5.11 CALIBRATION ACCURACY

To ensure accuracy of dial calibration, the tune circuits for the Master Oscillator and the buffer stages are fitted with permeability adjusted cores and trimmer condensers which permit the calibration to be made with great accuracy. As a result of this feature, coupled with the type of gang condenser used, the dial calibration is to be adjusted to an accuracy of 0.5% of the emitted frequency at any point on the five ranges of the unit. During the adjustment process at the factory, the trimmers and the iron cores used for tracking are adjusted against a precision standard to a much greater degree of accuracy than this and, therefore, these adjustments should not be changed in service unless means are at hand to reset them to within the accuracy quoted above.

5.12 POWER AMPLIFIER STAGE

The output from the 2nd buffer stage is fed from appropriate taps on the anode coil through C32 to the grid of the power amplifier vacuum tube (V5 813), a beam pentode which is arranged to operate as a Class C amplifier when the transmitter is operating on CW and as a grid modulated stage when operating on MCW and radio-telephone. The anode circuit of the stage is contained in the output tuning unit, and connection to the anode of the vacuum tube is made via a special form of terminal attached to the anode cap which makes contact with a spring terminal at the upper rear of the chassis. This connects to the output tuning unit, and through it to the high voltage anode supply. It will be noted that this stage, as distinct from all the other RF stages, is series fed. The screen voltage is taken from the low voltage supply through a suitable dropping resistor, R15, and the associated bypass condenser C40. The grid circuit of the stage contains an RF choke L15 to prevent the radio frequency currents from entering the modulation transformer T1. Bias resistor R16 is provided and is suitably bypassed by the condenser C48. When this stage is operating on CW, the seconday of the modulation transformer is shorted out of circuit and the stage then delivers its maximum power output. The conventional bypass condensers C35, C36 and C38 are provided on the filaments in order to effectively hold the RF potentials to the proper point on the chassis. For MCW operation, the short on the modulation transformer is removed but the circuit is otherwise unchanged. When operating on Phone, bias for the stage is derived from the cathode resistors R18 and R19, and the grid leak R16 is shorted out. It will be noted that when operating on high power phones, R18 alone provides the bias, R19 being shorted out.

5.13 MODULATOR STAGE

(1) The modulator tube performs two functions:

(a) It receives the audio input of the microphone and raises the level of this audio voltage to a suitable level to modulate the power amplifier stage.

(b) It provides the time delay which is described in 5.20.

(2) The input from the microphone is impressed on the primary of the microphone

transformer and through it to the grid of the vacuum tube. The secondary of this transformer is shunted by the damping resistor R31 and one side of the transformer is bypassed to ground through the condenser C42. In the anode circuit of the vacuum tube is placed the primary of the modulation transformer and the coil of the relay E1 (the function of which will be described later, Section 5-20). The secondary of this transformer is connected in the grid of the power amplifier stage. As previously described, for operation on MCW the secondary of the transformer is connected back to the input side of the microphone transformer through a resistor and condenser network R21 and C45. The constants of the latter, together with C42, are so chosen that the output circuit oscillates at the frequency of 1000 cycles. Cathode bias for the stage is provided by R25 in conjunction with C39, the bypass condenser. Cathode current also flows through R26 providing a voltage drop to polarize the microphone. C56 is the audio bypass for this circuit.

5.14 OUTPUT TUNING UNIT

The output circuit of the power amplifier vacuum tube and the components that make up the antenna matching circuit are contained in the upper section of the transmitter cabinet; contact with the remainder of the circuits is by means of snatch plugs as is used elsewhere in the transmitter supplemented by additional spring type connections where required. From an examination of the circuit it will be seen that the anode circuit of the power amplifier stage is made up of the tapped coil L18 and the condensers C50 and C51, which are arranged to work in conjunction with the switch S7-3, to cover the various frequency ranges of the transmitter. It will be seen that two variable coupling coils are provided to transfer the radio frequency power from the anode circuit to the antenna tuning section of the unit. These coils are controlled by a common shaft, but are so arranged that the correct coupling coil is connected in circuit when the "RANGE" switch is manipulated to the various bands corresponding to specified frequencies. When the transmitter is operating on the low frequency portion of the range, the antenna circuit consists of the low frequency coupling coil in series with a variometer, and the contacts of the antenna changeover relay. For high frequencies the antenna elements are L19 and C53. The coil L19 is tapped at various points and is connected to a tap switch operated from the front of the panel, so that any combination of turns can be used in conjunction with the variable condenser. As a general rule it will be found that the combination of inductance and capacitance provided will match any aerial within the range given in Section 1 when arranged in the parallel circuit. In cases where the antenna impedance is low it will usually be found that the series arrangement of the antenna components will produce a better match to the antenna constants, but in general there will usually be some small loss of efficiency when using the series type of circuit.

5.15 MEASUREMENT OF ANTENNA CURRENT

Included in the antenna circuit are two small current transformers which are associated with two copper oxide type rectifiers. These rectifiers supply rectified radio frequency currents to the multimeter and can therefore be used to indicate the presence and the relative magnitude of the radio frequency current flowing in the aerial circuit. It is not possible to construct a bandpass transformer having a flat response curve over the rather considerable frequency range of the transmitter, and in order to provide the most efficient operation of the antenna current indicating circuit two transformers are provided for the two sections of the frequency spectrum and are designated on the circuit diagram as T4 and T5.

