

changes in the master oscillator and power amplifier circuits to alter the frequency range of some tuning units.

NOTE.—There is no BAND CHANGE SWITCH A control on transmitter tuning units TU-7-A or -B to TU-10-A or -B.

(2) The master oscillator tuning control marked B M. O. TUNING is located in the upper left part of the tuning unit panel. It is used to tune the tank circuit of the master oscillator. The control consists of two dial mechanisms and a lock. The dial mechanism used to select the desired frequency also acts as a vernier and is divided into 100 divisions. The flat, fully exposed circular scale located to the left of the dial lock has 25 divisions and indicates hundreds, while the so-called vernier indicates tens and units, as related to the column marked B on the CALIBRATION CHART. For example, to set the control for 2,000 kilocycles when using tuning unit TU-5-A or -B, look under column B on the CALIBRATION CHART for the number opposite 2,000 kilocycles. If it happens to be 1,250, proceed as follows:

- (a) Unlock LOCK control by turning counterclockwise.
- (b) Rotate knurled knob at right of LOCK control. This will cause the round flat scale to revolve. Rotate in the direction which will bring the graduation on the round flat scale for 12 (two graduations above 10) directly under the marker.
- (c) Slowly rotate knurled knob again, this time observing the numbers on its surface. When 50 is reached, stop.
- (d) Check round scale again. It should read midway between 12 and 13.
- (e) Lock control by turning LOCK knob clockwise. The control is now set at 1,250.

(3) The power amplifier tuning control located in the upper right corner is marked C P. A. TUNING. This control is used to tune the tank circuit of the power amplifier. It also is provided with a lock to hold its final setting. The dial calibrations are referred to in column C of the CALIBRATION CHART.

(4) The antenna coupling switch located in the lower right corner of the panel is marked ANT. COUPLING SWITCH D. It has six positions for selecting a different tap on the antenna coupling coil.

(5) Behind the CALIBRATION CHART is the control for the neutralizing capacitor. (See pars. 8 and 35b.) It is not adjusted in the normal operation of the transmitter.

13. Adjustments prior to operation.—Determine from the Technical Manual for the radio set of which the transmitter is a component the type of power supply equipment which will be used.

Paragraph 4 describes the several types of equipment authorized for use with this transmitter.

a. Filament circuit switches, d-c operation.—On the panel behind the vacuum tubes in the tube compartment are several knobs and switches. (See fig. 4.) Between tubes four and five (counting from the VT-25 at the left end) there are two switches, the 12V. 14.2V. switch and the A-C D-C switch. The proper operating position of these switches is determined by the power supply equipment used. Place the A-C D-C switch in the D-C position when using a battery-driven dynamotor or an internal combustion engine-driven generator for power supply. Operate the 12V. 14.2V. switch in the 14.2V. position when the power supply is a battery-driven dynamotor in which the battery is on charge while the equipment is in operation (a condition existing in virtually all vehicle and aircraft installations). Move the switch to the 12V. position when using a battery-driven dynamotor supply in which the battery is not on charge. When the transmitter is used with the engine-driven generator power supply, a fairly long connecting cord is used between the generator and the transmitter. The resistance of this cord and the resultant voltage drop are sufficiently high to require operation with the 12V. 14.2V. switch in the 12V. position, even though the generator output is 14.6 volts. The adjustment of the filament circuit for this condition is explained in paragraph 15.

b. Filament circuit switches, a-c operation.—Set the A-C D-C switch in the A-C position and the 12V. 14.2V. switch in the 14.2V. position when the transmitter is operated with a rectifier type power supply from a 110- to 120-volt a-c power source.

14. Filament voltage adjustment, d-c operation, storage battery-dynamotor supply.—When operating the transmitter from a storage battery-dynamotor power supply with battery on charge (the normal condition in vehicles and aircraft), adopt the following procedure of filament voltage adjustment:

a. Interconnect all cording between the transmitter and the dynamotor (*except the high voltage cords to sockets PL-59*). Place the transmitter OFF ON switch at OFF. If a radio control box is used, place its OFF ON switch at OFF. Now connect the two cables from the dynamotor to the storage battery. Be certain that proper polarity is followed in doing this.

b. Have the vehicle engine turning over so that the battery is charging.

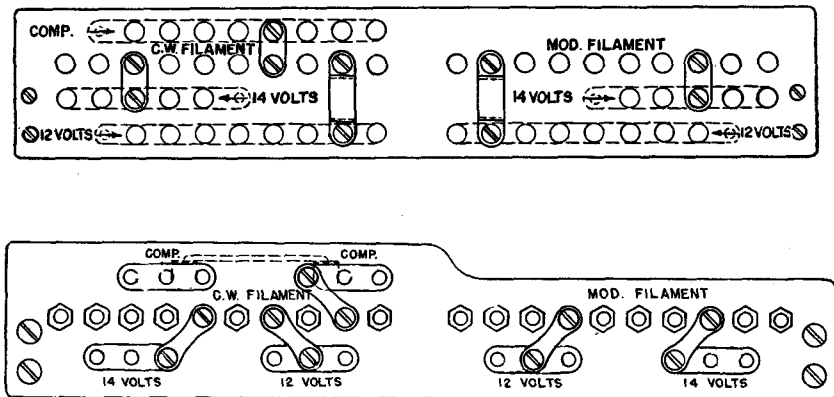
c. Remove the front cover from the tube compartment and place the A-C D-C switch in the D-C position. Also remove the 16 screws which fasten the transmitter top and remove the top.

d. At the top left of the tube compartment is the filament resistor connection board. (See fig. 4.) On the left end of the board are four rows of studs, beginning at the top of the board, labeled as shown in figure 5: COMP., C. W. FILAMENT, 14 VOLTS, and 12 VOLTS. (COMP. is abbreviation for compensator.) On the right are three rows of studs, MOD. FILAMENT, 14 VOLTS and 12 VOLTS. Links connect together the various rows of studs. Remove all links by unscrewing the holding screws.

e. Set 12V. 14.2V. switch in the 14.2V. position; set TONE C. W. VOICE switch in the C. W. position; and set C. W. FIL. MOD. FIL. switch in the C. W. FIL. position.

f. Set transmitter OFF ON switch in the ON position. This should start the dynamotor.

g. With a screw driver or short piece of wire W-128 (or larger), make a connection between the extreme left stud on the C. W. FILAMENT row and the stud on the 14 VOLTS row directly under it. The master oscillator and power amplifier tube filaments (two of the VT-4-C tubes) should light and the FIL. VOLTAGE meter should give a reading. Progress to the right, stud by stud, until a connection between rows of studs is found that causes the FIL. VOLTAGE meter to read about 10.5 volts.



