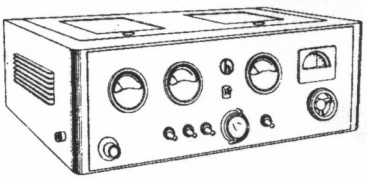
technical manual for model HT-9 radio transmitter



JUNE, 1946 94A018

the hallicrafters co.
MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 16, U. S. A.

IMPORTANT

Remove the transmitter and accessories from the crate and inspect carefully for any damage which may have occurred during transit. In case of damage a claim should be filed at once with the transportation company.

FILL OUT AND MAIL ENCLOSED RETURN CARD IMMEDIATELY

technical manual for model HT-9 radio transmitter

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Warranty

The Hallicrafter's Company warrants each new radio product manufactured by it to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part in exchange for any part of any unit of its manufacture which under normal installation, use and service discloses such defect, provided the unit is delivered by the owner to us or to our authorized radio dealer or wholesaler from whom purchased, intact, for our examination, with all transportation charges prepaid within ninety days from the date of sale to original purchaser and provided that such examination discloses in our judgment that it is thus defective.

This warranty does not extend to any of our radio products which have been subjected to misuse, neglect, accident, incorrect wiring not our own, improper installation, or to use in violation of instructions furnished by us, nor extend to units which have been repaired or altered outside of our factory, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith not of our own manufacture.

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by the authorized radio dealer or wholesaler without charge to the owner.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our radio products.

Revised November 1946

TABLE OF CONTENTS

DIAGRAMS AND ILLUSTRATIONS

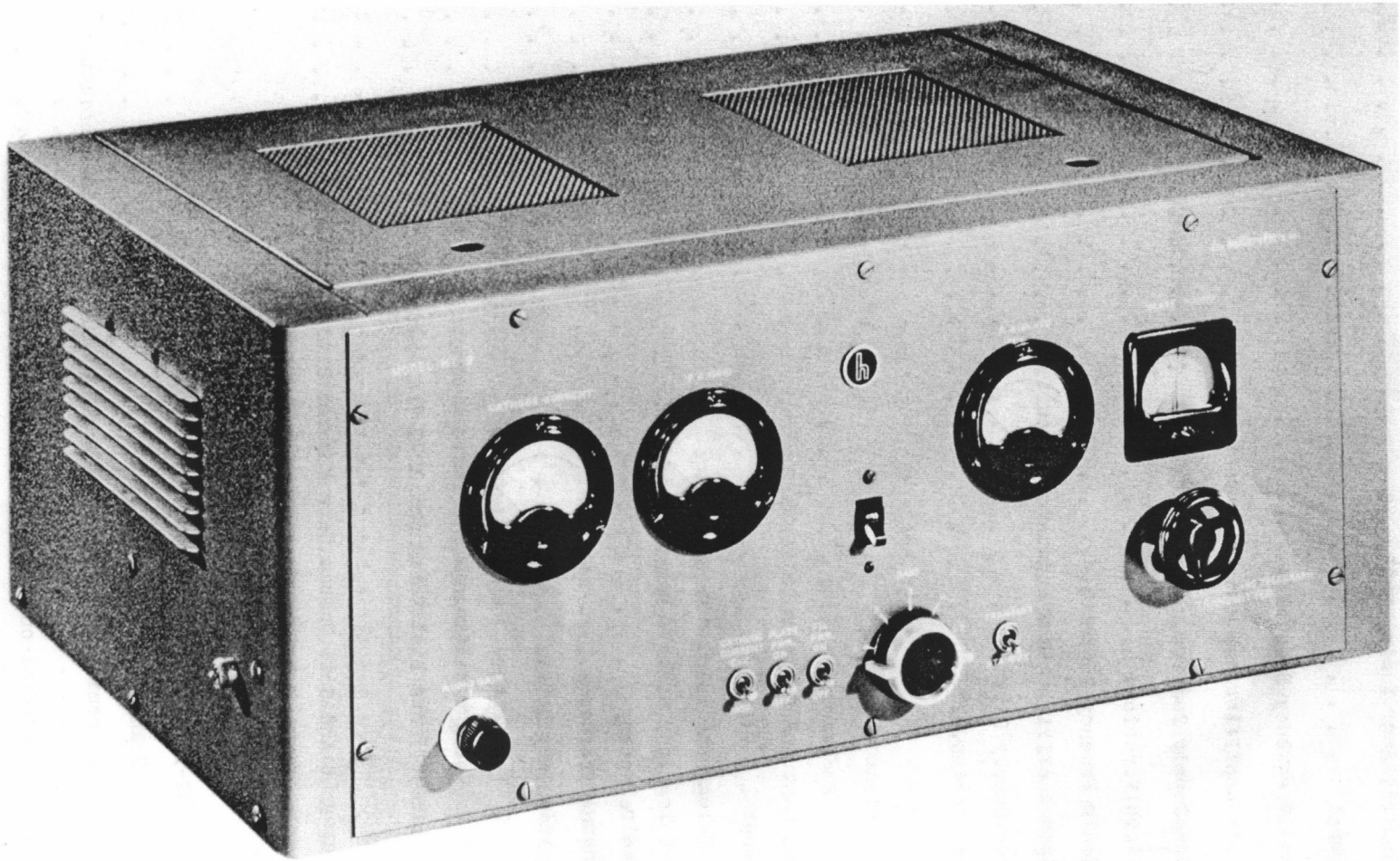


Figure 1. Model HT-9 Transmitter, front view.

INSTRUCTION BOOK FOR MODEL HT-9

RADIO TRANSMITTING EQUIPMENT

A. DESCRIPTION OF EQUIPMENT

A-1. GENERAL - The Model HT-9 telephone and telegraph transmitter consists of a band-switching radio frequency section, speech amplifier, modulator, and five power supplies, compactly arranged in a table mounting cabinet. The only accessories needed are a microphone, key, and suitable antenna installation. Provision is made for 5 pretuned channels in the oscillator and doubler stages, any one of which may be selected by means of a band switch on the panel. In changing frequencies it is merely necessary to turn the band switch, plug in the correct final amplifier coil unit, and tune the plate circuit to resonance. The HT-9 is designed to give a power output of approximately 100 watts on c-w telegraphy, and 75 watts on phone. Coils are available covering frequencies from 1500 KC to 30,000 KC.

A-2. RADIO FREQUENCY SECTION - The r-f section of the HT-9 transmitter uses two type 6L6 tubes (V_1 and V_2) as oscillator and doubler and a type 814 beam power tube (V_3) as a final amplifier. Refer to the circuit diagram, figure 6, for electrical connections, and to plan view of chassis, figure 7, and top view of transmitter, figure 3, for location of the various components. When operating on frequencies below 10 megacycles tube V_1 is not used and tube V_2 functions as a crystal oscillator, driving the final amplifier tube V_3 on the crystal frequency. At frequencies above 10 megacycles tube V_1 is the crystal oscillator and tube V_2 acts as a frequency doubler. Under this condition the final amplifier stage operates at twice the crystal frequency.