5.16 POWER SUPPLY UNIT #110-982A, ZM-11A

The ZM-11A Power Unit contains the necessary rectifiers to supply the power demands of both the receiver and the transmitter sections of the apparatus. There are in the interior of the unit three units: the H.T. Power Unit #102-900, the L.T. Power Unit Type #102-902, and the Receiver Power Unit Type #102-903A. These three units are arranged to supply the power demands of the equipment from either of the two input voltages for which the power supply unit is designed, in this case 24 volts DC and 115 volts AC. The L.T. and the receiver power units are equipped with changeover switches located on the chassis to permit the input to be connected to the correct section of the power unit for the type of power supply in use. The units are mounted on separate chassis and are arranged to slide into the back of the cabinet of the power supply unit and there to make contact with the matching counterparts of the plugs in the same manner as is used on the transmitter cabinet assmbly. A terminal strip is provided on the side of the cabinet to connect the cables leading to the power supply sources, while the connections to the transmitter-receiver unit are made via the flexible plug connected cables already mentioned in the section on the transmitter.

5.17 HT POWER UNIT #102-900.

This unit is intended to supply the anode voltage for the power amplifier of the transmitter section of the equipment. From an examination of the circuit it will be seen that the rectifier section is made up in a conventional full wave bridge circuit working from a single phase supply. The Transformer T1 supplies the anodes of the mercury vapour rectifying tubes Type JAN 816. The filament voltage to supply these rectifying tubes is supplied from the Transformer T2 and the output from the rectifier is filtered by means of the choke input filter, comprising L1 and C1, while R1 is provided as a safety bleeder across the output of the rectifier, to stabilize the voltage and to keep the filter condensers discharged when the unit is not operating. Attention should be paid to the primary winding of the input transformers which, it will be noticed, has a number of taps so arranged that either the major part of the winding, or a portion thereof, can be connected to the AC input supply, thus varying the output voltage from the rectifier. The action of the relay that controls this function (E1) is controlled from the "POWER" switch on the front panel of the transmitter-driver section of the equipment. This relay has two operating coils arranged so that positive control of the operation is obtained. As the voltage output from this rectifier is moderately high (1250-1300 volts under normal line conditions) the rectifier is arranged for protection to be given to operating personnel by the addition of a gate and lock switch, so arranged that the switch is opened when the cover is taken off the power supply unit. The lock switch is provided to permit the operation of the equipment when the cover is not in place, for test or service purposes.

5.18 L.T. POWER UNIT #102-902.

The L.T. power unit consists of two separate rectifying systems, which may or may not be in operation at the same time depending on the input voltages at the time the apparatus is in use. One rectifier consists of a full wave, single phase, rectifier employing a high vacuum, vacuum tube rectifier, of the JAN 5Y4G type in conjunction with a choke input filter (L2 and C2) equipped with the customary bleeder resistor R2. The output of this rectifier is comparatively low (400 volts) as it is used to supply the low voltage circuits of the driver section of the transmitting equipment. The contactor E2 is arranged to switch the circuit of the rectifier "ON" when the control switch on the panel of the driver section is closed and also to set into operation the starting circuits

of the dynamotor when the unit is operating from a battery source of supply. The second rectifier on this chassis is arranged to provide a source of direct current to the equipment when it is operating from an AC source of supply. This supply is used for the operation of the various control relays throughout the equipment. When the unit is operated from a battery source the rectifier is cut out of circuit, as the 24 volt battery supply is used to operate the control circuits. The rectifier consists of the transformer T4, and a dry plate type metallic rectifier equipped with a conventional filter choke L3, and a stabilizing bleeder resistor R3. The switches S3 and S4 on the body of this unit arrange the input circuits so that either battery or alternating current supplies can be accommodated when desired. The connection to the rest of the circuit is made by means of "snatch plugs".

5.19 REC. POWER UNIT #102-903A

(1) The third unit contained in the power supply unit is the Receiver Power Unit whose function is to supply power to the receiver section of the equipment. Here also the unit consists of a dynamotor and a full wave rectifier. The circuits are so arranged that when the equipment is operating from an alternating current supply the primary of the rectifier unit is supplied with alternating current from the mains. The rectifier employed is a conventional full wave, single phase rectifier employing a high vacuum tube type JAN 5Y4G operated from a composite transformer T5 and equipped with a two section choke input filter consisting of the inductances L4 and L5 and the electrolytic smoothing condensers C5 and C6, and equipped with the customary bleeder stabilizing resistor R4.

(2) When it is desired to operate the unit from a battery source of supply a small dynamotor is cut into circuit and the primary circuit of the rectifier is fed with 115 volts AC from this source. This avoids running the main dynamotor for receiving, with a consequent heavy drain on the battery. It will be observed that the input circuit is controlled by means of a similar switch S5 to that employed on the LT power unit for the selection of the correct input voltage. Under normal operating conditions the relay E3 controls the application of power to the primary circuit, the coil circuit being controlled from a switch located on the front panel on the receiver unit. It will be noted that both the primary and secondary circuits of the dynamotor are equipped with hash filters in order to reduce the interference in the receiver from the dynamotor.

5.20 TIME DELAY CIRCUIT

Some explanation of the operation of the time delay circuit is necessary, as it differs from those usually encountered. It will be seen that the operating coil of relay E1 is in series with the modulator tube V6. When voltage is applied, the passage of cathode current through R24, R25, R26, raises the cathode potential above ground. However C44, being uncharged, maintains the grid circuit at ground potential. In this way the anode current is limited to a very low value, which is not sufficient to operate E1. The cathode potential produced gradually charges condenser C44 through R22 and R23, reducing the effective bias on the grid of V6. As the bias decreases, the anode current increases and eventually reaches a value sufficient to operate E1. The operation of E1 removes a short circuit from the secondary of the microphone transformer, places normal operating bias on V6, and through its auxiliary contacts completes the control circuit to the HT Rectifier. Thus it follows that the delay provided is dependent upon the time constant of the RC Network, R23, R27 and C44. The normal delay obtained by the value of these components is 10-15 seconds, some variation being due to vacuum tube constants.