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FIGURE 5.—Radio transmitter BC-191-(*), filament resistor connection board.

h. Set transmitter OFF ON switch in OFF position and connect one of the short links between the two studs just located, screwing it down securely.

i. Set TONE C. W. VOICE at VOICE, and C. W. FIL. MOD. FIL. switch on MOD. FIL. position.

- j.* Set OFF ON switch at ON.
- k.* In a manner similar to that described in *g* above, begin at the extreme right end of the MOD. FILAMENT row and successively make connections to the stud directly beneath on the 14 VOLTS row until a connection is found that will cause the FIL VOLTAGE meter to read about 10.5 volts.
- l.* Set the OFF ON switch in the OFF position and connect a short link between the two studs.
- m.* Set the C. W. FIL. MOD. FIL. switch on C. W. FIL.
- n.* Set the OFF ON switch to the ON position.
- o.* The continuous wave filament voltage will now be less than 10 volts. Using the method described in *g* above, but starting with the first stud to the right of the connection made in *g*, and moving to the right, determine a stud on the COMP. row and one on the C. W. FILAMENT row directly below which will cause the FIL. VOLTAGE meter to read about 10.5 volts.
- p.* Set the OFF ON switch in the OFF position and connect a short link between the two studs, screwing it down securely.
- q.* Shut off the vehicle's engine, so that the battery is no longer on charge.
- r.* Set the 12V. 14.2V. switch in the 12V. position, the TONE C. W. VOICE switch on C. W. and the C. W. FIL. MOD. FIL. switch on C. W. FIL.
- s.* Place the OFF ON switch in the ON position and allow the battery voltage to fall to a steady value on the FIL. VOLTAGE meter. It will be less than 10.5 volts. With a short piece of wire, beginning at the right end of the C. W. FILAMENT row, successively connect between a stud on the C. W. FILAMENT row and the stud directly below it on the 12 VOLTS row, working to the left, stud by stud until a connection is found which gives a reading of about 10.5 volts on the FIL. VOLTAGE meter.
- t.* Set OFF ON switch at OFF and connect a link between the two studs, securing it with the screws.
- u.* Set TONE C. W. VOICE switch on VOICE and C. W. FIL. MOD. FIL. switch on MOD. FIL. Place OFF ON switch at ON.
- v.* Starting at the left end of the MOD. FILAMENT and 12 VOLTS rows, and using the method described in *s* above, successively move to the right until a connection is found that will cause a reading of about 10.5 volts on the FIL. VOLTAGE meter.
- w.* Place OFF ON switch at OFF. Connect the link remaining between the studs just located.
- x.* Place 12V. 14.2V. switch in 14.2V. position once more.
- y.* Replace transmitter top and front cover of tube compartment.

z. The filament voltage is now adjusted so that the filament voltages will not require readjustment if the transmitter mode of operation is changed through TONE C. W. and VOICE in a given installation. If the charging generator, the storage battery, or the dynamotor is replaced or if the length of the power cords is changed, the adjustment indicated in *a* to *y* above must be repeated.

15. Filament voltage adjustment, d-c operation, gas engine-generator supply.—When operating this transmitter with a gasoline engine-generator type of power supply equipment in the field, where cord lengths of 100 feet or more are used to connect the power equipment to the transmitter, adapt the following procedure for filament voltage adjustment:

a. Interconnect all cording (*except the high voltage cord to sockets PL-59*) between power equipment and transmitter. Make sure OFF ON switch on transmitter and on control boxes (if used) is set at OFF.

b. Start power equipment, following instructions in the set or power unit Technical Manual. Allow it to operate for 5 to 10 minutes (preferably with a battery on charge across it) to be sure that a stable operating point of 14.6 volts is reached, as read on a voltmeter across the battery terminals or on the voltmeter in the power equipment itself.

c. Remove front cover from transmitter tube compartment, place A-C D-C switch in the D-C position and 12V. 14.2V. switch in the 12V. position. Also remove the 16 screws which fasten the transmitter top and remove the top.

d. At the top left of the transmitter is the filament resistor connection board. (See fig. 4.) On the left end of the board are four rows of studs labeled as shown in figure 5, beginning at the top of the board: COMP., C. W. FILAMENT, 14 VOLTS and 12 VOLTS. (COMP. stands for compensator.) On the right are three rows of studs marked MOD. FILAMENT, 14 VOLTS and 12 VOLTS. Links connect together the three rows of studs. Remove all links by loosening the holding screws with a screw driver.

e. Set TONE C. W. VOICE switch in the C. W. position and set C. W. FIL. MOD. FIL. switch in the C. W. FIL. position.

f. Connect a short link between a stud on C. W. FILAMENT row and stud directly under and at the extreme left end of the 14 VOLTS row.

g. Connect a short link between a stud on the MOD. FILAMENT row and the stud directly under at the extreme right end of the 14 VOLTS row.

h. Set transmitter OFF ON switch in the ON position.

i. With a screw driver or short piece of wire W-128 (or larger) make connections successively between studs on the C. W. FILAMENT row and studs on the 12 VOLTS row directly beneath, starting at the right end of the 12 VOLTS row. On each connection, the C. W. filaments should light and the FIL. VOLTAGE meter will give a reading. Progress to the left, stud by stud, until a connection is found that causes the meter to read slightly over 10 volts.

j. Set transmitter OFF ON switch in the OFF position and connect a link between the studs just located.

k. Set TONE C. W. VOICE switch on VOICE and C. W. FIL. MOD. FIL. switch on MOD. FIL. position.

l. Set OFF ON switch in the ON position.

m. In a manner similar to that described in *i* and *j* above, beginning at the left end of the 12 VOLTS row, connect a link between a stud on the MOD. FILAMENT row and the stud directly under on the 12 VOLTS row until a connection is found that will cause the FIL. VOLTAGE meter to read slightly over 10 volts.

n. Set transmitter OFF ON switch at OFF and connect a link between the studs just located.

o. Set C. W. FIL. MOD. FIL. switch on C. W. FIL.

p. Set OFF ON switch in the ON position.

q. The C. W. filament voltage will now be less than 10 volts.

r. In a manner similar to that described in *i* and *j* above, starting with the next stud to the right of the stud found in *f* above and working to the right, determine a connection between a stud on the COMP. row and one just below it on the C. W. FILAMENT row which will cause the FIL. VOLTAGE meter to read slightly over 10 volts.

s. Restore transmitter top and front cover to the tube compartment. As now adjusted, the filament voltages for the transmitter will not require readjustment if the mode of operation of the transmitter is changed through TONE C. W. and VOICE. However, if it is not possible to secure the above adjustment it will be necessary to readjust the output voltage of the power supply equipment. Consult the Technical Manual for the radio set or for the power supply equipment, if one has been issued.