A-3. SPEECH AMPLIFIER AND MODULATOR SECTION - The speech amplifier uses a type 6SJ7 tube (V_5) resistance coupled to a type 6J5 tube (V_6). The latter drives four type 6L6 tube (V_7, V_8, V_9 and V_{10}) connected in push-pull parallel which serve as the modulator. These modulator tubes operate as a class A amplifier going into class AB on modulation peaks. The speech amplifier input is designed to use a high impedance microphone (crystal or dynamic).

A-4. POWER SUPPLY SECTION.- As stated in Section A-1, five separate power supply sections are provided. The first, consisting of transformer T-1, supplies filament current to tubes V-1, V-2, V-3, V-13 and V-14. The second, consisting of transformer T-2 supplies, filament current to tubes V-5, V-6, V-7, V-8, V-9, V-10, V-11 and V-12. The third, consisting of transformer T-3 rectifier tubes V-3 and V-4 filter choke CH-3 and filter condenser C-22, supplies plate power to the final amplifier and tube V-3. The fourth, consisting of transformer T-6, rectifier tube V-4, filter choke CH-1 and filter condensers C-12 and C-13, supplies plate power to exciter tubes V-1 and V-2. The fifth, consisting of transformer T-7, rectifier tubes V-11 and V-12, filter choke CH-2 and filter condensers C-31 and C-19, supplies plate power to tubes. V-5, V-6, V-7, V-8, V-9 and V-10.

B. CIRCUIT FUNCTIONS

B-1. RADIO FREQUENCY CIRCUITS - Transmitter HT-9 uses a 6L6 tube as a crystal controlled generator of radio frequency current. On frequencies below 10 megacycles tube V_2 is used as a pentode crystal oscillator and tube V_1 is idle. Refer to figure 6. On these frequencies the crystal is plugged into socket SO_1-and is connected directly to the grid circuit of tube V_2 through selector switch SW_{5C}. Note that switches SW_{5B}, SW_{5C} and SW_{5D} short circuit the positions which are not in use. An oscillator tuning unit such as 51B508 is inserted into socket SO_2-and is connected to the plate circuit of tube V_2 through switch SW_{5D}. When the power is applied to tube V_2 and the tuning unit in the plate circuit is adjusted to resonance at the crystal frequency the tube will oscillate at that frequency. The output is taken from a tap on the plate coil which is connected through switch SW_{5E} and coupling condenser C_6 to the grid of the final amplifier tube V_3. The plate circuit of tube V_3 is tuned to resonance with the frequency applied to it's grid circuit by means of condenser C_{10}. Tube V_3 greatly amplifies the radio frequency current generated in the oscillator tube V_2. This amplified current is transferred to the antenna by means of inductive

coupling in radio frequency coil L-4. Coil L-4 is plugged into socket SO_3.

On frequencies above 10 megacycles the operation of the exciter stages is somewhat different. On these higher frequencies tube V_1 acts as the crystal oscillator and tube V_2 functions as a frequency doubling amplifier. An oscillator tuning unit, such as 51B512, is inserted in socket SO_1-and a doubler unit, such as 51B510, is inserted in socket SO_2-. The crystal plugs into the top of the oscillator unit. Switch SW_{5A} connects the crystal to the grid circuit of tube V_1 and switch SW_{5B} connects the plate circuit to the coil and condenser in the oscillator tuning unit. Switch SW_{5C} now connects the grid of tube V_2 to the output of tube V_1 through a coupling condenser mounted in the oscillator unit. The plate circuit of tube V_1 is tuned to resonance at the crystal frequency but the plate circuit of tube V_2 is now tuned to twice the crystal frequency.

Under these conditions tube V_1 generates radio frequency current at the crystal frequency and tube V_2 amplifies the second harmonic of that frequency. Tube V_3 functions as before, amplifying the radio frequency voltage applied to its grid circuit. Switches SW_{5F} and SW_{5G} are used to provide correct operating voltages for tube V_2 either as an oscillator or as a doubler. When operating as an oscillator, switch SW_{5G} shorts out resistor R_4, thus reducing the grid bias on tube V_2. When operating as a doubler, resistor R_4 is left in the circuit and switch SW_{5F} shorts out resistor R_7 thereby raising the screen voltage of the tube V_2. On all frequencies, keying for c-w telegraphy is accomplished by breaking the cathode circuits of tubes V_1 and V_2.

B-2. SPEECH AMPLIFIER AND MODULATOR CIRCUITS - When the Model HT-9 Transmitter is used as a radio telephone transmitter the speech amplifier and modulator are used. Voice frequency voltages generated in a crystal or dynamic microphone are applied to the grid of a type 6SJ7 tube (V_5). These voltages are amplified in tube V_5 and coupled to the grid of a type 6J5 tube (V_6) through resistors R_{14} and R_{16} and condenser C_{16}. R_{16} is a variable potentiometer mounted on the front panel and is used to control the audio power level. The output of tube V_6 is inductively coupled to the grids of the four modulator tubes by means of transformer T_4. The four type 6L6 modulator tubes V_7, V_8, V_9 and V_{10} are connected in push-pull parallel and their output is applied to the plate and screen circuits of the final amplifier tube V_3 through transformer T_5. Note that transformer T_5 has two secondary windings thus providing simultaneous modulation of both plate and screen. Switch SW_8 short circuits the plate circuit secondary on transformer T_5 when the transmitter is used for c-w telegraphy in order to prevent dangerous transient voltages.

B-3. POWER SUPPLY CIRCUITS - The power supplies in the HT-9 transmitter use conventional full wave rectifier circuits. Referring to figure 6, 105 to 125 volt alternating current is supplied to the primary of transformer T-1. This transformer has four secondary windings. Numbering from left to right, number 1 winding supplies 10 volts A-C to the filament of tube V-3, number 2 supplies 2.5-volts A-C to the filaments of rectifier tubes V-13 and V-14. This winding is well insulated from ground as the high voltage for the final amplifier is taken from it. Secondary number 3 furnishes 6.3-volts A-C to the heaters of tubes V-1 and V-2. Number four heats the filament of rectifier tube V-4.

The secondary winding of transformer T-6 is center tapped and the two ends are connected to the plates of rectifier tube V-4. As these plates conduct on alternate half cycles, the output of tube V-4 is pulsating D-C with a frequency of 120 pulses per second. This pulsating D-C is filtered by means of choke CH-1 and condensers C-13 and C-14.

The operation of the other power supplies is similar and will not be described here in detail. Further information will be found in the chapter on power supplies in "The Radio Amateur's Handbook" published by the American Radio Relay League, or in any good textbook on radio.