5.21 CONTROL CIRCUITS

The whole transmitter is controlled from the front panel of the Transmitter Unit through a series of multipoint switches which either control directly or through relays mounted in various parts of the equipment. Reference to the simplified diagram of connections will disclose the locations and the sequence in which the various circuits are brought into operation. Described briefly these are as follows: moving the "CONTROL" switch to any one of three modes of operation, viz. C.W., M.C.W. or Phone will close the main contactor E3 in the power supply unit, and apply power from the A.C. Lines. If the power supply is DC, this operation will start the main dynamotor. This will result in all the filaments being energized and will bring the low voltage rectifier into operation. When the low voltage appears, the circuit which controls the delay period of the high voltage rectifier will commence operating and after some 15 seconds will permit the high voltage supply to be applied by turning the "POWER" switch to either the "HIGH" or "LOW" position. Once the high voltage supply has been applied the transmission can be proceeded with, or if the transmitter is being run up for the first time the tuning as described in Section 3 can be carried out. If adjustments are being made, at the completion of such as are required, the "CONTROL" switch will be placed in the correct position for the mode of transmission which is required. The circuits of the control section are so arranged that when operation from the remote point is required the transmitter will be left in the normal position for transmitting but the "CONTROL" switch will be turned to "OFF REM", when the control of the transmitter will be vested in the remote point. Transmission from the remote point will, as mentioned before, be possible on PHONE only and is dependent on the transmitter having been properly adjusted by the operating staff in the Radio Office.

5.22 EMERGENCY OPERATION

Various references have been made throughout the text of these instructions concerning emergency operation of the equipment. This is achieved by short circuiting Resistor R23 in the Time Delay Network (see Fig. 21) and thus reducing the time constant of the circuit. When use is made of this feature it must be borne in mind that, while no untoward ill effects will be immediately apparent in the mercury vapour rectifying tubes, their life expectancy will be materially shortened thereby and that if use is made of this feature the rectifying tubes must be replaced as soon thereafter as convenient, in order that continuity of service may be maintained, without the possibility of breakdown.

SECTION 6 - MAINTENANCE

6.1 REQUIREMENTS

Adjustments to the various circuits of the driver section should not be made unless properly calibrated and accurate test instruments are available. Any adjustments made without the necessary instruments are more likely to do harm than good.

6.2 PRELIMINARY CHECKS

Before attempting service work on the complete transmitter the mechanical adjustments in the Aerial Tuning Unit section should be checked to ensure that all the movable controls are correctly set with reference to the scales. The following checks should be made: the settings of the variable condensers are such that when the plates are fully meshed the dials will read "0", the coupling coils will be so set that the dial is at "0" when the coils are at right angles to the outer coil; and the variometer setting is such that with the dial at "0" the two rear junction lugs of the inner and outer coils should be opposite each other and on the same side of the shaft.

6.3 ALIGNMENT OF BUFFER STAGES

(1) If it is necessary to check the alignment of the buffer stages, the transmitter unit should be removed and connected to the cabinet circuits via the test cable, which is placed in the sockets marked "TEST PLUG HERE ONLY".

(2) Assuming that the calibration of the master oscillator has not been disturbed, proceed with alignment of the buffer stages, as per the table 6.3.

(3) Unlock the panel nuts in the various trimmer adjusting screws associated with the buffer stages. To clarify further these controls, the range numbers are stamped on the chassis adjacent to each.

Operation Number	Range	Frequency	Adjust for Max. p.a. Grid Current
1	1	375	L10 (Track)
2	2	2.6	C14 (Trim)
3	2	1.5	L9 (Track)
4	3	4.5	C13 (Trim)
5	3	2.6	L8 (Track)
6	4	7.8	C9 and C12 (Trim)
7	4	4.5	L5 and L7 (Track)
8	5	13.5	C8 and C11 (Trim)
9	5	7.8	L4 and L6 (Track)

Table 6.3 Alignment of Buffer Stages

(4) On each of the ranges except No. 1, the trim and track adjustments should be repeated until adjustment at one end of the band makes little or no difference at the other. This is not required on Range 1, as the tuning is quite broad.

(5) After adjustment the locks should be tightened, taking care not to disturb the settings of the trim and track controls.

6.4 OSCILLATOR CALIBRATION - PART 1

(1) The oscillator can be checked and readjusted if necessary in the following manner: Set up a frequency meter, such as the AN/URM 32 or equivalent, and couple its input to the transmitter unit. Tight coupling will be required to produce a satisfactory indication when operating on low frequencies.

Operation	Range	Frequency	Normal Limit	Adjust for Specified Frequency
1	1	515 kc	Plus or minus 52 cyc.	C3 Trim
2	1	375 kc	" " " 38 "	L1 Track
3	2	2.6 mc	" " " 260 "	C5 Trim
4	2	1.5 mc	" " " 150 "	L2 Track
5	3	4.5 mc	" " " 450 "	C7 Trim
6	3	2.6 mc	" " " 260 "	L3 Track

Table 6.4 Calibration Adjustments on the Oscillator Section

(2) The trim and track adjustments should be repeated until adjustment at one end of the band has little effect on the adjustment at the other end.

(3) This completes the adjustment on the oscillator section as Ranges 4 and 5 operate on harmonics of Ranges 2 and 3 respectively. If the adjustments have been carried out with sufficient accuracy, the dial calibration will then be within 0.5% at any frequency within the range of the unit.

(4) If at the conclusion of the calibration the grid current at any frequency is found to be less than 6.5 ma, the buffer stages should then be re-adjusted as outlined under Paragraph 6.3 above.