16. Filament voltage adjustment, a-c operation.—When operating the BC-191-(*) transmitters from rectifier power supply equipment attached to a 110- or 220-volt a-c power source follow the procedure indicated below to adjust filament voltages.

a. Remove front cover from tube compartment on transmitter. Take out the 16 screws which hold the top plate and remove it. Set

A-C D-C switch at A-C, 12V. 14.2V. switch at 14.2V. and connect all power cords (*except the high voltage cord to sockets PL-59*) between power supply equipment and the transmitter.

b. Set transmitter OFF ON switch at OFF.

c. At the top left of the tube compartment is the filament resistor connection board (fig. 4). On the left half of the board are four rows of studs, marked as shown in figure 5: COMP., C. W. FILAMENT, 14 VOLTS and 12 VOLTS. (COMP. is an abbreviation for compensator.) Remove links connecting them by loosening the screws. Do not touch links and studs on the right half of the board. (When the A-C D-C switch is set at A-C, the studs on the right half are cut out of the circuit, making adjustment unnecessary.)

d. Place TONE C. W. VOICE switch at C. W. and C. W. FIL. MOD. FIL. switch in the C. W. FIL. position.

e. Set low voltage OFF ON power switch on the power supply equipment at ON. Set power equipment high voltage OFF ON switch at OFF.

f. Adjust filament voltage control on power equipment so that rectifier filament voltage meter reads 12 volts.

g. Turn TONE C. W. VOICE switch to VOICE. Leave C. W. FIL. MOD. FIL. switch at C. W. FIL. The filaments of all tubes should light. (On a-c operation, the transmitter OFF ON switch disconnects only the high voltage plate supply; it does not disconnect the filament voltage.)

h. Readjust the filament voltage control on the rectifier unit so that a reading of approximately 10.5 volts appears on the FIL. VOLTAGE meter on the transmitter.

i. Set TONE C. W. VOICE switch at C. W. All tube filaments should go out.

j. Using a screw driver or a short piece of wire W-128, make a connection between a stud at the left end of the C. W. FILAMENT row and one directly below it on the 14 VOLTS row.

k. Still maintaining this connection, take another short piece of wire, starting at the right end of the COMP. row, work to the left, stud by stud, successively connecting studs on the COMP. row and on the C. W. FILAMENT row directly beneath, until a connection is found that gives a reading of about 10.5 volts on the transmitter FIL. VOLTAGE meter.

l. If no connection will give this voltage reading, change the connection between the studs made in operation j above, moving the connection to the next set of studs to the right.

m. Now repeat operation *k* above with the second piece of wire, until a reading of 10.5 volts is secured. If voltage is still low, repeat operation *l* above, moving the connection to the next set of studs to the right and then repeating operation *k* above until the meter reads 10.5 VOLTS. When this adjustment is properly made, movement of the TONE C. W. VOICE switch through its three positions should cause practically no change in the reading of the FIL. VOLTAGE meter.

n. Turn off rectifier power supply equipment.

o. Replace temporary wire connections between studs with the short links provided.

p. Connect a link between the two studs at the right end of the C. W. FILAMENT and 12 VOLTS rows.

q. Replace top shield and tube compartment cover. This completes the adjustment. Minor voltage variations can now be adjusted for by use of the filament voltage control on the power supply equipment. If cording lengths are changed, or any major change made in the installation, repeat operations *a* to *p* above, if necessary.

17. Tuning.—*a. Preliminary checks.*—(1) Make certain that all power supply equipment is *turned off*. Check all cording to see that it follows the cording diagrams in the Technical Manual for the radio set. Set OFF ON switch at OFF.

(2) Connect high voltage cord into sockets PL-59 on the transmitter and power supply equipment.

(3) Connect antenna system to output terminal strip, following the diagrams in the radio set Technical Manual or the cording diagrams on the set chests. If transmission is to be made at frequencies of 800 kilocycles or lower, see *c*(7) below and figure 9 for method of connecting antenna tuning unit BC-306-A.

Caution: *When the power supply equipment is started or turned on, high voltage is present in the transmitter. BE CAREFUL!*

(4) Adjustment of the controls in the tube compartment can be made safely with high voltages connected, as there are no exposed high voltage elements, if all tubes are inserted in their sockets. Removal of the transmitter tuning unit from the transmitter operates the safety interlock switch 1102 (fig. 4) which disconnects all voltages from the transmitter.

(5) The transmitter can be operated for continuous wave telegraph, tone or voice transmission. *Adjust transmitter initially for continuous wave transmission.* Before the power is turned on, tune the transmitter approximately as described in (6) below.

care should be exercised to protect the equipment from direct rain and conditions of unusually high humidity. At all times when not in use, the components should be made secure in their respective chests and covers.

25. Storage.—If the transmitter is to be removed for storage, cover or wrap it securely against dust, place it in a dry, protected location, and safeguard it against accidental damage. Inspect it frequently for dust and rust, and clean and repair if necessary.

