INSTALLING & OPERATING INSTRUCTIONS FOR MARCONI PORTABLE & FIXED STATION TRANSMITTER-RECEIVERS TYPES IV-IA & IV-IB

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INSTALLING AND OPERATING INSTRUCTIONS
MARCONI TRANSMITTER-RECEIVERS
TYPES PN1A AND PN1B

GENERAL DESCRIPTION

The Marconi types PN1A and PN1B Transmitter-Receiver equipments have been designed for low power portable and fixed station applications respectively, primarily for use by the Armed Services.

The PN1A Transmitter-Receiver Unit embodies a low power transmitter, a superheterodyne receiver, a telescopic rod antenna, a carbon microphone with incorporated "press-to-talk" switch, a pair of light weight headphones, a signalling key, and accommodation for a light weight combination A and B battery pack. The equipment is provided with a carrying harness, by means of which it can be carried comfortably on a man's back. The harness consists of a light tubular metal framework to which is attached leather straps by which the weight is evenly distributed to the wearer. A pocket conveniently located on the harness, is provided for the storage of the microphone. The equipment, complete with a battery pack capable of providing 8 to 9 hours of continuous operation, weighs approximately 35 pounds.

The 8 foot telescopic rod antenna has a collapsed height of 15 inches, and is secured to one side of the case by means of a simple looking device. When not in use it may be quickly dismantled and stowed in clamps which are provided inside the case.

The PN1B Transmitter-Receiver Unit is basically the same as the PN1A, differing only in those details necessary to contribute most effectively to its use as a fixed or semi-fixed station. The PN1B has no carrying harness or rod antenna, but has a 3 inch permanent magnet loudspeaker incorporated. It is usually used with a straight wire antenna up to a quarter wave in length, instead of the whip antenna. The PN1A Transmitter-Receiver Unit measures approximately 19¼" x 18" x 16½" overall, including the carrying harness and collapsed antenna. The PN1B measures approximately 16" x 16" x 10" overall.

A Battery Box Assembly is available for use with the PN1A or the PN1B when either is used as a semi-fixed station. It provides accommodation for a heavy duty combination A and B battery pack, which is capable of operating the equipment for from 75 to 100 hours. The assembly includes a six foot cable for interconnection with the Transmitter-Receiver Unit. Accommodation is also provided in the Battery Box Assembly for stowing a length of antenna wire to be used in place of the whip antenna. A shoulder strap is provided to facilitate transportation. The assembly measures approximately 13" x 12" x 9", and weighs approximately 45 pounds, complete with battery and antenna.

For PN1B fixed station installations, standard A cells and B batteries are normally supplied. These large batteries will give in excess of 200 hours of service. A special battery cable is available for use with these batteries, having at one end a connector which fits the power plug on the chassis and at the other end spade lugs and battery plugs for connection to the "A" and "B" batteries respectively.

The service life ratings which have been quoted above for the three different types of battery available with this equipment are based on an assumed continuous discharge of 5 minutes transmit - 5 minutes receive. Considerably longer service life will be realized if the discharge conditions are less stringent than those stated.

The transmitter will deliver a carrier power output of 2 to 2.5 watts to a resistive load, on any one of three crystal-controlled frequencies between 3.0 and 6.0 megacycles. This carrier can be keyed for C.W. operation, or 100% speech modulated for Radiotelephone operation. On Radiotelephone operation the carrier is controlled by the "press-to-talk" switch incorporated in the microphone, the transmitter being turned off and the receiver turned on when the "press-to-talk" button is released.

The receiver is continuously tunable over the same frequency range as the transmitter, the dial being calibrated directly in megacycles. The receiver employs six vacuum tubes in a superheterodyne circuit, providing high sensitivity, selectivity, signal to noise ratio, and image attenuation. Automatic volume control is used for telephone reception but is automatically removed when the receiver is switched over for the reception of C.W. signals.

TRANSMITTER-RECEIVER DESCRIPTION

Reference should be made to the Diagrams of Connections contained in the back of this manual when reading the following technical description. The overall cabinet is constructed of aluminum, weatherproof construction being used throughout. The transmitter and receiver are built on a common chassis, which fits into the upper compartment of the cabinet where it is secured by screws through the top of the front panel and through the sides of the cabinet. The lower half of the cabinet provides accommodation for the portable battery and the telegraph key, and stowage for the whip antenna, earphones and microphone when not in use. In the PN1B the loudspeaker is also mounted in this compartment.

Battery voltage is supplied, from one of the three types of battery already described, through a four conductor cable, terminating in a locking type plug connector which fits into a receptacle mounted in a flange under the front panel at the centre of the transmitter receiver chassis. This receptacle is labelled "Power". Another similar receptacle labelled "Audio" and mounted on the same flange as the "Power" receptacle, receives the plug from the microphone-headset assembly. Located between these receptacles, but towards the rear of the chassis, is a small jack which receives the plug on the lead-in from the rod antenna.

Battery voltage is applied to the unit by the operation of the OFF-ON switch S6. In the PN1A (portable) version of the equipment this is a push switch which extends on a hanging lead from the right rear of the chassis. It is secured to the bottom of the case near the right edge, so as to be within easy reach of the operator when he is carrying the unit. In the PN1B (fixed station) version S6 is a standard toggle type switch, and is mounted at the lower left hand corner of the front panel next to the C.W.-PHONE switch. When the OFF-ON switch is placed in the "ON" position, connections are made to the transmitter-receiver circuits from the "A" positive, and from the combined "A" and "B" negative leads of the batteries.

The voltages delivered by the batteries are 180 volts, with a tap at 135 volts, for the "B" supply, and three volts for the "A" supply. The receiver valves require 1.4 to 1.5 volts for each filament, and are connected in a series parallel arrangement across the 3 volt source. A rheostat is employed to reduce the supply to between 2.0 and 2.1 volts for the transmitter valves. This rheostat is mounted on the front panel, where its control is designated "FIL". The high tension required for the receiver is approximately 90 volts and is obtained through the dropping resistor R31 suitably bypassed by the electrolytic condenser C26.