6.5 OSCILLATOR CALIBRATION - PART 2

(1) Now connect a jumper between terminals marked BIAS and "400 V. D.C.", and set the switches as follows:

CRYSTAL — MO
METER — P.A. GRID
CONTROL — C.W.
POWER — High

(2) Calibrate the Oscillator, and align the Buffer Stages as follows: The base plate should be in place during oscillator calibration. With the dial set at the nominal high frequency extreme of each range (See Table 6.3) adjust the oscillator trimmer condensers on Ranges 1, 2 and 3 to produce the indicated frequency, and adjust the trimmers of Buffer No. 2 on these ranges to maximize the P.A. grid current indicated by the panel meter. With the dial set at the nominal low frequency extreme, adjust the oscillator coil cores (trackers) to produce the specified frequency on Ranges 1, 2 and 3, and adjust the cores in the coils of Buffer No. 2 to maximize the grid current. Alternate these adjustments until the frequency at each end of these three ranges is within 0.01% of the specified frequency. Lock the adjustments on all Oscillator cores and condensers by tightening their locking nuts, verifying that this does not disturb the frequency adjustment.

(3) On Ranges 4 and 5, the oscillator adjustments need not be touched, but the two buffer stages must be trimmed and tracked in a similar manner to maximize the P.A. Grid current. On these ranges the 2nd buffer is not provided with trimmer condensers, so the alignment is carried out in the middle of the range (12 on the Logging Scale). Check that the frequency at the two nominal band limits is as specified within 0.05%. Lock all Buffer adjustments.

Range	Frequency		Oscillator		Buffer No. 1		Buffer No. 2	
	Trim	Track	Trim	Track	Trim	Track	Trim	Track
1	515 kc	375 kc	C3	L1	-	-	C16	L10
2	2.6 mc	1.5 mc	C5	L2	-	-	C14	L9
3	4.5 mc	2.6 mc	C7	L3	-	-	C13	L8
4	7.8 mc	4.5 mc	-	-	C9	L5	C12	L7 *
5	13.5 mc	7.8 mc	-	-	C8	L4	C11	L6 *

*Adjust L7 and L6 for maximum grid current with the dial pointer at 12 on the logging scale.

Table 6.5 Buffer Adjustments

6.6 OSCILLATOR CALIBRATION - PART 3

(1) Check that the calibration accuracy of the dial is within 0.5% at the following frequencies:

400 kc	4.0 mc
500 kc	5.0 mc
1.7 mc	7.0 mc
2.3 mc	9.0 mc
3.0 mc	12.0 mc

(2) In sweeping across each range, check that the grid current does not fall below 6.5 ma. nor rise above 14.0 ma. at any frequency.

6.7 OSCILLATOR CALIBRATION - PART 4

Adjust the transmitter for operation on 10.0 mc with master oscillator control, and use logging scale of dial and vernier to record the exact dial setting. Rotate the main tuning dial from end to end, and rotate the CRYSTAL and RANGE switches back and forth. Now return to the recorded dial and switch settings. The frequency must be within 0.05% of the original frequency. Also check that operation of the dial lock does not shift the setting of the vernier scale by more than 1/4 division.

6.8 OSCILLATOR CALIBRATION - PART 5

Plug in at least three crystals of different frequencies distributed evenly across the Range of 1.5 to 4.5 mc. Adjust the main tuning control to maximize the P.A. grid current on both the fundamental and third harmonic frequencies. In no case should the grid current obtained be less than 6.5 ma. When checking the third harmonic frequencies (ranges 4 and 5), verify that the MO frequency at the corresponding dial position is within 0.5% of that obtained when frequency control is by crystal.

6.9 OSCILLATOR CALIBRATION - PART 6

With the r-f circuits operating on some frequency such as will produce a grid cur-

rent of 9 to 10 ma., switch to M. C. W. and check that an audio voltage of at least 90 volts appears across the secondary (terminals 3 and 4) of T1 when relay E3 is operated by hand. The audio frequency as heard in a monitoring receiver shall be 1000 cycles, plus or minus 10%.

VACUUM TUBE SOCKET VOLTAGES

In order to localize faults efficiently, the DC voltages between pins of the vacuum tubes and ground can be measured. Measurements should be made with a high resistance volt-meter (1000 ohms per volt or better). The following readings were taken on a transmitter operating at a line voltage of 115V and at a frequency of 4.5 mc/s, with a Simpson model 215 volt-meter (resistance of 5000 ohms per volt). Some variation from the figures given below can be expected with change in frequency as well as with a change in line voltages.

Tube No.	Pin No. 1	2	3	4	5	6	7	8	Remarks
V1	Gnd.	9.2	150	80	0	NC*	9.2	Gnd	CW Key Down
1619	"	68	150	93	0	"	68	"	CW Key Up
HIGH	"	9.2	150	80	0	"	9.2	"	MCW Key Down
POWER	"	68	150	93	0	"	68	"	MCW Key Up
	"	9.2	150	80	0	"	9.2	"	Phone Send
	"	68	150	93	0	"	68	"	Phone Rec.
V1	"	9.2	150	80	0	"	9.2	"	CW Key Down
1619	"	68	150	93	0	"	68	"	CW Key Up
LOW	"	9.2	150	80	0	"	9.2	"	MCW Key Down
POWER	"	68	150	93	0	"	68	"	MCW Key Up
	"	9.2	150	80	0	"	9.2	"	Phone Send
	"	68	150	93	0	"	68	"	Phone Rec.
	Fil. Volts across pins 2-7 = 2.4V AC								
V2	Gnd.	9.2	150	150	-17	NC	9.2	Gnd	CW Key Down
1619	"	68	150	150	36	"	68	"	CW Key Up
HIGH	"	9.2	150	150	-17	"	9.2	"	MCW Key Down
POWER	"	68	150	150	36	"	68	"	MCW Key Up
	"	9.2	150	150	-17	"	9.2	"	Phone Send
	"	68	150	150	30	"	68	"	Phone Rec.
V2	Gnd.	9.2	150	150	-17	NC	9.2	Gnd	CW Key Down
1619	"	68	150	150	34.5	"	68	"	CW Key Up
LOW	"	9.2	150	150	-17	"	9.2	"	MCW Key Down
POWER	"	68	150	150	34.5	"	68	"	MCW Key Up
	"	9.2	150	150	-17	"	9.2	"	Phone Send
	"	68	150	150	27	"	68	"	Phone Rec.
	Fil. Volts across pins 2-7 = 2.4V AC								