C. INSTALLATION

C-1. CAUTION - High voltages are used in transmitter HT-9 and accidental contact with the plate supply to the final amplifier could be fatal. When working with radio transmitters it is essential that safety precautions be observed at all times. Model HT-9 is provided with a safety interlock switch (SW_7) which turns off the high voltage supply when the top of the cabinet is opened thus preventing accidental shock while tuning the exciter stages. Never change crystals or plug in tunin urits

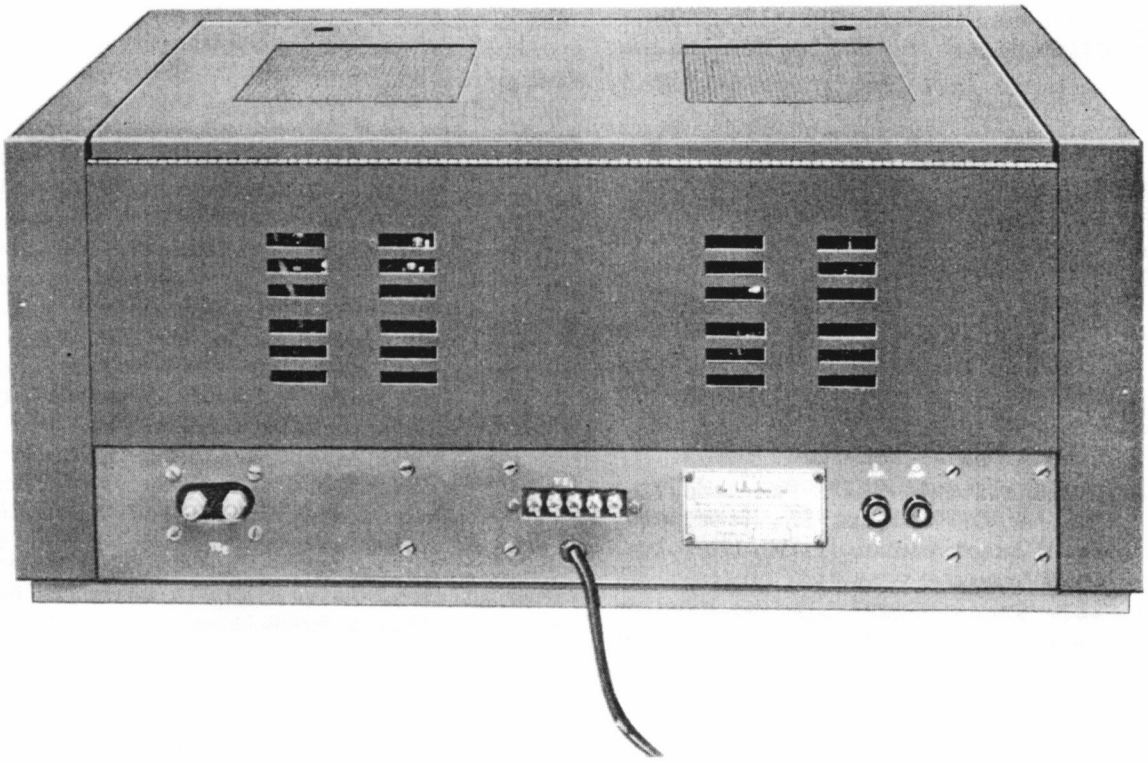


Figure 2. Model HT-9 Transmitter, rear view.

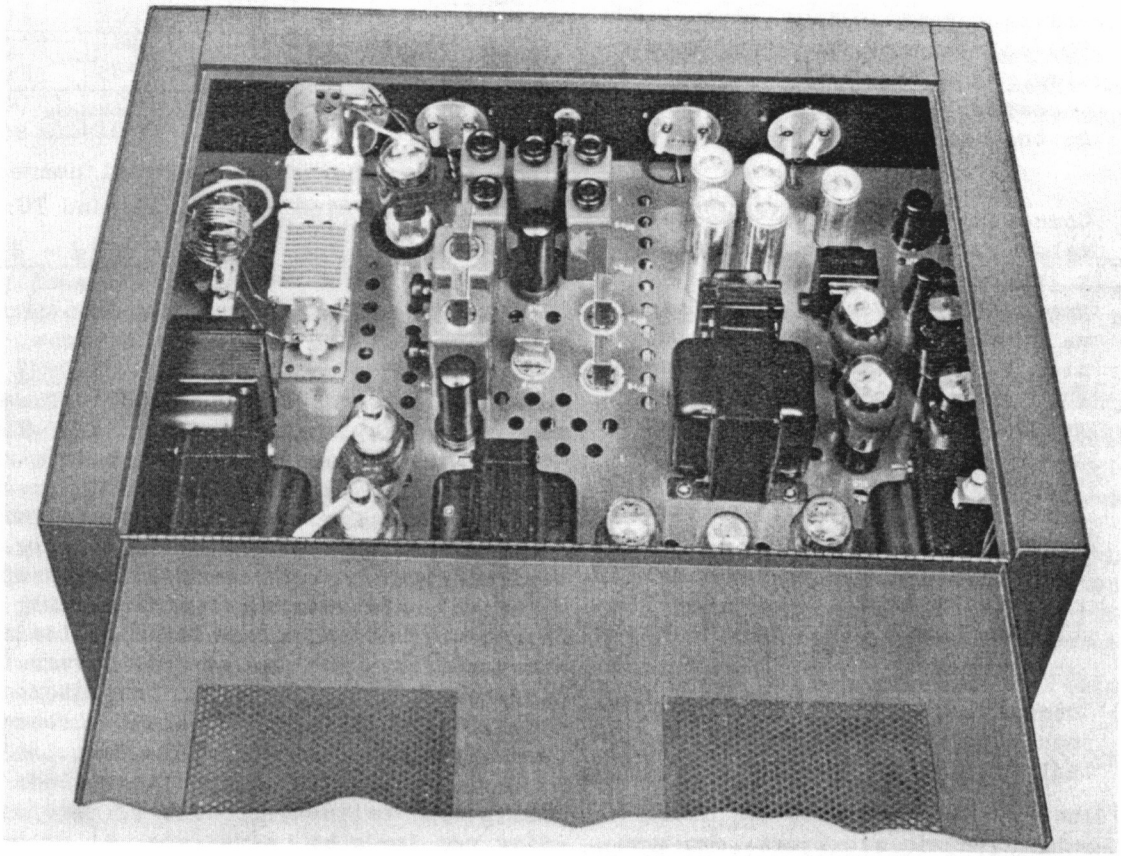


Figure 3. Model HT-9 Transmitter, top view showing tuning units and coil units in place.

without first placing the TRANSMIT-STANDBY switch at STAND-BY and the PLATE PWR. switch at OFF.