Mounted in the center of the chassis is a telephone type relay which is operated from the 3 volt supply circuit through either the SEND-RECEIVE switch on the panel, or the "Press-to-Talk" switch on the microphone. It transfers the 3 volt supply from the receiver valves to the transmitter valves, and also transfers the antenna from the receiver to the transmitter,

The receiver section occupies the left-hand portion of the combined chassis. It utilizes six valves in a superheterodyne circuit performing nine functions, as follows.

The r-f amplifier uses a type 1P5GT/G pentode valve. The grid of this valve receives the incoming signal from the tuned grid winding of the r-f transformer T1. The base of this winding is connected through R1 to the automatic volume control circuits, the tuned circuit being completed through the .01 uf. condenser C1. The antenna winding of T1 is of high impedence and matches either the wire or the rod antenna. The plate of the 1P5GT/G is connected through the primary winding of the detector transformer T2 to the main 90 volt high tension supply.

The detector-oscillator or converter valve is a type 1A7GT/G which performs the double function of a frequency-changing rectifier and high-frequency oscillator. Across its signal grid are impressed the incoming r-f signals, which have been selected and amplified by the r-f and detector transformers and the r-f amplifier valve. The triode portion of the converter valve is used for the high-frequency oscillator and is shunt-fed; the anode grid receiving its voltage from the 90 volt supply through the dropping resistor R5. The oscillator transformer T3 provides plate-to-grid coupling, and grid tuning, and the grid tank circuit is normally tuned to a frequency 455 kilocycles higher than the r-f signals. The oscillations set up are fed through the grid coupling

condenser C8 to the oscillator grid, where they are mixed with the signals appearing in the valve from the signal grid. The base of the secondary winding of the detector transformer T2 is connected to the voltage divider in the filament circuit of the 1A7GT/G converter valve. This divider consists of resistors R2 and R3 and supplies a slight negative bias, approximately 0.8 volts, to the signal grid. Condenser C11 serves to complete the detector tuned circuit.

Another 1P5GT/G valve is used as the intermediate frequency amplifier. From the signals appearing at the plate of the converter valve, those at 455 kc are selected by the transformer T4, and impressed across the grid of the i-f valve. Here they are amplified and passed through the second i-f transformer T6 to the second detector circuits. It is in the i-f amplifier that the major portion of the amplification and selectivity of the complete receiver is obtained.

A 1H5GT/G valve is used for the detector, automatic volume control, and 1st audio amplifier circuits. The detector circuit consists of the diode section of V5 and the diode load R12 and R14. R12 in conjunction with C23, acts as an r-f filter and prevents r-f voltage from going into the audio system. The audio component is passed through the audio coupling condenser C22 to the top of the audio volume control R17. On C-W the grid of the 1H5GT/G is connected directly to C22 while on PHONE R17 is connected into circuit to provide control over the audio gain of the amplifier. The automatic volume control circuit consists of R15, R1, R6, C1 and C39 and functions as follows:

In the diode detector circuit there is developed across the load resistor, R12 plus R14, a voltage proportional to the carrier strength at the diode. The diode end of this load is negative with respect to ground and a negative AVC voltage is applied to the r-f and i-f amplifier grids. The AVC resistors R1 and R6 are intended to provide decoupling between the r-f and i-f circuits.

Valve V4, a 1G4GT/G triode, is used for the beat-frequency-oscillator. The circuit is set into operation by the PHONE-C.W. switch S1 which, when set at C.W., supplies voltage to the plate of V4 through the dropping resistor R10. The tank circuit of transformer T5 is adjusted to approximately 456 kilocycles and oscillations set up in this transformer are coupled through the small capacity existing across pins #4 — #5 of V5 to the diode plate, where they are mixed with the i-f signals, resulting in a 1000 cycle beat note. In addition to applying high tension voltage to V4, S1 also performs three other functions when turned from PHONE to C.W. The AVC line to V1 and V3 is shorted to ground and connection to the AVC resistor R15 broken, thus removing the automatic control of volume. The audio gain is fixed by transferring the audio grid of V5 from the slider of R17 to the junction of C22 with R17. Also the screen grids of V1 and V3, which on PHONE receive a fixed supply from the junction of R13 and R11, are connected to the slider of R11 where screen voltage is varied by its manipulation; this provides an r-f sensitivity control to replace the audio gain control now fixed. In brief the changes accomplished by changing from PHONE to C.W. are:— (1) Supplying HT to BFO circuit (2) Removing the AVC (3) fixing the audio gain (4) Providing r-f gain control through the screen supply to V1 and V3.

The power output valve is a 1Q5GT/G beam power amplifier. Here the audio signals received by the grid through C24 are amplified and impressed across the primary of the output transformer T7. In the PN1A the secondary of this transformer supplies the induced audio frequency signals to the headphones through the audio socket CC1. In the PN1B the transformer feeds either the earphones or the loudspeaker, as determined by the setting of a DPDT Toggle switch, S7, connected to its output terminals. This switch is mounted on the front panel, above the filament rheostat, and is marked "SPEAKER-PHONES".

The overall amplification of the receiver is controlled by the panel control designated VOLUME. This is a dual control consisting of R11 and R17. The functions have already been described.

The selection of any desired frequency within the range of the receiver is made by a three gang tuning condenser which tunes the r-f and detector transformer circuits to the desired frequency, and as previously stated, the oscillator secondary to a frequency 455 kc higher. The gang condenser is adjusted by the tuning dial mounted on the front panel, the scale of which is calibrated in megacycles. The only other controls necessary for operation of the receiver are the controls marked VOLUME and the PHONE-C.W. switch.

The r-f detector and oscillator transformers are wound on high grade, low loss bakelite formers, the secondaries being space-wound. The transformers are impregnated with a non-hygroscopic bakelite varnish, baked and waxed. These precautions serve to prevent losses due to excess humidity, and provide good stability under all climatic conditions. The i-f transformers are likewise impregnated but use litz wire coils on fish paper formers. The BFO transformer uses duo-lateral wound coils on a bakelite former, all being similarly treated as the r-f and i-f coils. For adjustment all r-f and i-f transformers use high grade powdered iron cores, which are sealed in place before the equipment is shipped.

The following is a tabulation of the Technical Specifications and Ratings of the receiver section of the Transmitter-Receiver.