*NC = No Connections

Table 6.9 Vacuum Tube Socket Voltages

Tube No.	Pin No. 1	2	3	4	5	6	7	8	Remarks
V3	Gnd.	9.2	395	150	-2.8	NC*	9.2	Gnd	CW Key Down
1619	"	68	420	150	0	"	68	"	CW Key Up
HIGH	"	9.2	395	150	-2	"	9.2	"	MCW Key Down
POWER	"	68	420	150	0	"	68	"	MCW Key Up
	"	9.2	410	150	-1.3	"	9.2	"	Phone Send
	"	68	420	150	0	"	68	"	Phone Rec.
V3	Gnd.	9.2	395	150	-1.7	NC	9.2	Gnd	CW Key Down
1619	"	68	420	150	0	"	68	"	CW Key Up
LOW	"	9.2	395	150	-1.3	"	9.2	"	MCW Key Down
POWER	"	68	420	150	0	"	68	"	MCW Key Up
	"	9.2	410	150	-.8	"	9.2	"	Phone Send
	"	68	420	150	0	"	68	"	Phone Rec.
	Fil. Volts across pins 2-7 = 2.4V AC								
V4	NC	Gnd	NC	NC	150	NC	NC	NC	CW Key Down
VR150/30	"	"	"	"	150	"	"	"	CW Key Up
HIGH	"	"	"	"	150	"	"	"	MCW Key Down
POWER	"	"	"	"	150	"	"	"	MCW Key Up
	"	"	"	"	150	"	"	"	Phone Send
	"	"	"	"	150	"	"	"	Phone Rec.
V4	NC	Gnd	NC	NC	150	NC	NC	NC	CW Key Down
VR150/30	"	"	"	"	150	"	"	"	CW Key Up
LOW	"	"	"	"	150	"	"	"	MCW Key Down
POWER	"	"	"	"	150	"	"	"	MCW Key Up
	"	"	"	"	150	"	"	"	Phone Send
	"	"	"	"	150	"	"	"	Phone Rec.
V5	8	NC*	310	-58	Gnd	NC	.8 Cap	1325	CW Key Down
813	65	"	430	0	"	"	65 "	1500	CW Key Up
HIGH	.7	"	310	-82	"	"	.7 "	1325	MCW Key Down
POWER	65	"	430	0	"	"	65 "	1500	MCW Key Up
	108	"	400	-.1	"	"	108 "	1325	Phone Send
	65	"	430	0	"	"	65 "	1500	Phone Rec.
V5	.6	NC	260	-65	Gnd	NC	.6 Cap	700	CW Key Down
813	65	"	430	0	"	"	65 "	825	CW Key Up
LOW	.5	"	280	-87	"	"	.5 "	700	MCW Key Down
POWER	65	"	430	0	"	"	65 "	825	MCW Key Up
	122	"	400	-.05	"	"	122 "	700	Phone Send
	65	"	430	0	"	"	65 "	825	Phone Rec.
	Fil. Volts across pins 1-7 = 10V AC								

*NC = No Connections

Table 6.9 (cont'd) Vacuum Tube Socket Voltages

Tube No.	Pin No. 1	2	3	4	5	6	7	8	Remarks
V6	Gnd	15.2	320	150	9.0	NC*	15.2	Gnd.	CW Key Down
1619	"	15.4	340	150	10	"	15.4	"	CW Key Up
HIGH	"	20	300	150	11	"	20	"	MCW Key Down
POWER	"	15.4	340	150	10	"	15.4	"	MCW Key Up
	"	15.2	330	150	9.5	"	15.2	"	Phone Send
	"	15.4	340	150	10	"	15.4	"	Phone Rec.
V6	Gnd	15.2	320	150	9.0	NC	15.2	Gnd.	CW Key Down
1619	"	15.4	340	150	10	"	15.4	"	CW Key Up
LOW	"	20	300	150	11	"	20	"	MCW Key Down
POWER	"	15.4	340	150	10	"	15.4	"	MCW Key Up
	"	15.2	330	150	9.5	"	15.2	"	Phone Send
	"	15.4	340	150	10	"	15.4	"	Phone Rec.

Fil. Volts across pins 2-7 = 2.5V AC

Voltage from 24V Rectifier at 115 Volts Line

Key Up 27 volts Key Down 24.8 volts

*NC = No Connections

Table 6.9 (conc.) Vacuum Tube Socket Voltages

SECTION 7 - PARTS LIST

7.1 CM-11A EQUIPMENT - CONDENSERS

Circuit Symbol	Function	Description	RCN Stock No.
C1	Main Tuning	4 gang	410-0069
C2	Osc. Padder	240 uuf 2% 500V ceramic	405-0056
C3	Osc. Tracking	100 mmf air, variable	410-0062
C4	Osc. Padder	125 uuf 2% 500V	405-0048
C5	Osc. Tracking	50 mmf air, variable	410-0046
C6	Osc. Padder	110 uuf 2% 500V ceramic	405-0047
C7	Osc. Tracking	Same as C5	
C8	Buffer Tracking	25 mmf air, variable	410-0019
C9	Buffer Tracking	Same as C8	
C10	Not used		
C11	Buffer Tracking	Same as C5	
C12	Buffer Tracking	Same as C5	
C13	Buffer Tracking	Same as C3	
C14	Buffer Tracking	Same as C3	
C15	Buffer Padder	100 uuf 10% 300V Mica, fixed	407-0068
C16	Not used		
C17	Osc. Filament by-pass	10,000 uuf 10% 300V Mica, fixed	407-0252
C18	Same as C17		
C19	Osc. Screen bypass	5100 uuf 5% 500V Mica, fixed	407-0345
C20	Osc. Grid coupling	51 uuf 5% 500V Mica, fixed	407-0040
C21	Osc. Anode coupling	150 uuf 10% 500V Mica, fixed	407-0079
C22	Buffer Grid coupling	Same as C20	
C23	Buffer Filament by-pass	Same as C17	