C-2. CONNECTIONS - Before making any connections to the HT-9 transmitter be sure that all tubes are in the proper sockets and that the plate caps on the type 866 tubes (V_{11} and V_{12}) and on the type 814 tube (V_3) are in place. The transmitter should be located on the operating table in a convenient position. The following connections are necessary:

(a) Place switches PLATE PWR. and FIL. PWR. at OFF and plug PL_1 (the power cord) into a source of 110/120 volts, 50-60 cycle alternating current. If this transmitter is to be used on voltages of 150, 210, 220 or 250 at 50-60 cycles, a special auto transformer is available as an accessary. This transformer must have a 500 volt-ampere rating. If the only power available is direct current or 25 cycle alternating current, a rotary converter or motor generator set is recommended. This machine should have an output of at least 500 volt-amperes and good regulation. A filter will probably be necessary to prevent interference in the receiver.

(b) Connect a telegraph key to terminals #1 and #2 on terminal strip TS_1 at the back of the cabinet. The frame of the key should go to terminal #1 which is grounded to the chassis. It is recommended that terminal #1 be connected to a good external ground. If the HT-9 transmitter is to be used only for radio telephony the key terminals #1 and #2 can be shorted by a jumper. If the transmitter is to be used for both telegraphy and telephony a standard Morse key with a circuit closing lever will be found convenient.

(c) Connect a crystal or dynamic microphone to socket SO_4 located on the left side of the cabinet.

(d) Connect a suitable antenna to the terminals of TS_2 at the rear of the cabinet. See section C-3 for antenna recommendations.

*(e) Connect terminal #3 of TS_1 to the transformer center-tap terminal on the receiver. All Hallicrafters receivers are provided with an external plug connection for this purpose. When this connection is made, and both transmitter and receiver are connected to a good ground, the TRANSMIT-STANDBY switch SW_3 will turn the receiver on in the STANDBY position and off when the switch is at TRANSMIT.

*(f) Terminals #4 and #5 may be connected to a 110-volt a-c winding of an antenna changeover relay. This will permit the same antenna to be used for sending and receiving as the relay will be automatically energized when switch SW_3 is at TRANSMIT.

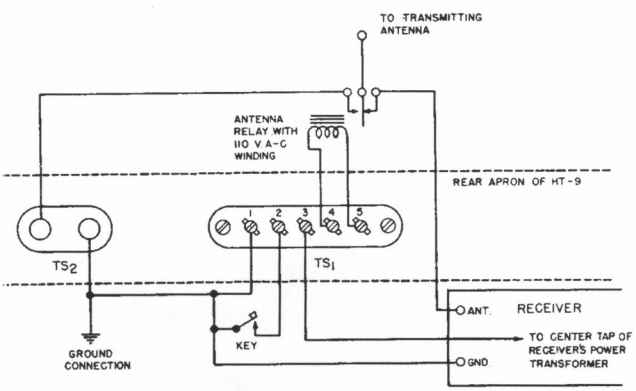


Figure 4. Suggested external connections to terminal strips TS_1 and TS_2.

*Note: These additional connections will be convenient in most installations.

C-3. ANTENNA RECOMMENDATIONS - The final amplifier coil units used in the HT-9 transmitter are provided with individual antenna pick-up coils. The number of turns in use in the antenna coil can be adjusted by means of a flexible lead and clip. If a matched impedance antenna of the proper dimensions is used no further tuning equipment is needed as the correct load on the transmitter may be secured by varying the number of turns in use in the antenna pick-up coil. With other types of antennas such as the Marconi, Zeppelin, etc., external tuning or loading circuits will be necessary.

In any installation the antenna to be used must be selected with due consideration for the available space and contemplated oper-

ating frequencies. Much information concerning the various types may be found in the chapter on antennas in "The Radio Amateur's Handbook" mentioned previously. The most desirable antennas from the standpoint of efficiency of power transfer, simplicity of coupling arrangements, and minimum radiation from feeders are the Johnson "Q", the two wire matched impedance "Y" type, the single wire matched impedance type, and the twisted pair doublet. The efficiency of the latter falls off at frequencies above 10 megacycles.

The chief disadvantage of the above mentioned antennas is the fact that they are designed for operation on one frequency only. The single wire fed antenna however is moderately efficient on harmonics of its fundamental frequency and that fact combined with its simplicity of coupling makes it useful when multi-band operation is desired.

The following table of dimensions refers to a single wire fed antenna.

Frequency	Length of antenna in feet	Distance from center of antenna to point where feeder is attached	Approximate number of turns in pick-up coil
1,800 KC	260'	37'	10
3,600 KC	130'	18'6"	8
7,200 KC	65'	9'3"	6
14,400 KC	32'6"	4'7½"	4
28,800 KC	16'3"	2'3-3/4"	2

For frequencies not given in the table, the antenna dimensions may be calculated from the following empirical formulas.

Antenna length in feet

$$= \frac{468}{\text{frequency in megacycles}}$$

Distance from center of antenna to point where feeder is attached in feet = Antenna length in feet x .1424

Example: Frequency = 5 MC

Antenna length = $\frac{468}{5}$ = 93.6 feet

Distance from center of antenna to feeder = 93.6 x .1424 = 13.3 feet (approximately)

With this type of antenna the single feed wire must run directly away from the antenna for a distance of at least 1/3 the antenna length. Sharp bends in the feeder should be avoided and the antenna should be as high and as free from obstructions as possible. The single feed wire is connected to one of the antenna terminals on the HT-9 transmitter and the other terminal is connected to a good ground. For dimensions and details of other types of antennas refer to "The Radio Amateurs Handbook". Those wishing a more technical discussion of the subject are directed to "Radio Engineering Handbook" by Henney and "Radio Engineering" by Terman.

D. ADJUSTMENT AND OPERATION

DANGER - HIGH VOLTAGE. If you have not already done so, read Section C-1 before proceeding.

D-1. GENERAL - The Hallicrafters model HT-9 transmitter is designed with an ample factor of safety and all components are more than adequate for continuous normal operation. In order to secure the maximum in performance and service however a few simple precautions should be observed. When tuning the transmitter the key should not be held down for long periods with the plate circuits de-tuned as the large overload will shorten tube life. When adjusting antenna coupling always start with a few turns (clip near outside end of coil) and increase the load gradually to the proper point. Keep the transmitter dry and clean. If the transmitter is out of service for a long period it is advisable to check the voltage of bias battery BA_1 (located under right end of chassis) before turning the power on. In any case this battery should be replaced after approximately two years of service. Never change the position of the BAND SWITCH while the transmitter is operating. Do not operate on c-w telegraphy with CW-PHONE switch at PHONE.

D-2. C-W TELEGRAPHY BELOW 10 MEGACYCLES -

(a) Insert a crystal in socket $SO_{1-}(\ )$* and an oscillator tuning unit covering the crystal frequency in the corresponding $SO_{2-}(\ )$* socket. Insert the final amplifier coil unit for the same frequency range in socket SO_3. Leave the clip on the flexible lead detached.