VALVES:

1 — RVC 1P5GT/G — R-F Amplifier.
1 — RVC 1A7GT/G — Converter.
1 — RVC 1P5GT/G — I-F Amplifier.
1 — RVC 1H5GT/G — Detector, AVC and Audio.
1 — RVC 1G4GT/G — BFO.
1 — RVC 1Q5GT/G — Power Output.

FREQUENCY RANGE: 3 megacycles to 6 megacycles.
INTERMEDIATE FREQUENCY: 455 kilocycles.
ANTENNA INPUT: High impedance matched to rod antenna or wire antenna up to ¼ wave-length long.

OUTPUT IMPEDANCE: For high impedance phones, or loudspeaker voice coil.

POWER OUTPUT: 350 milliwatts maximum, 225 milliwatts undistorted.

SENSITIVITY FOR 10 MILLIWATTS OUTPUT: 5 microvolts average.

SELECTIVITY IN KC OFF RESONANCE: Averages 19 kc at 60 db down.

IMAGE ATTENUATION: Averages 65 db.

SIGNAL-TO-NOISE AT MAXIMUM SENSITIVITY: Averages 8 db.

I-F INTERFERENCE RATIO: Averages –85db.

A.V.C.: Holds the output level within ± 15db when the input varies 80 db.

AUDIO CHARACTERISTICS: Within 2 db from 250 to 1500 cycles. Down 10 db at 100 and 2500 cycles.

MODULATION CAPABILITY: 85%.

The transmitter section of the unit is located on the right hand end of the chassis. Its circuit employs four valves which perform functions as follows:

The crystal oscillator stage employs a type 1H4G valve. One of the three crystals is selected by the rotary switch, whose panel control is designated CHANNEL. The crystal selected connects to the 1H4G in a standard grid-to-ground oscillator circuit. The plate circuit of this valve is tuned by a tank circuit consisting of an inductance and one of three variable air condensers which are also switched by the CHANNEL switch. Three tank circuits are thus effectively employed so that each tank can be pre-tuned to the frequency of the associated crystal. These oscillator tank condensers, C34, C35 and C36, are located in a row in the right hand end of the chassis under their respective crystal sockets.

The inductance in the oscillator tank circuit is tapped for connection to the 180 volt supply so that double-ended tank operation is provided. One end of this tank is connected to the parallel control grids of a type 1J6G power amplifier valve through a coupling condenser, C32, while the other end is connected through the adjustable air condenser, C31, to apply out-of-phase neutralizing voltage to the paralleled plates of the p-a inductance.

The plates of the 1J6G p-a valve are supplied with 180 volts d-c through the secondary winding of the modulator transformer and through an r-f choke, while the r-f voltage generated by the valve is fed through a d-c blocking condenser, C29, to an output tuning circuit consisting of a tapped coil and variable condenser. The taps on the coil are connected to a 17 point rotary tap switch mounted on the front panel and designated COUPLING. The variable condenser is fitted with a vernier drive and locates beside the coil. These two components are connected to form what is commonly known as an "L" network in which the antenna is connected as a series element rather than a shunt element of the output tank. The main advantage of this type of circuit is its simplicity, since both the p-a plate and antenna circuits are tuned simultaneously. The constants of this circuit are chosen to allow the transmitter to feed antennae of length between that of the rod and a wire antennae one quarter wavelength long, as may be used in semi-fixed station service.

The modulator valve is another 1J6G having its two triode sections connected in push-pull, and which operates class "B". It is transformer-coupled to the output of a type 1F5G driver valve whose grid is in turn connected to the microphone transformer. Bias for both these audio valves is obtained from the 4.5 volt tap on the "C" battery, which is mounted on the chassis base behind the relay. Microphone current is obtained from the transmitter filament circuit and is applied to the microphone through the primary of the microphone transformer.

Keying of the carrier for c-w operation is accomplished by opening the grid circuit of the p-a valve. This takes place when the key cable is pushed into the jack designated KEY on the front panel. The break is transferred to the key contacts, and so is closed when the key is pressed. This method of keying is not perfect, since a small amount of power will feed through due to imperfect neutralization. However, a difference in signal level between key up and key down of approximately 25 db will be obtained with an average adjustment. It will be noted that when the key plug is pushed in, back contacts on the jack operate to open the filament circuit to the modulator valves to conserve battery current, and also insert a resistance in series with the filaments of the r-f valves to maintain approximately constant filament voltage on these latter valves in spite of the reduced voltage drop in the filament rheostat.

The meter mounted on the front panel is arranged to measure the transmitter plate and filament supply voltages as well as the plate current to the p-a stage. This is accomplished by using a low current meter in conjunction with voltage multipliers and a current shunt, these being switched by the meter switch S4 which is located below the meter. The main scale of the meter is calibrated 0–50 ma for p-a plate current measurements, this scale being read when the meter switch is in the position marked TRANS TUNE. When the switch is moved to B VOLTS, the full scale range is 200 volts, although a complete calibration does not appear on the meter scale, but merely spot calibrations at 180, 144 and 120 volts. The 0–5 scale obtainable with the switch in the TRANS FIL position is only marked 2.15 volts at a red line on the main scale, as this is the only reading of interest on this range.

The main tuning dials of both the transmitter and the receiver sections are fitted with clamps that act on the periphery of the dial scales, and so lock the condensers in any desired position. These locks locate at the extreme ends of the front panel.

PRELIMINARY ADJUSTMENT

On receipt of the equipment it should be carefully examined for possible damage in transit. Before leaving the Factory, each set is thoroughly inspected and tested, using the customer's crystals if these are available. Otherwise the transmitter section is tested using standard test crystals at either end of its frequency range, and since the adjustments are not numerous, no difficulty should be experienced in tuning it to the desired frequency in the field.

To put the unit into operation proceed as follows:

First undo the canvas cover and open the metal doors to expose the chassis panel and the battery compartment. Then remove the transmitter-receiver chassis by extracting the four screws through the top of the panel and the two screws into the sides of the chassis. If the customer's crystals were available before shipment, these will be in place in the sockets along the right hand side of the chassis. If the crystals are separate, they should be placed in these sockets, care being taken to orient them so that the pin connecting to the exposed metal plate of the holder is located in the right hand, or outside hole of each socket, this pin being the ground side. Make certain also that all valves are in their proper sockets as indicated by the markings on the base beside each socket.