SECTION III

FUNCTIONING OF PARTS

	Paragraph
General circuit.....	26
Radio transmitters BC-191-(*) and transmitter tuning units TU-3-A or -B, TU-5 to TU-10-A or -B, TU-22-A or -B and TU-26-A or -B.....	27
Antenna tuning unit BC-306-A.....	28

26. General circuit.—*a.* The transmitter, together with the transmitter tuning units, contains the circuit elements for continuous wave, tone, and voice transmission. With the various transmitter tuning units, the transmitter covers a frequency range of 200 to 800 and 1,500 to 12,500 kilocycles. During the explanation of the detailed functioning of the transmitter, it will be assumed that transmitter tuning unit TU-6-A or -B (3,000 to 4,500 kc.) is being used.

b. The circuits of the various radio transmitters BC-191-(*) are for all practical purposes identical. The radio frequency circuit is of the master oscillator, power amplifier type. The audio frequency circuit consists of a push-pull modulator which is driven by an audio amplifier. The transmitter utilizes a tube VT-4-C for the oscillator, a tube VT-4-C for the power amplifier, two tubes VT-4-C in push-pull for the modulator, and a tube VT-25 for the audio amplifier (speech amplifier). (See fig. 11.) For continuous wave transmission, only the master oscillator, power amplifier, and speech amplifier tubes operate. For tone and voice transmission, all tubes operate. The power amplifier operates class C; the modulator tubes in push-pull operate class B; the audio amplifier driver tube operates class A. Sufficient audio frequency power is obtained from the modulator tubes for plate modulation of the power amplifier on tone or voice transmission. Side tone for monitoring purposes is supplied from the speech amplifier during continuous wave, tone, and voice transmission.

27. Radio transmitters BC-191-(*) and transmitter tuning units TU-3-A or -B, TU-5 to TU-10-A or -B, TU-22-A or -B and TU-26-A or -B.—*a. Oscillator circuit.*—The master oscillator circuit is schematically illustrated in figure 12. The oscillatory

circuit by which the frequency of the transmitter is controlled is contained in the transmitter tuning unit being used. When the transmitter tuning unit TU-6-A or -B is employed and the BAND CHANGE SWITCH A is in position 2 (fig. 20), the oscillatory circuit comprises the tapped coil 601 and the variable capacitor 607. Moving the BAND CHANGE SWITCH A to position 1 places the fixed capacitors 603 and 613 in parallel with the variable capacitor 607 and enables this tuning unit to cover the lower ranges of its frequency band. Continuous adjustment of frequency is accomplished by means of the variable capacitor 607, control B. Controls, coil, and capacitors of the other transmitter tuning units (fig. 20) are arranged for similar operation on either one, three, or four bands, depending on the unit. In each tuning unit, both coils and capacitors are thermally compensated to reduce frequency variation due to normal changes in air temperature. Subsequent discussion of the master oscillator circuit is limited to the circuit shown in figure 12, which results when transmitter tuning unit TU-6-A or -B is used with BAND CHANGE SWITCH A on position 2. The radio frequency voltage across the lower half of the coil 601 provides the master oscillator grid excitation voltage. The coil is also tapped an equal number of turns on either side of the center tap. The grid excitation voltage for the power amplifier is furnished through capacitor 609. The master oscillator grid excitation voltage is obtained through capacitor 610, which also blocks the d-c plate voltage from the grid circuit. Resistor 1183 and choke 1184, in parallel, are connected in series with the grid of the master oscillator tube to prevent the generation of parasitic oscillations. The plate voltage for the master oscillator is fed to the tuning unit through radio frequency choke 1106, which, with capacitor 1105, prevents radio frequency current from flowing into the power supply. Resistors 1109 (three in series) function as the master oscillator grid leak which provides the required operating bias for the master oscillator tube from the rectified grid current. Part 1108 is a radio frequency bypass capacitor. Grid choke 611, in conjunction with resistors 1109, serves as the necessary d-c path from the grid to the filament, maintaining at the same time a high impedance to the radio frequency grid excitation voltage. Capacitor 1104 is the calibration reset by means of which the master oscillator tuning circuit can be adjusted to correspond to the calibration chart whenever the oscillator tube is changed. This capacitor is adjusted through a small port in the front panel to the right of TEST KEY. Capacitor 1103 is a sealed capacitor which provides the necessary thermal compensation for any frequency drift normally

caused during warming up or by variation of the temperature of the oscillator tube.

b. *Power amplifier circuit.*—(1) The power amplifier circuit is schematically illustrated in conjunction with the master oscillator circuit in figure 12. The power amplifier plate tank circuit, by means of which the plate load impedance is adjusted, is contained in the transmitter tuning unit. When the transmitter tuning unit TU-6-A or -B is employed and BAND CHANGE SWITCH A is in position 2, the plate tank circuit comprises the coil 621 and variable capacitor 627. Moving BAND CHANGE SWITCH A to position 1 places

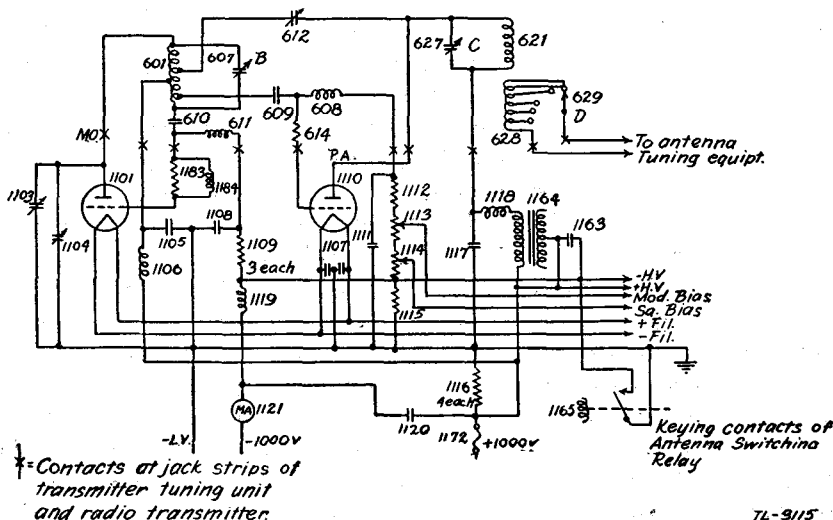


FIGURE 12.—Radio transmitter BC-191-(*), radio frequency and high voltage circuits—functional diagram.

the fixed capacitor 623 in parallel with the variable capacitor 627 and enables this tuning unit to cover its lower frequency range. Continuous frequency adjustment of the plate tank circuit is accomplished by means of the variable capacitor 627, control C. P. A. tuning controls, coil, and capacitors of the other transmitter tuning units are arranged for operation on either one, three, or four bands as mentioned in the discussion of the oscillator circuits in *a* above.