(b) Set the switches as follows:

(1) AUDIO GAIN at OFF
(2) CATHODE CURRENT at EXC.

*Note: Be sure that crystal and coils for any one range are placed in similarly numbered sockets SO_{1-1} and SO_{2-1}, SO_{1-5} and SO_{2-5}, etc. The prongs on the crystal go in holes 2 and 4 (diametrically opposite holes) in socket $SO_{1-}(\ )$.

(3) PLATE PWR at OFF
(4) TRANSMIT-STANDBY at STANDBY
(5) CW-PHONE at CW
(6) BAND SWITCH at the number corresponding to socket numbers in which crystal and tuning unit are inserted.
(7) FIL PWR at ON

(c) Wait for at least 30 seconds for the tube filaments and heaters to warm up. When first placing transmitter in operation it is advisable to wait for 15 minutes, so that the rectifier tubes can evaporate any mercury which has splashed on the elements.

(d) With the cover of the transmitter open set the TRANSMIT-STANDBY switch at TRANSMIT. Press the key and turn the knob on top of the oscillator tuning unit until the CATHODE CURRENT meter reaches a minimum, P.A. GRID meter reading should be a maximum at this same point. (See Section E-1 in the back of the book for representative meter readings). When the knob on the oscillator tuning unit is turned through resonance it will be noticed that the P.A. GRID current falls off sharply on one side and rather slowly on the other. Detune the oscillator slightly on this "easy" side. (Reduce P.A. GRID about 1 milliampere below maximum). It will be helpful to listen to the signal from the exciter on a monitor or a receiver with the gain reduced appropriately. In order to secure clean keying free from "chirps" it is necessary to use a good crystal, Bliley LD2, B5 and HF2 crystals are recommended.

(e) Lower the cover of the cabinet, place the PLATE-PWR switch at ON and press the key again. (Tap on antenna coil is still disconnected). Turn the PLATE TUNING wheel until the reading of the P.A. PLATE meter is a minimum. (See Section E-1) Note the dial reading of PLATE TUNING.

(f) Set the PLATE switch at OFF, open cover of cabinet and attach clip to antenna coil at about half the number of turns recommended in section C-3 for the frequency you are using.

(Note: Final amplifier coil unit should be inserted in socket SO_3 with the end covered by antenna coil toward the back of the cabinet. Turns in the antenna coil are counted from that end.) Close the cover, set PLATE switch at ON, press the key and readjust PLATE TUNING for minimum current on P.A. PLATE meter. Repeat this process, increasing the number of turns in use in the antenna coil until the desired loading is obtained, not exceeding 150 ma. for C-W. (It is assumed that some form of matched impedance antenna such as the single wire feed is in use. For antennas requiring external tuning the procedure will have to be modified) If the antenna is of correct dimensions for the frequency being used it will be found that full loading is obtained at approximately the same setting of PLATE TUNING as was noted in paragraph D-2, (e). If the minimum reading under load of P.A. PLATE meter occurs at a setting of PLATE TUNING more than ten degrees off from the no load reading it indicates a reactive load due to improper antenna dimensions. Under such circumstances the efficiency will be low and severe harmonic radiation may take place.

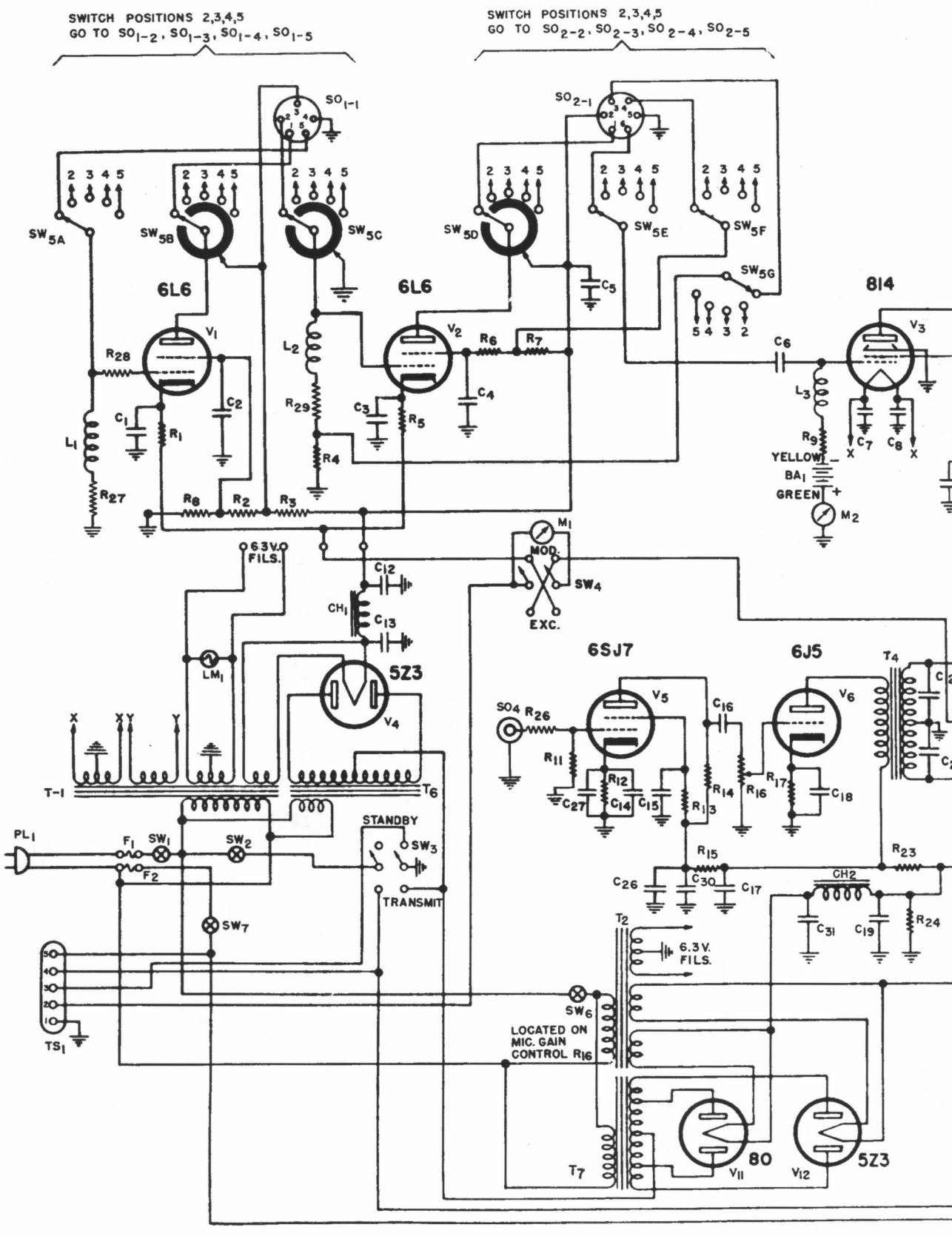
(g) Assuming that the preceeding steps have been carried out as described the transmitter is now ready for operation on c-w telegraphy. During receiving periods it is merely necessary to place the TRANSMIT-STANDBY switch at STANDBY. To shut down the transmitter place PLATE PWR and FIL. PWR switches at OFF.