Power should now be applied to the chassis before replacing it in the case. Either light duty or heavy batteries may be used for this purpose, the connection to the POWER receptacle being made by means of the appropriate battery cable. The microphone-headset assembly should be plugged into the receptacle designated AUDIO and the unit turned on by means of the OFF-ON switch. The receiver should now become operative and if the volume control is advanced, a signal or background noise will be audible in the headphones. Battery voltage will be indicated on the meter if its switch is moved to the B-VOLTS position. Normally no further receiver adjustments will be necessary.

Now with the meter switch on TRANS FIL, press the button on the microphone. This should operate the relay and cause a reading to appear on the meter. The FIL control should be adjusted to make the meter pointer fall on the red line at 2.15 volts. If the meter switch is now moved to TRANS TUNE, a reading of approximately 15 ma will be observed if the crystal is not oscillating, or a very high reading if it is oscillating. The crystal stage is tuned by the three small screwdriver-adjusted condensers that locate in a row in the right hand side of the chassis. These condensers must be adjusted with an insulated screwdriver or socket wrench, since the shafts carry an r-f potential as well as the 180 volt d-c supply. Each of the three condensers is associated with the crystal socket immediately above it, which in turn is in circuit when the CHANNEL switch is set to the channel number that is also stamped beside the crystal socket. The condensers should be adjusted to a point just before the crystal stops oscillating, as indicated by a falling of the meter reading to about 15 ma. The adjustment should not be so close to this point that oscillations are not established at once every time the microphone button is pressed. The value of the p-a grid current (or in other words the magnitude of the oscillator output) may be measured, if desired, by plugging a d-c milliammeter connected to a two-circuit plug into the KEY jack, and for normal operation should be approximately 3 ma.

Neutralization of the p-a stage is carried out accurately at the Factory before shipment, so care should be taken that the setting of the neutralizing condenser C31 is not disturbed. The correct position of this condenser usually will be with its plates slightly less than half meshed, and such a setting may

be tried if its position is accidently changed. The neutralizing adjustment is quite critical if optimum operation on c-w telegraphy is to be obtained and the adjustment procedure is somewhat involved and requires the use of special instruments. The proper procedure will be described under the heading "SERVICING INSTRUCTIONS".

Having adjusted the oscillator stage as outlined above on all active channels, the chassis now can be returned to the case and the antenna connected. Either the rod antenna or a wire antenna up to ¼ wave in length may be used. (The length in feet of a ¼ wave antenna is equal to 246 divided by the frequency in megacycles.) Simultaneous loading of the p-a stage, and tuning of the p-a stage and the antenna, can now be carried out. The method of adjustment is the same irrespective of which antenna is used, except that if the equipment is to be used for portable operation the final trimming of the p-a tuning and loading adjustments should be made with the transmitter-receiver raised a few feet off the ground, otherwise these adjustments will be affected when the equipment is transferred to the operator's back. Also, for fixed, or semi-fixed operation, using either the rod or the wire antenna, a ground connection should be made to one of the bolts provided in the bars under the case, to increase the efficiency of the antenna, and so radiate a maximum of r-f power.

The transmitter tuning condenser should be set at 0 and the COUPLING control set at position 1. Select one of the active channels and press the microphone button. Quickly rotate the tuning condenser in a clockwise direction until the p-a plate current reaches a minimum value (read with the meter switch on TRANS TUNE.) Now further advance the COUPLING control a step at a time, manipulating the tuning condenser after each step to obtain resonance — i.e. minimum plate current. It will be found that as this process is continued the plate current at resonance increases, indicating that the p-a valve is being loaded. The transmitter will deliver rated power to the output circuits when the p-a plate current lies in the range 25 to 35 ma.

The unit should not be operated for long periods either with the output circuit out of resonance or with the p-a plate current in excess of 40 ma, as this may seriously shorten the life of the valve. Therefore, continue to advance the COUPLING control until a p-a plate current of between 25 and 35 ma is obtained after having obtained resonance with the main tuning condenser. When this condition has been reached the transmitter is ready for operation on this frequency, and the adjustments will not change appreciably unless the length of the antenna is changed.

The procedure outlined above should now be repeated for the other two channels if these are to be used.

The main points to be borne in mind when tuning and operating the transmitter are:—

(1) The filament voltage should be maintained at 2.15 volts.
(2) Tuning always should be commenced with the COUPLING and tuning controls at the low end of their scales.

(3) Adjustment of the COUPLING control should be such that the tune point can be found within the range of the tuning condenser and that this tune point does not occur exactly at either maximum or minimum capacity.

(4) Normal plate current with the output circuit in tune should not exceed 40 ma — normally between 25 and 35 ma.

(5) Retuning must be carried out every time the frequency and/or the antenna length is changed.

In order to facilitate the rapid setting up of any frequency with a given antenna, it is suggested that a small chart be made and filled in, at this time, listing the settings of the two controls on each frequency, and recording the length of antenna in use.

ROUTINE OPERATION

Once the transmitter section of the equipment has been properly tuned with a given antenna length and on given frequencies in accordance with the description in the preceding section, the routine operation of the unit is very simple.

When fixed or semi-fixed station operation is desired, set the transmitter-receiver and the batteries in the desired operating location, open the doors of the transmitter-receiver case and bring the appropriate battery cable into it through the opening in the bottom of the case. Connect it and the Microphone-Headset Assembly to their respective sockets. Erect the rod antenna or the single wire antenna, as required, and connect on a ground wire. Move the power switch to ON and manipulate the receiver tuning and volume controls to receive the desired signal.

To transmit on Phone, press the microphone button and check that the meter reads 2.15 volts in the TRANS FIL position of the meter switch and between 25 and 35 ma in the TRANS TUNE position (The transmitter tuning controls having first been set for the required frequency). Talk into the microphone at an average room level, holding it at right angles to, but close to, the lips. Release the button again to receive.