(2) Subsequent discussion of the power amplifier circuit is limited to the circuit shown in figure 12, which results when the transmitter tuning unit TU-6-A or -B is used with BAND CHANGE SWITCH A on position 2. The power amplifier grid receives excitation through capacitor 609 from the master oscillator tank coil. Capacitor 609 also keeps the master oscillator d-c plate voltage from the

power amplifier grid. The power amplifier negative grid bias is obtained from the flow of rectified grid current through resistors 614, 1112, 1113, and 1114. Choke 608 provides a low resistance path for the d-c grid current but a high impedance path at radio frequency.

(3) Plate voltage for the power amplifier is applied through the modulation transformer 1164, the radio frequency choke coil 1118, and the tank coil 621. The capacitor 1117, in conjunction with choke coil 1118, prevents radio frequency currents from flowing into the power supply. The neutralizing capacitor 612 in the tuning unit forms a part of a bridge circuit, including the power amplifier grid plate capacitance. Balancing this circuit by means of capacitor 612 prevents any interaction of the power amplifier on its grid input circuit, thus eliminating the possibility of self-oscillation of the amplifier. All transmitter tuning units are properly balanced or neutralized at the time of manufacture and should not require adjustment in service unless the setting is accidentally disturbed. The power amplifier is inductively coupled to the antenna circuit by means of a tapped inductor 628, the taps of which are selected by a panel-controlled tap switch 629, ANTENNA COUPLING SWITCH D. Sufficient variation in coupling is provided to allow operation into a wide range of antenna reactances.

c. Modulation.—Modulating voltage is applied to the plate circuit of the power amplifier by means of the modulating transformer 1164. The modulator tubes 1161 and 1162 are operated in a push-pull, class B circuit in which they are biased almost to plate current cut-off, drawing 20 milliamperes together. The modulator tubes receive excitation from the speech amplifier tube 1154, through an interstage transformer 1157. The secondary of this transformer is loaded by resistors 1181 to reduce the effective load variation caused by modulator grid current. Plate power for the speech amplifier is obtained from the positive high voltage supply through resistor 1156, which limits it to the proper value. Capacitor 1155 (1197b) serves as an audio frequency bypass for this power source. Receiver side tone for monitoring the transmitted signal is provided by a tapped winding on the interstage transformer 1157. Switch 1179 selects the proper tap on this transformer winding to give the proper side tone level if this feature is used.

d. Tone, continuous wave, and voice operation.—(1) The TONE C. W. VOICE switch, 1141 (fig. 11), serves to select the desired type of transmission. It performs the following functions:

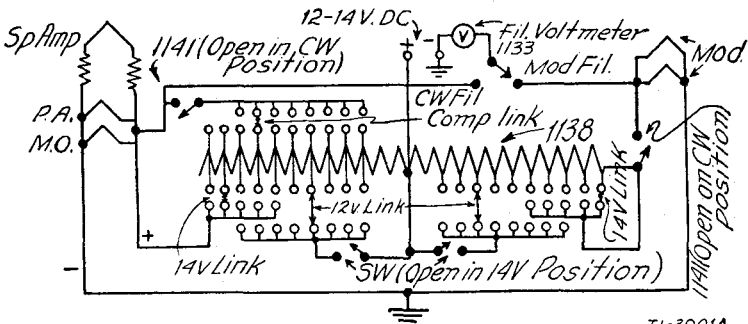
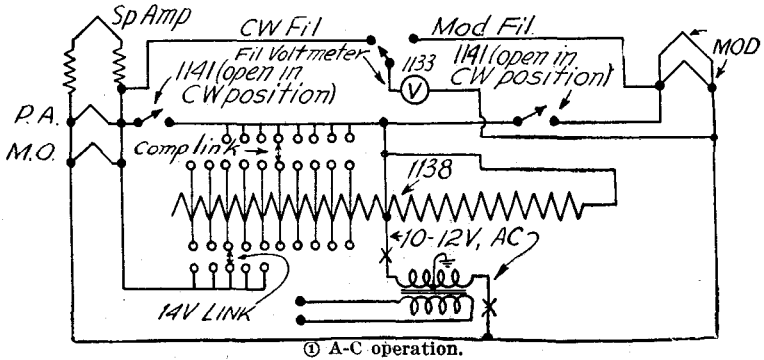
(a) Controls the modulator filaments.

(b) Controls a line-compensating section of the filament resistor (fig. 13).

(c) Controls the oscillator feed-back circuit for side tone on continuous wave and tone operation.

(d) Connects the microphone circuit to the input transformer 1149 for voice operation.

(2) With switch 1141 in the TONE position (fig. 14), capacitor 1142 feeds back energy from the speech amplifier plate to its grid in



7L-3901A

FIGURE 13.—Radio transmitter BC-191-(*) filament circuit—functional diagram.

the proper phase relation to cause oscillation at an audio rate, and thus the required tone voltage is generated. The secondaries of input transformer 1149 and interstage transformer 1157 are resonated by capacitors 1150 and 1180, respectively, to provide the required tuned circuits in both grid and plate circuits of the audio oscillator. The tuning of these circuits is such as to establish a frequency of oscillation of 500 to 1,000 cycles. Resistor 1151 on the primary of input transformer 1149 serves to stabilize the grid excitation of the speech amplifier tube.