D-3. C-W TELEGRAPHY ABOVE 10 MEGACYCLES -

(a) Insert an oscillator tuning unit covering the proper frequency range in socket $SO_{1-(*)}$ and the corresponding doubler tuning unit in socket $SO_{2-(*)}$. Insert the crystal in the socket on top of the oscillator tuning unit. Place the proper final amplifier coil unit in socket SO_3.

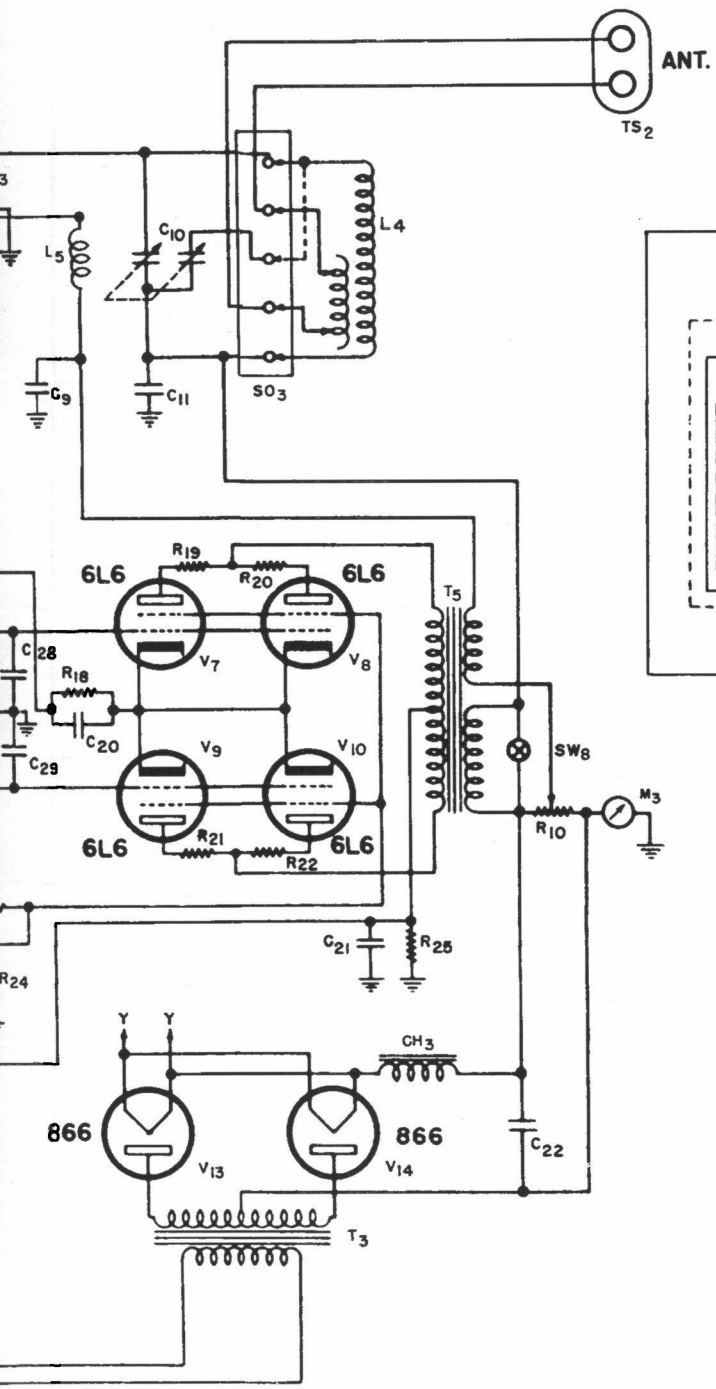
(b) (Repeat paragraph (b) section D-2)

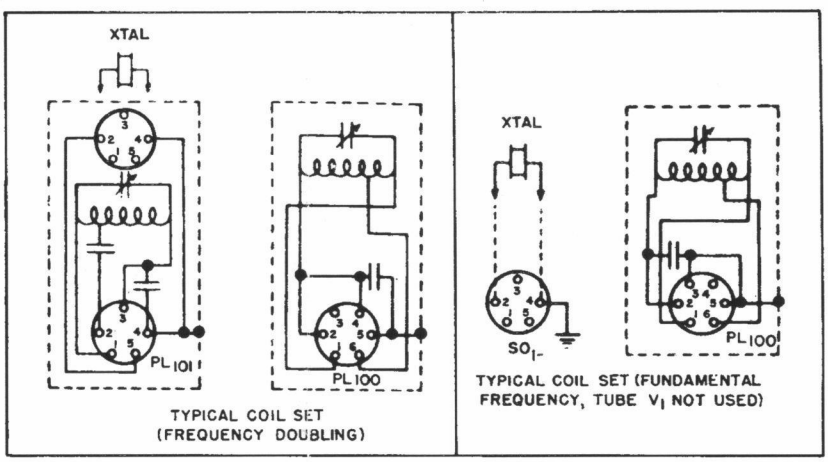
(c) (Repeat paragraph (c) section D-2)



SCHEMATIC DIAGRAM—MODEL HT-9

Figure 6. Model HT-9 Trans





SWITCH AND FUSE IDENTIFICATION

SW_1	FIL. PWR.
SW_2	PLATE PWR.
SW_3	TRANSMIT STANDBY
SW_4	CATHODE CURRENT
SW_5	BAND SWITCH
SW_6	AUDIO GAIN (SWITCH ON BACK OF GAIN CONTROL R_{16})
SW_7	SAFETY INTERLOCK LOCATED AT LEFT REAR OF CABINET UNDER COVER.
SW_8	CW. PHONE
F_1	10 AMP.
F_2	3 AMP.

T-9 TELEGRAPH-TELEPHONE TRANSMITTER

ransmitter, schematic wiring diagram.