To transmit on c-w, plug the cable from the key into the KEY jack, move the SEND-RECEIVE switch to SEND, and proceed with the transmission. Return to RECEIVE when the transmission is completed. (Note that the key cable must be removed from its jack for Phone transmissions, otherwise the modulator valves will be inoperative.)

For portable operation of the equipment, the light duty battery is plugged-in, and the Microphone-Headset cable taken out through the aperture in the bottom of the case. Before setting out, the rod antenna should be extended to the required height and the tuning adjustments of both the transmitter and receiver sections made for the desired frequencies as for fixed station operation above. As previously stated, for portable operation the final adjustments should not be made with the unit resting directly on the ground. The tuning dials then may be locked in position, the doors of the case closed, and the canvas covering secured in place.

When the site of desired operation is reached, pull out the knob of the ON-OFF switch in the bottom of the case to apply battery voltage to the unit. The receiver now will be operative. To transmit, press the button on the microphone, releasing it again to receive.

If the unit is to be operated continuously for a long period, occasional checks on the transmitter filament voltage should be made, as the transmitter output power falls off rapidly with small decreases in filament voltage. These checks can be made most conveniently by an assistant.

A change of frequency to either the transmitter or the receiver will also have to be made by an assistant unless the operator removes the unit from his back.

When the equipment is no longer needed, the battery should be conserved by pushing in the operating knob of the ON-OFF switch, and so opening the battery circuit.

SERVICING INSTRUCTIONS

BATTERY REPLACEMENT

The combination "A" and "B" battery packs should be replaced when the "B" voltage falls to 120 volts or when the "A" voltage falls to about 2 volts, whichever occurs first.

The "C" battery mounted on top of the transmitter-receiver chassis should be checked periodically with a high resistance voltmeter, and replaced when the voltage at its 4.5 volt tap drops below 3 volts. Such replacement should not be necessary more than once every three months or so, providing it is fresh when installed, and depending considerably on the service hours and climatic conditions to which the unit is subjected.

TRANSMITTER SECTION

The valves in the transmitter section should be checked periodically using a reliable tube checker or by replacing them, one at a time, by ones known to be good, and noting the resulting operation for possible improvement. Apart from valves, little trouble is likely to be experienced with the transmitter section since all tuned circuits can be kept adjusted quite readily in the manner outlined under "Preliminary Adjustments".

The contacts of the telephone-type relay should be cleaned periodically using a "contact burnisher" as employed in the telephone industry.

Should accurate neutralizing of the p-a stage ever be considered necessary, the following procedure should be employed:

Connect a resistance of from 30 to 40 ohms between the antenna terminal and ground and tune the transmitter in the usual way into this dummy load on the highest frequency. Now plug the key cable into the key jack, leaving the key contacts *open* and connect a 0–120 ma, r-f meter in series with the dummy load resistance. If the transmitter is properly neutralized, the

current indicated by the meter will not be more than 10 milliamperes. If it is higher than this value, use a long bakelite screwdriver or socket wrench to adjust the neutralizing condenser, C31, until the load current reaches a minimum. The transmitter tuning dial should be rocked back and forth through the tune point during this adjustment to ensure that the p-a stage is kept in tune.

RECEIVER SECTION

A good check on the operation of the receiver section is provided by voltage measurements at various points in the circuit. All voltages should be taken to ground, unless otherwise specified, with a 1000 ohms-per-volt voltmeter and should be within plus or minus 10% of the voltages given below. New batteries should be used for this check. When checking voltages at other points than those given, allowances should be made for voltage drop through resistances and transformer coils.

Pin #3 of Power plug	180	volts
Pin #4 of Power plug	135	"
Pin #2 of Power plug	3	"
Across Pin #2 and Pin #7 of V1 to V6 inclusive	1.5	"
Junction of R31 and C26	100	"
Pin #4 of V1 and V3	88	"
Pin #3 of T2	0.8	"
Pin #6 of V2 (oscillator working)	60	"
Pin #6 of V2 (oscillator not working)	62	"
Pin #3 of V4 (switch S1 on C.W.)	27	"
Pin #3 of V5	32	"

COMPLETE ALIGNMENT

The necessary equipment for complete alignment of the receiver includes an accurately calibrated signal generator and a good quality output meter capable of reading 10 milliwatts across a 20,000 ohm load.

Proceed as follows:—

Connect the signal generator, by means of two short leads, to chassis and the grid of the 1A7GT/G valve at the gang condenser. The high side of the signal generator should have a .1 or .05 uf. condenser in series with the lead.

Connect the output meter to pins Nos. 1 and 4 of the AUDIO connector with the Microphone-Headset assembly disconnected. The controls should be set as follows:

ON-OFF switch in ON position.
SEND-RECEIVE switch in RECEIVE position.
PHONE-C.W. switch in PHONE position.
Panel volume control full clockwise.
Dial at 5.8 megacycles.
Center section of gang shorted to ground.

Set the signal generator to exactly 455 kc and adjust iron cores in T4 and T6 for maximum output. The overall sensitivity of the i-f amplifier can now be measured and should be 70 microvolts for 10 milliwatts out, if the signal generator is reliable and the output meter matched to the output transformer, i.e., approximately 17,000 ohms. The selectivity of the i-f channel should be such that signals are 40 db down, at 14 kilocycles off resonance.

For checking purposes the high side of the signal generator may be transferred to the grid of the 1P5GT/G i-f amplifier. Here an input of 4500 microvolts should give an output reading of 10 milliwatts.

After the i-f amplifier has been accurately adjusted, the PHONE-C-W switch should be turned to c-w and the core in the BFO transformer T5 adjusted to give a 1000 cycle beat with the i-f signal. This can best be adjusted by taking the modulation off the i-f signal from the signal generator.

The r-f detector and oscillator circuits may be adjusted now.

Connect the high side of the signal generator to the antenna connector through a 100 uuf condenser and the other side to any convenient point on the chassis. Leave controls as given above but remove the short from the gang condenser.

Set the receiver dial and signal generator to 5.8 megacycles modulated 30% at 400 cycles. Adjust the trimmer condensers C2, C4, and C9 for maximum output; these are mounted on the gang condenser. Considerable care must be taken in these adjustments to see that all three circuits are in tune. It will be found necessary to rock the gang condenser back and forth across the signal when adjusting the antenna and detector trimmers C2 and C4 respectively. Now set the signal generator and receiver dial to a frequency of 3.2 megacycles modulated 30% at 400 cycles and adjust the iron cores in transformers T1, T2, and T3 for maximum output.