CM-11A EQUIPMENT - CONDENSERS (Cont'd)

Circuit Symbol	Function	Description	RCN Stock No.
C24	Buffer Filament bypass	Same as C17	
C25	Buffer Screen bypass	Same as C19	
C26	Buffer Anode coupling	Same as C21	
C27	Buffer Grid coupling	30 uuf 5% 500V Mica, fixed	407-0026
C28	Buffer Filament bypass	Same as C17	
C29	Buffer Filament bypass	Same as C17	
C30	Buffer Screen bypass	Same as C19	
C31	Buffer Anode coupling	Same as C21	
C32	PA Grid coupling	1000 uuf 10% 500V Mica, fixed	407-0163
C33	Anode filter	0.1 uf 10% 600V	407-0095
C34	PA Grid bypass	Same as C19	
C35	PA Filament bypass	Same as C17	
C36	PA Filament bypass	Same as C17	
C37	Osc. and Buffer Filament bypass	Same as C17	
C38	PA Filament bypass	Same as C17	
C39	Modulator Filament bypass	5 uf 50V	406-0004
C40	PA Screen bypass	Same as C19	
C41	Relay bypass	0.5 uf 400V	408-0787
C42	Modulator Grid bypass	Same as C32	
C43	Spark suppressor	Same as C33	
C44	Time Delay circuit	1 uf 10% 400V	408-0790

CM-11A EQUIPMENT - CONDENSERS (Cont'd)

Circuit Symbol	Function	Description	RCN Stock No.
C45	Tone Generator feedback	0.1 uf 20% 600V	408-0784
C46	Osc. Screen bypass	Same as C19	
C47	Buffer Grid bypass	Same as C41	
C48	PA Amplifier Grid bypass	Same as C41	
C49	Surge suppressor	Same as C45	
C50	PA Anode tune	2 x 225 uuf variable air	410-0081
C51	PA Anode tune	240 uuf 5% 500V Mica, fixed	407-0095
C52	PA Anode blocking	.005 uf 2500V	408-0011
C53	Antenna tuning	Same as C50	
C54	Antenna Current Indicator filter	2 x 0.1 mfds ± 20% 600V	408-1532
C55	High tension bypass	1000 uuf 10% 2500V Mica, fixed	407-0161
C56		50 uf 50V	406-0082
C57	RF bypass	Same as C17	

7.2 CM-11A EQUIPMENT - RELAYS

E1	Time delay	For positive operation at 20 ma. DC.	422-0000
E2	Keying	For operation on 12V DC.	422-0001
E3	Keying	For operation on 12V DC.	422-0002
E4	Antenna changeover	For operation on 24 DC, plus or minus 15%.	422-0032

7.3 CM-11A EQUIPMENT - JACKS

J1	Phone jack	1 circuit	348-6062

7.4 CM-11A EQUIPMENT - INDUCTANCES

Circuit Symbol	Function	Description	RCN Stock No.
L1	Osc. Coil Range 1		435-0140
L2	Osc. Coil Range 2		435-0141
L3	Osc. Coil Range 3		435-0142
L4	Buffer Coil Range 5		435-0155
L5	Buffer Coil Range 4		435-0156
L6	Buffer Coil Range 5		435-0157
L7	Buffer Coil Range 4		435-0156
L8	Buffer Coil Range 3		435-0159
L9	Buffer Coil Range 2		435-0160
L10	Buffer Coil Range 1		435-0161
L11	Osc. Anode choke		435-0162
L12	Equalizer choke		438-0023
L13	Buffer Anode choke	Same as L11	
L14	Voltage Regulator anode	Same as L11	
L15	Power Amp. grid	Same as L11	
L16	Buffer Anode choke	Same as L11	
L17	Not used		
L18	Power Amplifier anode coil		438-0143
L19	Antenna loading coil	Part of assy 114-667	435-0282
L20	Antenna variometer		435-0144

7.5 CM-11A EQUIPMENT - METERS

M1	Multimeter		478-0187

7.6 CM-11A EQUIPMENT - LAMPS, INCANDESCENT

Circuit Symbol	Function	Description	RCN Stock No.
P1	Dial Light	12-16 V frosted lamp	328-2124
P2	Same as P1		
P3	Same as P1		
P4	Same as P1		

7.7 CM-11A EQUIPMENT - RESISTORS

R1	Osc. grid resistor		440-1206
R2	Not used		
R3	Osc. screen	100K 5% 1W	440-1677
R4	Osc. screen	Same as R1	
R5	Buffer grid	100K 5% 1/2W	440-1216
R6	Not used		
R7	Damper	1.5K 5%	440-1150
R8	Damper	2.2K 5% 1/2 W	440-1156
R9	Buffer grid	5.1K 5% 1 W	440-1631
R10	Buffer grid	5.1K 5% 1/2 W	440-1170
R11	Not used		
R12	Not used		
R13	Cathode bias	200 ohm 10% 4 W	442-0159
R14	Voltage regulator series	7K ohms 10% 20 W	442-0423
R15	Power amplifier screen	4K ohms 10% 10 W	442-0374
R16	Power amplifier grid	8K ohms 10% 4 W	442-0433
R17	Power amplifier grid meter	100 ohm 1% 1 W	442-0662

CM-11A EQUIPMENT - RESISTORS (Cont'd)