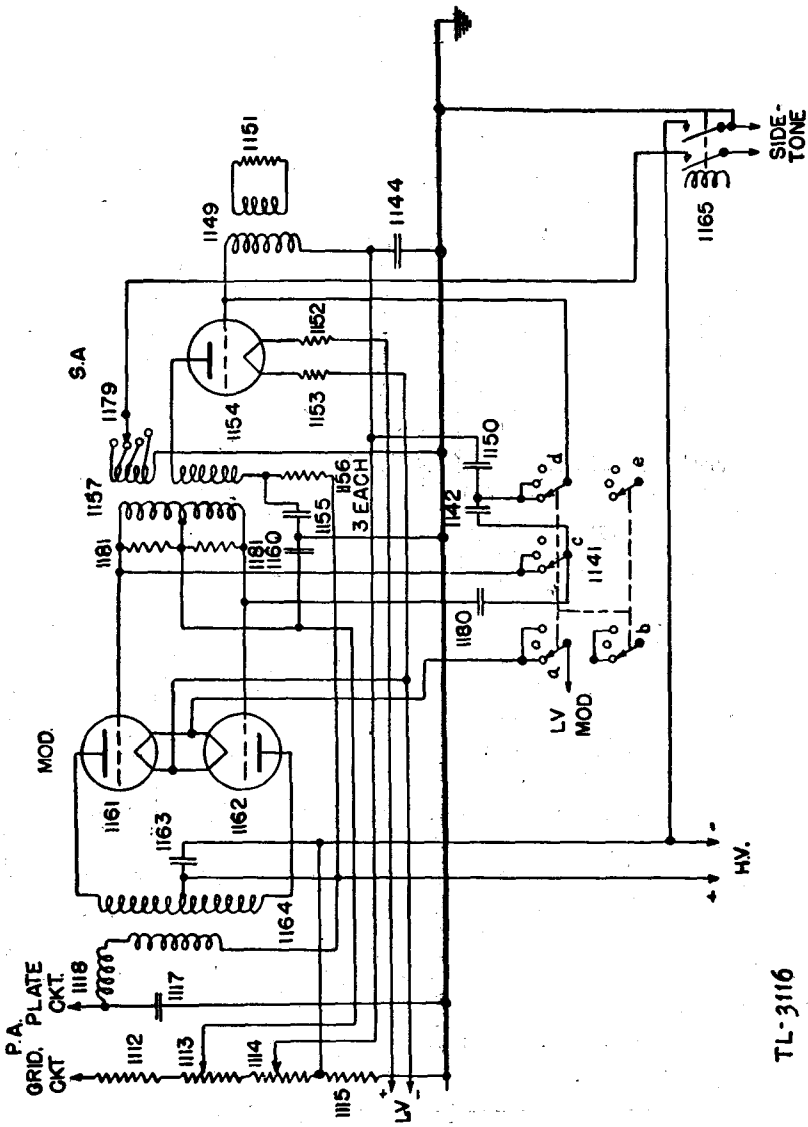
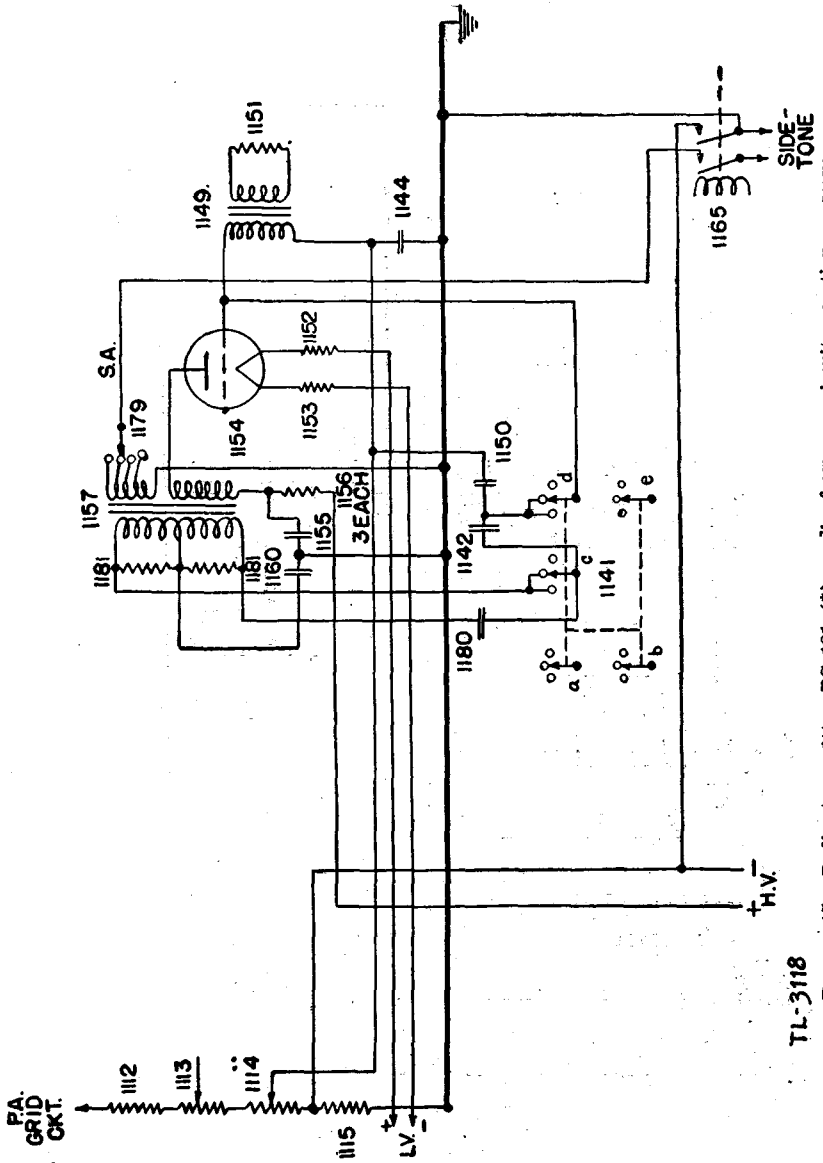


FIGURE 14.—Radio transmitter BC-191-(*), audio frequency circuits, tone operation—functional diagram.

TL-3116



TL-3118

FIGURE 15.—Radio transmitter BC-191-(*) , audio frequency circuits, continuous wave operation—functional diagram.