The above adjustments should be repeated until the correct adjustments of the cores do not affect the correct adjustments of the trimmer condensers.

When the receiver has been correctly adjusted the overall sensitivities at 3.2, 4.6 and 5.8 megacycles should be 4, 5 and 6 microvolts respectively for 10 milliwatts out. These figures will vary however, depending on the type of signal generator being used, so that if the sensitivities are approximately as above, the receiver should be considered correctly adjusted.

When replacing valves which are used in any part of the receiver circuit that has a tuning adjustment associated with it, that particular adjustment should be checked for maximum sensitivity. This may be done without a signal generator by adjusting for maximum noise level. However, the use of a signal generator is strongly recommended when at all possible. When the 1A7GT/G converter valve is changed it is necessary to trim the receiver at 5.8 megacycles, as previously outlined, to compensate for variations in valve capacities.

SISTORS

cuit bol	Specification	Type No.	
	100,000 ohms 10% ½ watt	Marconi	931-104
	15.0 ohms 5% ½ watt	I.R.C.	BW-½
	15.0 ohms 5% ½ watt	I.R.C.	BW-½
	220,000 ohms 10% ½ watt	Marconi	931-224
	22,000 ohms 10% ½ watt	Marconi	931-223
	100,000 ohms 10% ½ watt	Marconi	931-104
	47,000 ohms 10% ½ watt	Marconi	931-473
	30 ohms 5% ½ watt	I.R.C.	BW-½
	47,000 ohms 10% ½ watt	Marconi	931-473
	100,000 ohms 10% ½ watt	Marconi	931-104
	Dual Variable, 1 section 500,000 ohms, other section 2 megs.	Marconi	95192
	22,000 ohms 10% ½ watt	Marconi	931-223
	10,000 ohms 10% ½ watt	Marconi	931-103
	1.0 megs 10% ½ watt	Marconi	931-105
	3.0 megs 5% ½ watt	I.R.C.	BT-½
	220,000 ohms 10% ½ watt	Marconi	931-224
	Dual Variable, 1 section 500,000 ohms, other section 2 megs	Marconi	95192
	30 ohms 5% ½ watt	I.R.C.	BW-½
	1.0 megs 10% ½ watt	Marconi	931-105
	2.2 megs 10% ½ watt	Marconi	931-225
470	~~4700~~ ohms 10% ½ watt	Marconi	~~931-472~~ 931-471
	10,000 ohms 10% ½ watt	Marconi	931-103
	47,000 ohms 10% ½ watt	Marconi	931-473
	40,000 ohm multiplier part of M-1		
	980 ohm multiplier part of M-1		
	2.22 ohm shunt part of M-1		
	47,000 ohms 10% ½ watt	Marconi	931-473
	47,000 ohms 10% ½ watt	Marconi	931-473
	1.0 ohms	Marsland	107-252
	6.0 ohm Rheostat	Marconi	91084
	5000 ohms 5% 5 watt	Marconi	MA

NDENSERS

0.01 mf 300 WV	Marconi	914-103
Trimmer, Part of C3		
132.5 mmf Variable	Marconi	95190
Trimmer, Part of C5		
Second Section of C3		
0.01 mf 300 WV	Marconi	914-103
100 mmf 500 WV	Marconi	914-101
100 mmf 500 WV	Marconi	914-101
Trimmer, Part of C10		
3rd Section of C3		
1120 mmf 1% 500 WV	Aerovox	1464
0.1 mf 200 WV	Marconi	109-016M
90 mmf 2% 500 WV	Aerovox	1469
35 mmf 2% 500 WV	Aerovox	1469
100 mmf 500 WV	Marconi	914-101
100 mmf 500 WV	Marconi	914-101
120 mmf 2%	Aerovox	1469

PARTS LIST

Circuit Symbol	*Specification*	*Type No.*	
C18	7.5 mmf 5%	Aerovox	1469
C19	35 mmf 2% 500 WV	Aerovox	1469
C20	90 mmf 2% 500 WV	Aerovox	1469
C21	.1 mf 200 WV	Marconi	109-016M
C22	1000 mmf 500 WV	Marconi	914-102
C23	160 mmf 500 WV	Marconi	914-101
C24	0.01 mf 300 WV	Marconi	914-103
C25	0.02 mf 400 WV	Marconi	911-203
C26	12 mf 150 WV	Marconi	109-018B
C27	0.2 mf 400 WV	Marconi	911-204
C28	320 mmf Variable	Hammarlund	MC325-M
C29	1000 mmf 500 WV	Marconi	914-102
C30	1000 mmf 500 WV	Marconi	914-102
C31	25 mmf Variable	Marconi	109-093B
C32	100 mmf 500 WV	Marconi	914-101
C33	1000 mmf 500 WV	Marconi	914-102
C34	140 mmf Variable	Marconi	109-093E
C35	140 mmf Variable	Marconi	109-093E
C36	140 mmf Variable	Marconi	109-093E
C37	.5 mf 600 WV, Dual, One Section	Marconi	109-017C
C38	.5 mf 600 WV, Other Section of C37		
C39	0.01 mf 300 WV	Marconi	914-103
C40	0.01 mf 300 WV	Marconi	914-103

TRANSFORMERS

T1	Rec. Antenna Transformer	Marconi	95216
T2	Rec. Detector Transformer	Marconi	95200
T3	Rec. Oscillator Transformer	Marconi	95193
T4	1st I.F. Transformer	Marconi	95178
T5	B.F.O. Transformer	Marconi	95211
T6	2nd I.F. Transformer	Marconi	95183
T8	Transmitter Modulation Transformer	Marconi	89459
T9	Transmitter Coupling Transformer	Marconi	89458
T10	Transmitter Microphone Transformer	Marconi	89460

INDUCTANCES

L1	Transmitter Loading Inductance	Marconi	90666
L2	R.F. Choke	Marconi	110-097F
L3	R.F. Choke	Marconi	110-097F
L4	Plate Coil	Marconi	90687
L5	Filament Choke	Marconi	95207