Circuit Symbol	Function	Description	RCN Stock No.
R18	PA cathode bias	1.5K ohms 10% 20 W	442-0298
R19	Buffer cathode bias	Same as R18	
R20	Buffer cathode bias	5 ohms 10% 1 W	442-0650
R21	Tone generator	5K ohms 10% 4 W	442-0390
R22	Time delay circuit	1.5 megohms 10% 1 W	440-1719
R23	Time delay circuit	5.1 megohms 5% 1 W	440-1739
R24	Time delay circuit	390 ohms 5% 1/2 W	440-1129
R25	Time delay circuit	300 ohms 10% 1/2 W	442-0188
R26	Mic. input series	47 ohms 10% 1/2 W	442-0103
R27	PA cathode current measuring	Same as R21	
R28	Meter series	2.64K ohms 2% 1 W	442-0671
R29	Volume control	2.5K ohms variable	444-0068
R30	Rec. output series	1K ohms 5% 1/2 W fixed composition	440-1144
R31	Mod. transf. load	30K ohms 5% 1/2 W fixed composition	440-1197
R32	Spark supp.	100 ohms 5% 1/2 W fixed composition	440-1108
R33	Not used		
R34	Not used		
R35	HT meter series	1.5K ohms 1% 1 W	442-0687
R36	HT meter series	Same as R35	
R37	HT meter series	Same as R3	
R38	Ant. meter series	Same as R9	

7.6 CM-11A EQUIPMENT - LAMPS, INCANDESCENT

Circuit Symbol	Function	Description	RCN Stock No.
P1	Dial Light	12-16 V frosted lamp	328-2124
P2	Same as P1		
P3	Same as P1		
P4	Same as P1		

7.7 CM-11A EQUIPMENT - RESISTORS

R1	Osc. grid resistor		440-1206
R2	Not used		
R3	Osc. screen	100K 5% 1W	440-1677
R4	Osc. screen	Same as R1	
R5	Buffer grid	100K 5% 1/2W	440-1216
R6	Not used		
R7	Damper	1.5K 5%	440-1150
R8	Damper	2.2K 5% 1/2 W	440-1156
R9	Buffer grid	5.1K 5% 1 W	440-1631
R10	Buffer grid	5.1K 5% 1/2 W	440-1170
R11	Not used		
R12	Not used		
R13	Cathode bias	200 ohm 10% 4 W	442-0159
R14	Voltage regulator series	7K ohms 10% 20 W	442-0423
R15	Power amplifier screen	4K ohms 10% 10 W	442-0374
R16	Power amplifier grid	8K ohms 10% 4 W	442-0433
R17	Power amplifier grid meter	100 ohm 1% 1 W	442-0662

CM-11A EQUIPMENT - RESISTORS (Cont'd)

Circuit Symbol	Function	Description	RCN Stock No.
R18	PA cathode bias	1.5K ohms 10% 20 W	442-0298
R19	Buffer cathode bias	Same as R18	
R20	Buffer cathode bias	5 ohms 10% 1 W	442-0650
R21	Tone generator	5K ohms 10% 4 W	442-0390
R22	Time delay circuit	1.5 megohms 10% 1 W	440-1719
R23	Time delay circuit	5.1 megohms 5% 1 W	440-1739
R24	Time delay circuit	390 ohms 5% 1/2 W	440-1129
R25	Time delay circuit	300 ohms 10% 1/2 W	442-0188
R26	Mic. input series	47 ohms 10% 1/2 W	442-0103
R27	PA cathode current measuring	Same as R21	
R28	Meter series	2.64K ohms 2% 1 W	442-0671
R29	Volume control	2.5K ohms variable	444-0068
R30	Rec. output series	1K ohms 5% 1/2 W fixed composition	440-1144
R31	Mod. transf. load	30K ohms 5% 1/2 W fixed composition	440-1197
R32	Spark supp.	100 ohms 5% 1/2 W fixed composition	440-1108
R33	Not used		
R34	Not used		
R35	HT meter series	1.5K ohms 1% 1 W	442-0687
R36	HT meter series	Same as R35	
R37	HT meter series	Same as R3	
R38	Ant. meter series	Same as R9	

7.8 CM-11A EQUIPMENT - SWITCHES

Circuit Symbol	Function	Description	RCN Stock No.
S1	Frequency		420-1155
S2	Range		420-1175
S3	Control		420-1159
S4	Meter		420-1099
S5	Power		420-1092
S6	Not used		
S7	PA Range		420-1083
S8	Antenna Tune	(part of ass'y 114-667)	420-1067
S9	Series parallel		420-1019
S10	Gate		314-2529

7.9 CM-11A EQUIPMENT - TRANSFORMERS

T1	Modulation		457-0182
T2	Microphone		457-0131
T3	Filaments		456-0031
T4	Meter		434-0019
T5	Meter		434-0020

7.10 CM-11A EQUIPMENT - ELECTRON TUBES

V1	Master Oscillator		462-0248
V2	1st Buffer		Same as V1
V3	2nd Buffer		Same as V1
V4	Voltage Regulator		462-0076
V5	Power Amplifier		462-0009
V6	Modulator		Same as V1

7.11 CM-11A EQUIPMENT - MISCELLANEOUS MATERIAL

Circuit Symbol	Function	Description	RCN Stock No.
PC1		Chassis connector	425-0070
PC2		" "	425-0071
PC3		" "	425-0072
PC4		" "	425-0073
PC5		" "	425-0074
PC6		" " 1 pin	424-0070
PC7		" " 15 pin	424-0129
PC8		" " 6 pin	424-0104
RC9		Phone plug	348-6510
SC1		Socket connector	425-0307
SC2		" "	425-0308
SC3		" "	425-0309
SC4		" "	425-0310
SC5		Socket connector	425-0306
SC6		" " 5 pin	424-0033
SC7		" " 7 pin	424-0299
SC8		Connector Socket, 3 contact	425-0147
SC9		Connector Socket, 2 contact	425-0153