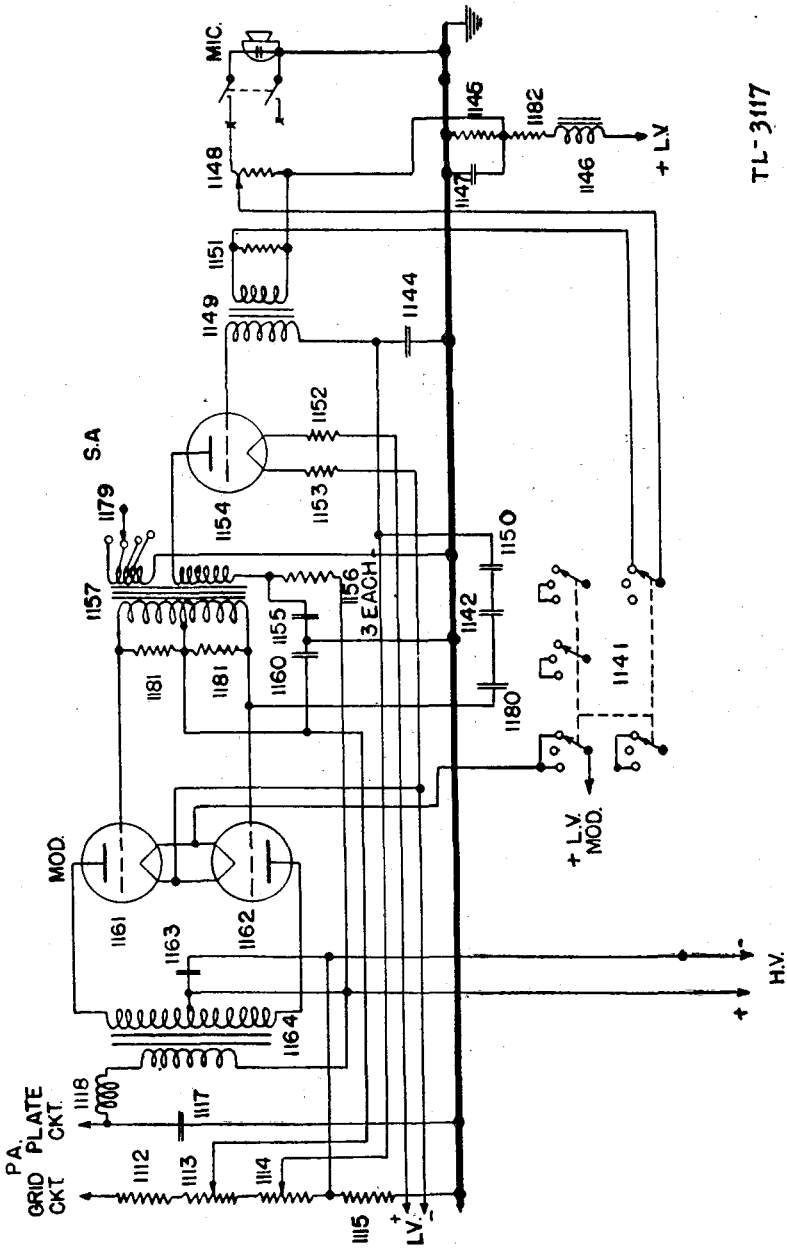
(3) When set at C. W. (fig. 15), switch 1141 shuts off the modulator tubes by removing the filament voltage. The speech amplifier functions the same as for tone operation, although it furnishes only the side tone audio frequency signal for monitoring the continuous wave transmission.

(4) Set at VOICE (fig. 16), switch 1141 disconnects the tone capacitors 1142, 1150, and 1180, connects the microphone circuit to the primary of the input transformer 1149, and makes the modulator tubes operative by connecting their filaments to the low voltage supply. Potentiometer 1148 is the speech INPUT LEVEL control. The speech amplifier will then receive its excitation from the microphone by means of input transformer 1149. The transmission is monitored through the receiver side tone circuit.

e. Bias voltages.—Bias for the modulator tubes is obtained from potentiometer 1113, and bias for the speech amplifier from potentiometer 1114 (fig. 14). These potentiometers form a part of the power amplifier grid leak, the voltage across them resulting from the rectified grid current of the power amplifier. Capacitors 1144 and 1160 serve as a low impedance bypass to ground for the speech amplifier and modulator bias, respectively, at audio frequencies. Both the modulator bias control (labeled MOD. BIAS), and the speech amplifier control (labeled S. A. BIAS), are accessible in the tube compartment. The speech amplifier grid bias is usually adjusted at the factory, and its value is not particularly critical.

f. Keying.—Keying of the transmitter (fig. 12) is controlled by means of resistor 1115, one end of which is connected to negative high voltage and to all grid circuit returns, and the other end to negative filament or ground potential. The keying contacts of relay 1165 are connected across this resistor. When the keying contacts are open, the voltage drop across 1115 is such that the grids of the tubes are negatively biased beyond plate current cut off, stopping oscillation. When these keying contacts are closed, resistor 1115 is shorted and normal grid biases on all tubes are reestablished. Operation of the keying contacts is accomplished by supplying power to the antenna switching relay 1165. (See fig. 17.) Power is supplied to this relay when the key, test key, or the microphone button switch is operated. Operation of the antenna switching relay performs the following additional functions:

- (1) Disconnects the receiving equipment from the antenna and grounds the receiver input circuit.
- (2) Connects the transmitter to the antenna circuit.
- (3) Keys the side tone circuit.



TL-3117

FIGURE 16.—Radio transmitter BC-191-(*) audio frequency circuits, voice operation—functional diagram.

g. Filament circuit.—The transmitter is so designed that it can be operated from either a d-c source or an a-c source in connection with a power supply unit consisting of a high voltage rectifier for plate supply, a low voltage rectifier for the control circuits, and a transformer to furnish a-c filament supply. The A-C D-C switch 1195 (1136-1137) (fig. 11) performs the circuit changes to allow the transmitter to be operated from either source.

(1) In the a-c position (figs. 13 and 18) the filament circuit is separated from the control circuit, and the normally grounded side of the filament is disconnected from ground. Capacitors 1107 then serve to maintain the tube filaments at ground potential with respect to radio frequency currents. When operating the filaments from an a-c source, the center tap of the transformer which supplies heating current to the filaments is grounded, providing a high voltage return circuit.

(2) Under the condition of d-c filament supply (fig. 17), resistor 1138 is used to adjust the filament potential to approximately 10 volts, as indicated by the red line on voltmeter 1133. The midtap of this resistor is connected to the power source. One side of the resistor is used for the adjustment of the filaments of the tubes used for continuous wave operation and the other side for the modulator tubes.