SWITCHES

S1	Switch 4 Pole 2 Position	Marconi	95191
S2	Part of L-1		
S3	Switch 3 Pole 3 Position	Marconi	91083
S4	Switch 3 Pole 3 Position	Marconi	91083
S5	Switch Toggle D.P.D.T.	Marconi	109-032B

VACUUM TUBES

V1	Tube	RVC	1P5GT/G
V2	Tube	RVC	1A7GT/G
V3	Tube	RVC	1P5GT/G

PARTS LIST

Circuit Symbol	*Specification*	*Type No.*	
V4	Tube	RVC	1G4GT/G
V5	Tube	RVC	1H5GT/G
V6	Tube	RVC	1Q5GT/G
V7	Tube	RVC	1J6G
V8	Tube	RVC	1H4G
V9	Tube	RVC	1J6G
V10	Tube	RVC	1F5G

MISCELLANEOUS

M1	Meter Assembly	Marconi	90910
E1	Relay 35 Ohm Coil, Code #4 Contacts	C. P. Clare	Type C
CC-1	Audio Cable Connector Socket	Amphenol	PC4F
CC-2	Power Cable Connector Plug	~~Amphenol PC4M~~ MARCONI	132-140B
J-1	Key Jack	Marconi	125-108
	Microphone-Headset Assembly	Marconi	91184
	Key, Morse	Signal	Type R-48
	Crystal Sockets	Marconi	131-085B
	Valve Sockets	Marconi	109-061A
	Tube Shield	"Goat"	#G-1222K
	Shield Ring	"Goat"	#G-691D
	Shield Ground Clip	"Goat"	#G-1004
	Grid Clips	Marconi	109-078A
	Light Duty Battery Cable	Marconi	111-277
	Cable for Battery Box (When Used)	Marconi	90906
	Key Cable Assembly	Marconi	90937
	C Battery	C. N. Carbon	Type 771
	Heavy Duty Pack Battery (When Used)	General	120D8L2
	Battery Box Assembly (When Used)	Marconi	88476

THE FOLLOWING ITEMS ARE USED WITH PN1A EQUIPMENTS ONLY

S6	Switch	Marconi	99829
T7	Transformer	Marconi	89528
	Harness	Marconi	90597
	Antenna Assembly	Marconi	99385
	Light Duty Pack Battery	General	120A4L2

THE FOLLOWING ITEMS ARE USED WITH PN1B EQUIPMENTS ONLY

S6	Switch Toggle DPST	Marconi	109-032A
S7	Switch Toggle DPDT	Marconi	109-032B
T7	Transformer	Marconi	116-745
Spkr.	Speaker	Oxford	3-CM-S
	Speaker Connectors — TIP Jack	I.C.A.	#889-B
	Speaker Connectors — Plug, Solderless	I.C.A.	#885-B
	Battery Cable Assembly	Marconi	110-734
	"A" Battery (2 req'd)	Eveready	#6 Drycell
	"B" Battery (4 req'd)	Eveready	#386

(1) RECEIVER INTERMEDIATE FREQUENCY 455 KC.
(2) ▼ DENOTES CHASSIS.
(3) FOR RESISTOR & CONDENSER LIST SEE Dwg. # 141-206-L
(4) ⌇ DENOTES PERMEABILITY TUNED.

WIRE LEGEND

ALL WIRES TO BE # 20 FLEX., UNLESS OTHERWISE SPECIFIED

"A" - RED -
"B" - BLUE -
"C" - WHITE -
"D" - BLACK -
"E" - GREEN -
"F" - BLACK - BROWN -
"G" - RED - ORANGE -
"H" - BLK - GREEN -
"J" - RED - BLACK -
"K" - GRN - BROWN -
"L" - BLUE - GREEN -
"M" - GREEN - RED -
"N" -
"O" - # 18 14 - BARE TINNED CU. WIRE
"P" - # 20 " " " "
"Q" - RED - BROWN -
"R" - BLUE - RED

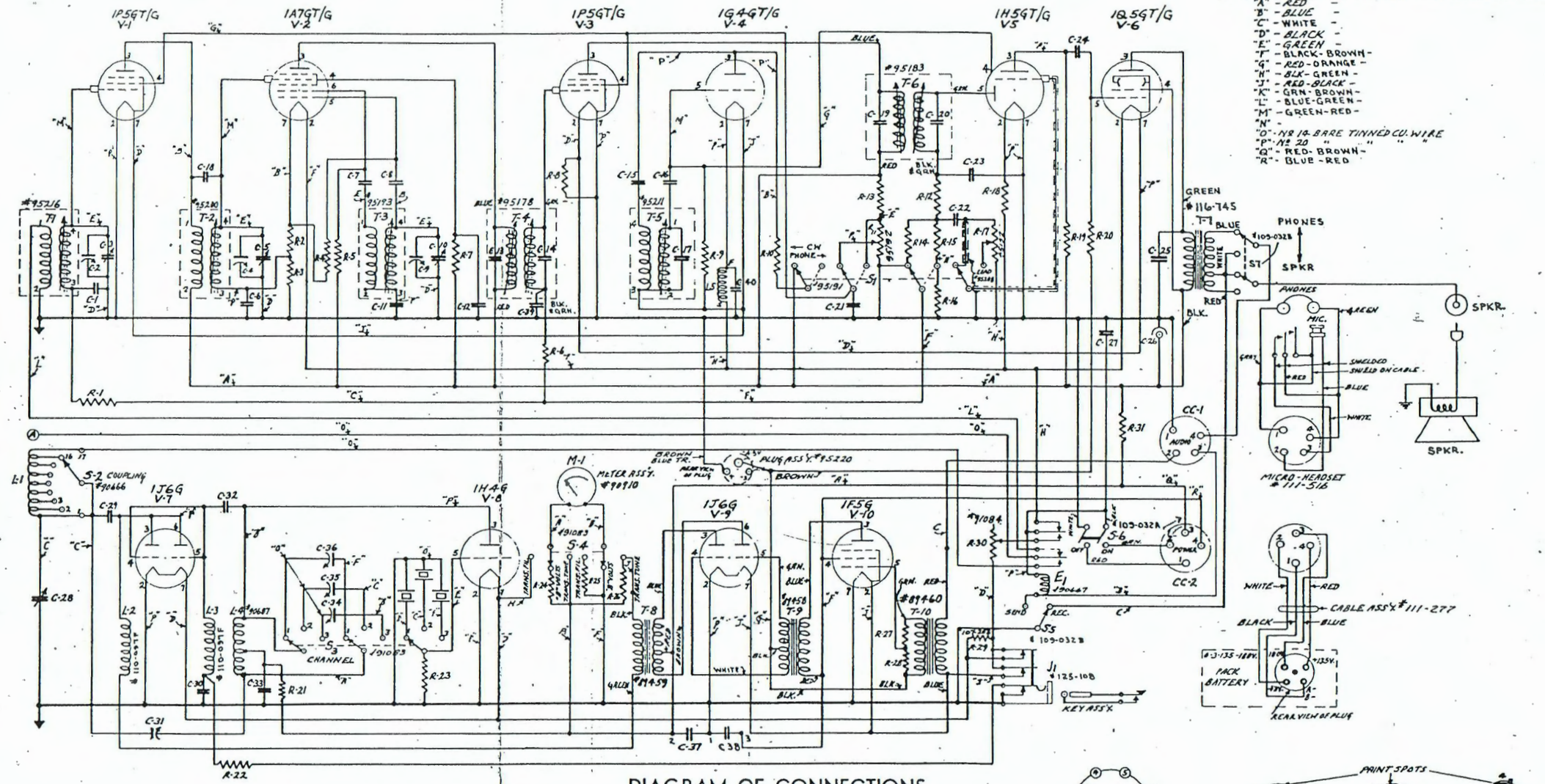
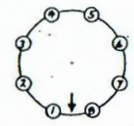