Vacuum Tube Sockets

XV1			427-0064
XV2		Octol Socket	
XV3		Same as XV1	
XV4		" " "	
XV5	Socket	" " "	427-0058

Vacuum Tube Sockets (Cont'd)

Circuit Symbol	Function	Description	RCN Stock No.
XV6		Same as XV1	
	Crystal Sockets		427-0141
	Iron core for RF coils		435-9005
	Test cable		404-0050
	Terminal Block		451-0091
	Ant. lead out bushing	480	324-0252
	Feed through insulator	502	324-1962
	Feed through insulator	55	324-1932
	Coupling	250	494-0136
	Coupling	251A	494-0137
	Insulator standoff	#398 L1/2"	324-0010
	Insulator standoff	#393 - L1-1/4"	324-0014
	Insulator standoff	#1050	324-0162
	Insulator standoff	#1052	324-0170
	Bushing	#20	442-9922

7.12 ZM-11A EQUIPMENT - CONDENSERS

C1	HT Filter	4 mf 10% 2000V	408-0870
C2	LT filter	8 mf 10% 600V	408-0877
C3	Line filter	.1 / .1 uf 20% 600V	408-1532
C4	Control rect. filter	100 uf 50V	406-0067
C5	Receiver rect. filter	10 uf 300V	406-0043
C6	Receiver rect. filter	Same as C5	

ZM-11A EQUIPMENT - CONDENSERS (Cont'd)

Circuit Symbol	Function	Description	RCN Stock No.
C7	Hash filter	2 x 0.5 uf 600V	408-0177
C8	Hash filter	Same as C7	
C9	Hash filter	Same as C4	
C10	Hash filter	Same as C4	
C11	Hash filter	Same as C7	
C12	Hash filter	Same as C7	
C13	Hash filter	2 x 0.1 uf 600V	408-0698

7.13 ZM-11A EQUIPMENT - RELAYS

E1	High low power	24V DC	422-0003
E2	LT Pri.	24V DC	422-0004
E3	Rec. Pri.	Same as E2	

7.14 ZM-11A EQUIPMENT - FUSES

F1	AC line	Case	309-2032
F1A	Fuse link, Electrical 8A		309-4307
F2	AC line	Same as F1	
F2A		Same as F1-A	
F3	Rec. line	Same as F1	
F3A	Fuse link, Electrical 3A		309-4303
F4	Rec. line	Same as F1	
F4A		Same as F3A	
F5	Rec. Batt. line	Same as F1	
F5A	Fuse link, Electrical 20A		309-4311
F6	Rec. Batt.	Same as F1	

7.15 ZM-11A EQUIPMENT - INDUCTANCES

Circuit Symbol	Function	Description	RCN Stock No.
L1	HT Filter		455-0090
L2	LT Filter		455-0133
L3	24V Filter		455-0073
L4	Rec. Filter		455-0082
L5	Rec. Filter	Same as L4	
L6	Hash Filter		455-0135
L7	Hash Filter	Same as L7	
L8	Hash Filter		435-0161
L9	Hash Filter	Same as L8	

7.16 ZM-11A EQUIPMENT - RESISTORS

R1	HT Rect. Bleeder	100,000 ohms plus or minus 10% 40W C coating #3 terminals	442-0530
R2	LT Rect. Bleeder	50,000 ohms plus or minus 10% 20W C coating #3 terminals	442-0519
R3	24V Rect. Bleeder	250 ohms plus or minus 10% 4W C coating #1 terminals	442-2011
R4	Rec. Rect. Bleeder	10,000 ohms plus or minus 10% 20W C coating #3 terminals	442-0451

7.17 ZM-11A EQUIPMENT - SWITCHES

S1	Lock switch		314 3031
S2	Gate switch		314 2529
S3	AC-DC switch		314 1045
S4	AC-DC switch		314 1045
S5	AC-DC switch		314 1045

7.18 ZM-11A EQUIPMENT - TRANSFORMERS

Circuit Symbol	Function	Description	RCN Stock No.
T1	HT Rect. Anode		456 0296
T2	HT Rect. Filament		456 0100
T3	LV Rect. Composite		456 0206
T4	24V Rectifier		456 0050
T5	Rec. Rect. Composite		456 0211

7.19 ZM-11A EQUIPMENT - MISCELLANEOUS MATERIAL

Socket and Chassis Connectors

SC7	AN3108B-18-16P		424 0299
SC9	AN3102A-22		424 0105
SC8	AN3102A-28-17S		424 0130
PC1			425 0069
PC2			425 0068
PC3			425 0067
PC4			425 0066
PC5			425 0065
PC6			425 0064
SC1			425 0302
SC2			425 0304
SC3			425 0300
SC4			425 0303
SC5			425 0301
SC6			425 0305

Electron Tubes

Circuit Symbol	Function	Description	RCN Stock No.
V1		JAN 816	462 0249
V2		Same as V1	
V3		" " "	
V4		" " "	
V5		5Y4G	462 0249
V6		Same as V5	

Vacuum Tube Sockets

XV1			427 0007
XV2		Same as V1	
XV3		" " "	
XV4		" " "	
XV5			427 0064
XV6		Same as V5	
	Selenium rectifier Dynamotor input 24V 110VA		418 0006 416 0043

7.20 SM-11 CONTROL UNIT

P1	Pilot Light Pilot Light Socket	24V Mazda	328 1898 329 5490
R1	Volume Control	500 ohm L Pad	444 0037
R2	450 ohms 5% 4W		442 0217
R3	50 ohm 10% 1W		442 0712
R4	Volume Control	2500 ohms	444 0068
S1	Spkr-phone switch	S. P. D. T.	314 0123

SM-11 CONTROL UNIT (Cont'd)

Circuit Symbol	Function	Description	RCN Stock No.
S2	On-off switch	S. P. S. T.	314 0120
T1	Transformer		457 0097
	Loudspeaker		447 0018