(3) Provision is made to short out a section of the continuous wave filament resistor by means of one section of switch 1141 (figs. 13 and 17) to compensate for the increased line drop which occurs when the modulator filaments are lighted. This arrangement makes it unnecessary to readjust the voltages when changing from continuous wave to tone or voice operation. A portion of the resistor may be short-circuited by the 12V. 14.2V. switch 1190 (1139, 1140) (fig. 17), so that the correct filament voltage may be applied both when the power supply storage battery is being charged and when it is not being charged. Switch 1135 connects filament voltmeter 1133 to either the continuous wave or modulator tube filaments. If the filaments are operated from an a-c source, resistor 1138 serves only as a compensating resistor to eliminate the need for readjusting the filament rheostat when changing from continuous wave to tone or voice transmission.

h. Antenna tuning equipment.—The antenna tuning equipment on the transmitter is capable of tuning practically any antenna to frequencies between 800 to 12,500 kilocycles. Inductive loading in series, and series and parallel capacitive loading is provided. The selection of a suitable tuning circuit and its subsequent tuning are readily accomplished by observation of the ANT. CURRENT meter and TOTAL PL. CURRENT meter. The latter meter by its sharp rise at resonance of the antenna circuit indicates most exactly the point of

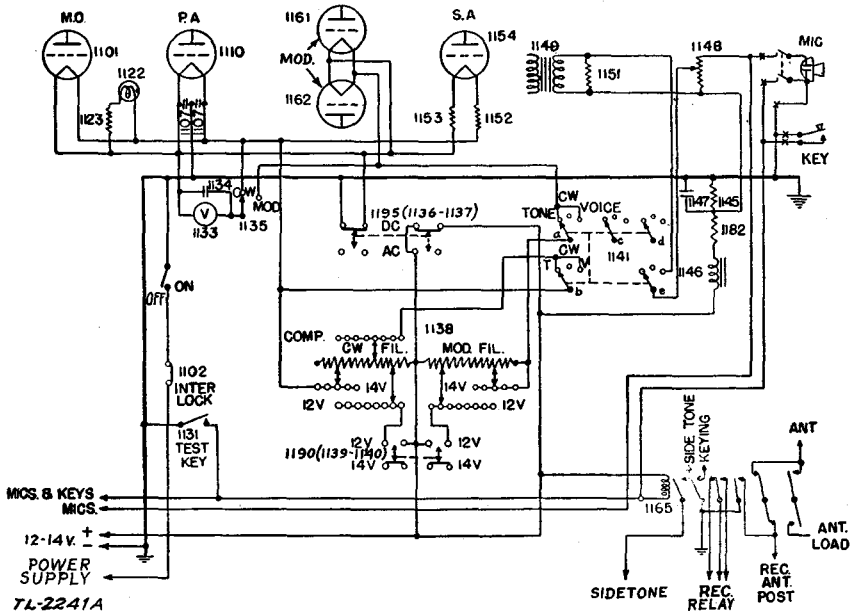


FIGURE 17.—Radio transmitter BC-191-(*) , low voltage and control circuits, d-c operation—functional diagram.

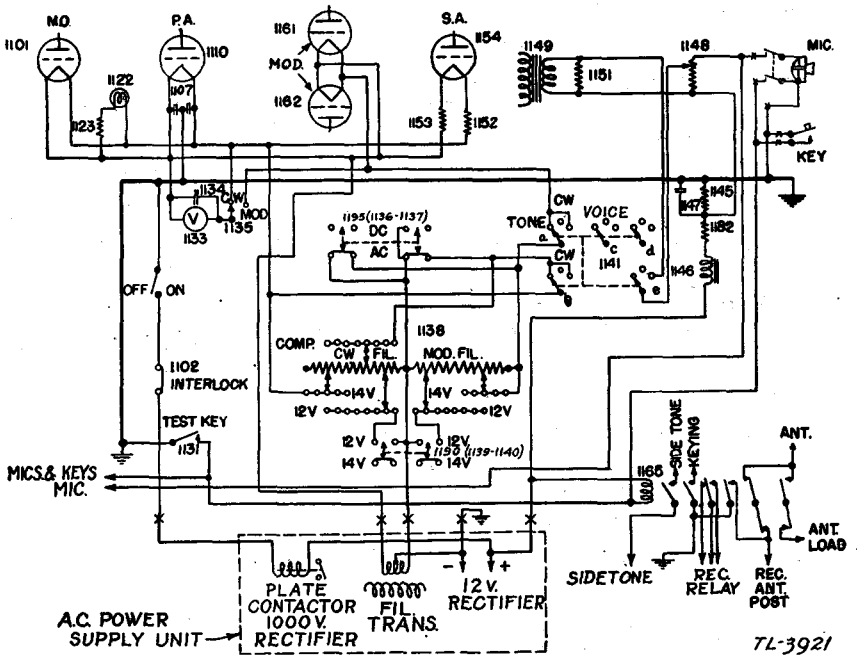


FIGURE 18.—Radio transmitter BC-191-(*) , low voltage and control circuits, a-c operation—functional diagram.

resonance. Detailed data on adjustment of these controls are given in paragraph 17*c* which also describes the functioning of the circuits.

28. Antenna tuning unit BC-306-A.—This antenna tuning unit is a tapped variometer. (See fig. 19.) In operation it furnishes the additional series inductive reactance loading required for resonating the antennas used with tuning units TU-3-A or -B, TU-22-A or -B, and TU-26-B on frequencies below 800 kilocycles. The antennas used at these frequencies are largely capacitive in their loading effect on the transmitter. The amount of inductive reactance required is

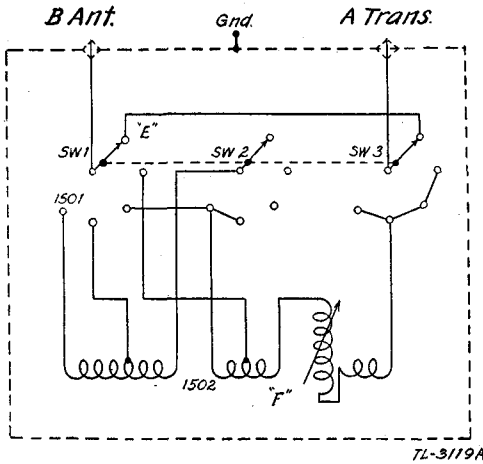


FIGURE 19.—Antenna tuning unit BC-306-A—schematic diagram.

selected and adjusted by a variable rotor, control ANTENNA VARIOMETER F, and a three-gang tap switch 1501, control ANTENNA VARIOMETER SWITCH E. The three-gang type of switch construction allows arrangement of circuits so that the BC-306-A is cut out of the antenna circuit when control E is on tap 1. Three terminals are provided on BC-306-A. One, the ground terminal, is connected to the shield and frame of the unit. The other two, marked A-TRANS. and B-ANT., serve to connect the ANTENNA VARIOMETER F, 1502, in series with the antenna system of the set. (See fig. 9.)