DIAGRAM OF CONNECTIONS

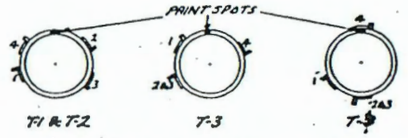
PN1B TRANSMITTER

RECEIVER

TYPE 118-980



BOTTOM VIEW OF ALL VALVE SOCKETS



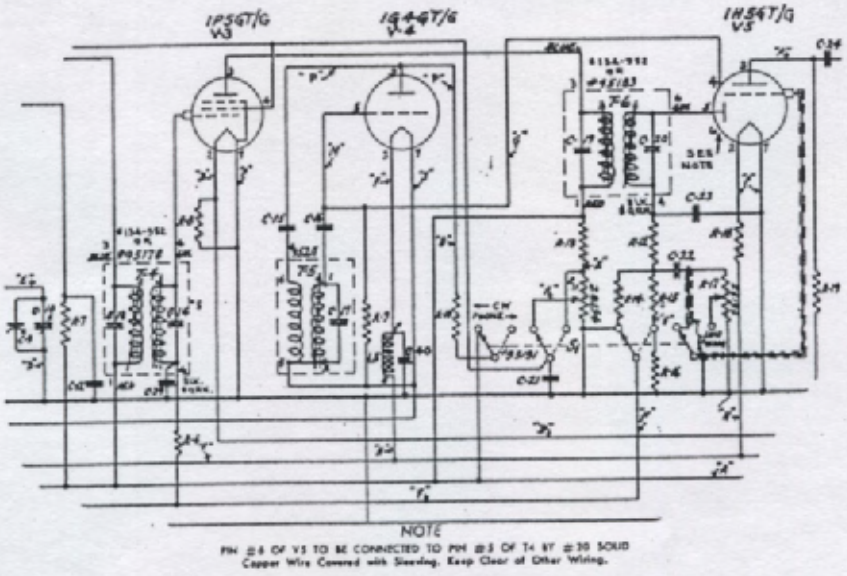
BOTTOM VIEW OF REC. COILS

ADDENDUM #1 TO FOLDER #131-666
INSTALLING AND OPERATING INSTRUCTIONS FOR MARCONI TRANSMITTER-RECEIVERS TYPES PN1A and PN1B

The following modifications have been incorporated in the latest productions of the PN1A — PN1B Transmitter-Receivers. This has been done to further improve the stability and performance of these equipments. The changes in question have been made in the receiver section, and will appear in all equipments manufactured after September 21, 1949.

The modifications are as follows:—

1. Condenser C12 becomes 0.05 mf + — 20% 400 W. V., Marconi #911-503.
2. A connecting link has been added between Pin #6 on V5, and Pin #5 on T4. This link is used as a regeneration adjustment, being bent slightly to increase or decrease sensitivity.
3. Transformers T4 and T6 have each been replaced by Marconi Type #134-952 connected as shown below.



ADDENDUM #2 TO FOLDER #131-666

INSTALLING AND OPERATING INSTRUCTIONS FOR
MARCONI TRANSMITTER-RECEIVERS TYPES PN1A AND PN1B.

The following should be noted when ordering spare or replacement components for PN1A and PN1B equipments:

In equipments manufactured prior to Sept.21, 1949, in which the transformer T4 is Marconi type 95178, and the transformer T6 is Marconi type 95183, the condensers C13 and C20 are 90mmf ±2%, 500WV, Aerovox type 1469, C14 and C19 are 35mmf ±2%, 500WV, Aerovox type 1469, C25 is 0.02 mf, 400WV, Marconi type #911-203, and the regenerative coupling link referred to in Modification #2 of Addendum #1 to these Instructions is not used.

In equipments manufactured after Sept.21, 1949, in which transformers T4 and T6 are Marconi type 134-552, as described in Modification #3 of Addendum #1, the condensers C13, C14, C19 and C20 are all 120 uuf ±5%, 500WV, Marconi type 914-121, C25 is eliminated, and the regenerative link is added.

When spare or replacement parts are being ordered for the condenser C12, Marconi type #911-503, referred to in Modification #1 of Addendum #1 may be specified and used in all PN1A and PN1B equipments. Marconi type 109-016M is suitable as a replacement for C12 only in those equipments manufactured prior to Sept.21, 1949, however.

Apr. 18, 1950.