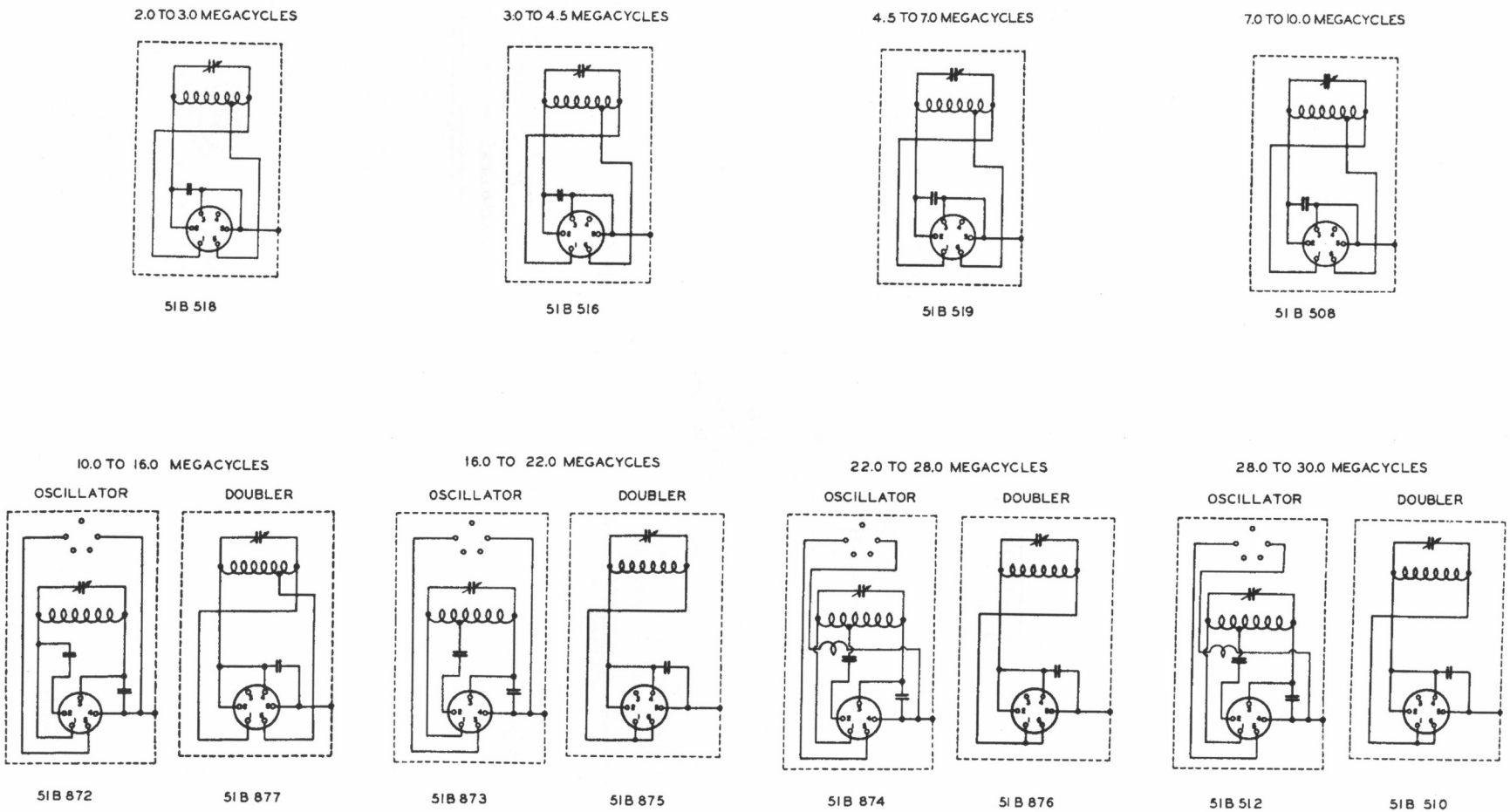


Figure 5. Tuning units for Model HT-9 Transmitter, schematic wiring diagrams.

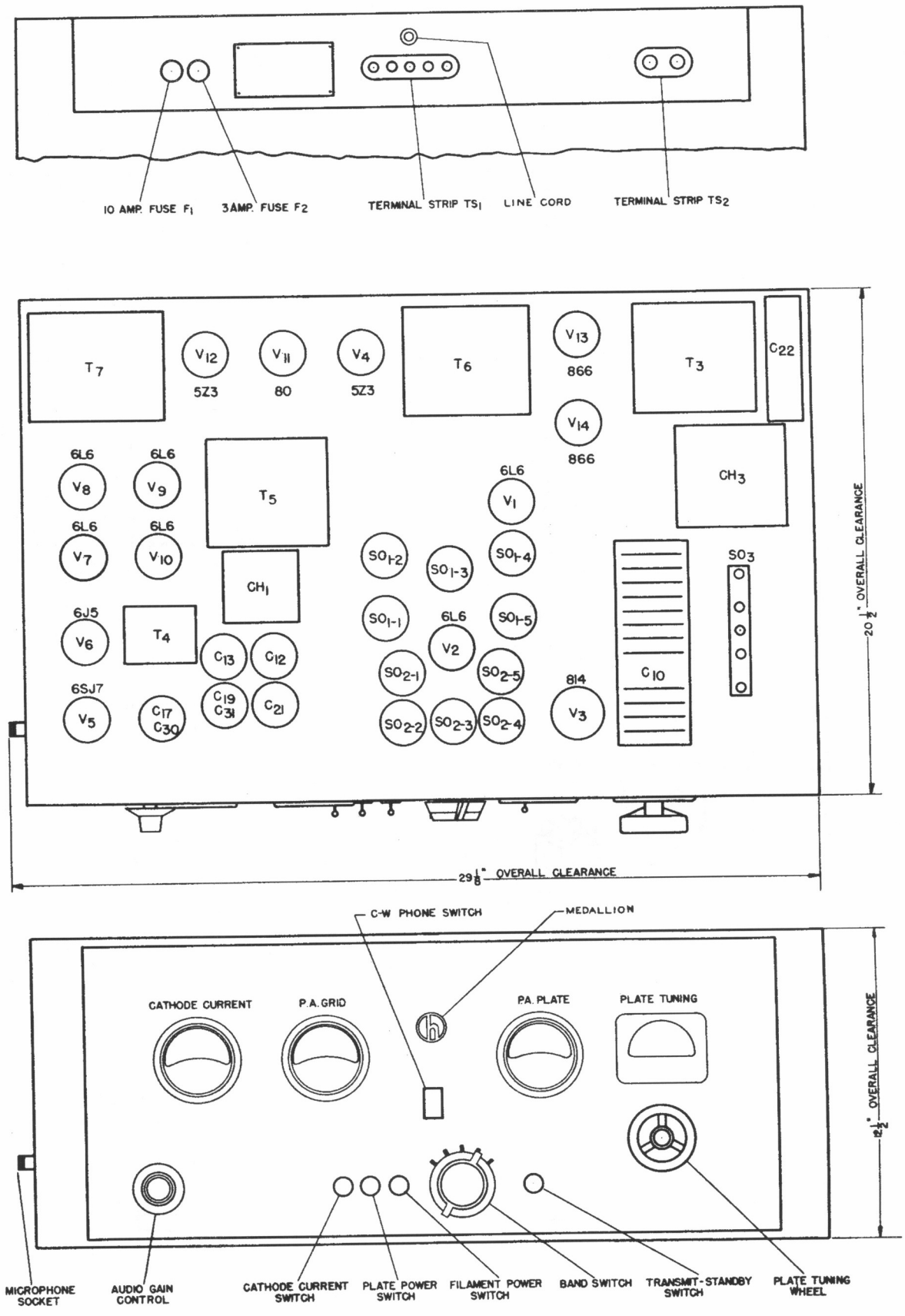


Figure 7. Model HT-9 Transmitter, front, top and rear views showing location of important parts.

(d) With the cover of the transmitter open, set the TRANSMIT-STANDBY switch at TRANSMIT. Press the key and turn the knob on the side of the oscillator tuning unit until the CATHODE CURRENT meter reaches a maximum. Now turn the knob on top of the doubler tuning unit until the CATHODE CURRENT meter drops to a minimum and the P.A. GRID meter reaches a maximum. The knob on the side of the oscillator tuning unit may now be backed off slightly on the "easy" side as described in paragraph (d) of Section D-2, but the doubler tuning unit should be kept at maximum output. (P.A. GRID meter at maximum)

(e) Tuning of the final amplifier is identical with the procedure described in paragraphs (e), (f) and (g) of Section D-2. Note that the final amplifier is now operating at twice the crystal frequency. Refer to Section E-1 for representative meter readings.

D-4. RADIO TELEPHONY -

(a) Tune the entire transmitter to the desired frequency in the same manner as for c-w telegraphy with the following exceptions:

(1) Reduce the number of turns used in the antenna coupling coil so that the P.A. PLATE meter does not read above 125 ma.

(2) If a jumper is used between terminals #1 and #2 of terminal strip TS_1, the closing of the key is eliminated and the transmitter is energized at once when the TRANSMIT-STANDBY switch is set at TRANSMIT.

(b) After the transmitter is properly tuned as described above set the TRANSMIT-STANDBY switch at STANDBY, the CW-PHONE switch at PHONE, and turn AUDIO GAIN to the right thus closing switch SW_6 (See figure 6) connecting the a-c power to the modulating equipment. Set the CATHODE CURRENT switch at MOD. If a key is used it should be closed by means of its closing lever or an auxiliary shorting switch.

(c) Turn on the transmitter by setting the TRANSMIT-STANDBY switch at TRANSMIT and advance the AUDIO GAIN at the same time speaking into the microphone. Watch the CATHODE CURRENT METER. (See Section E-1 for correct readings)

With the AUDIO GAIN control set at a low level and no sound going into the microphone the normal reading of the CATHODE CURRENT meter will be between 215 and 220 ma. With the AUDIO GAIN control turned up for normal operation the CATHODE CURRENT meter will show an increased reading on sound peaks. It should never be permitted to increase more than 30 ma. above the no modulation value and not that much if the transmitter is runing below maximum power output. (P.A. PLATE meter less than 125 ma.). A greater increase than 30 ma. will cause over-modulation and interference in adjacent radio channels. Under no circumstances should the P.A. GRID and P.A. PLATE meters fluctuate during modulation.

(d) If the HT-9 transmitter and associated station equipment are connected in accordance with the recommendations in Section C-2 it is only necessary to operate the TRANSMIT-STANDBY switch to change from transmitting to receiving. The antenna will be transferred and the receiver turned on and off automatically.

(e) When changing back to c-w operation be sure to:

(1) Open the shorting switch on the key.
(2) Set the CW-PHONE switch at CW. (See Section B-2)
(3) Set the CATHODE CURRENT switch at EXC.
(4) Turn the AUDIO GAIN control all the way to the left. (Until switch (SW_6) clicks thus disconnecting the a-c power from the modulating equipment).

For a temporary shutdown it is only necessary to set the PLATE PWR. and FIL. PWR. switches at OFF.

D-5. CHANGING FREQUENCY - When the transmitter has been properly adjusted for either c-w or phone operation on a given frequency it is a very simple matter to return to that frequency. The crystals, oscillator tuning units and doubler tuning units may be left in their respective sockets and the change from one frequency to another made by means of the BAND SWITCH. It will be necessary to insert the correct coil unit in the final amplifier socket SO_3 and readjust the PLATE TUNING control. It will be convenient to keep a record of PLATE TUNING settings for the different frequencies used. A table for recording this data will be found in Section E-4.

E. SUPPLEMENTARY DATA

E-1. CHART OF PERFORMANCE CHARACTERISTICS

DESCRIPTION	INDICATING METER	OPERATING FREQUENCY RANGE	NORMAL	MAXIMUM	MINIMUM
Exciter cathode current (Switch at EXC.)	CATHODE CURRENT	1500-8000 KC	55 MA	65 MA	45 MA
Exciter cathode current (Switch at EXC.)	CATHODE CURRENT	8000-18,999 KC	80 MA	100 MA	60 MA
Exciter cathode current (Switch at EXC.)	CATHODE CURRENT	18,000-30,000 KC	100 MA	110 MA	70 MA
Modulator cathode current (Switch at MOD.) Audio gain set at minimum gain. 0% modulation	CATHODE CURRENT	1500-30,000 KC	220 MA	230 MA	210 MA
Modulator cathode current (Switch at MOD.) Audio gain open and 100% modulation	CATHODE CURRENT	1500-30,000 KC	250 MA	260 MA	240 MA
Final amplifier grid current (PLATE PWR. switch at OFF)	P.A. GRID	1500-30,000 KC	15 MA	18 MA	10 MA
Final amplifier grid current (PLATE PWR. switch at ON, antenna clip disconnected)	P.A. GRID	1500-30,000 KC	13 MA	15 MA	9 MA
Final amplifier grid current (PLATE PWR. switch at ON and antenna connected)	P.A. GRID	1500-30,000 KC	11 MA	14 MA	8 MA
Final amplifier plate and screen current (Antenna clip disconnected)	P.A. PLATE	1500-18,000 KC	50 MA	60 MA	40 MA
Final amplifier plate and screen current (Antenna clip disconnected)	P.A. PLATE	18,000-30,000 KC	80 MA	90 MA	60 MA
Final amplifier plate and current (Antenna connected, C-w telegraphy)	P.A. PLATE	1500-30,000 KC	150 MA	150 MA	Depends on coupling to antenna
Final amplifier plate and screen current (Antenna connected, phone)	P.A. PLATE	1500-30,000 KC	125 MA	125 MA	115 MA (if less the AUDIO GAIN must be reduced proportionately

E-2. CHART OF VOLTAGE READINGS FOR SERVICE CHECKS

Meter resistance is 1000 ohms per volt

Circuit	Reading taken		Volts	Remarks
	From	To		
Line voltage	F_1	F_2	114 AC	All readings in this table were taken at this line voltage
Fil. of V_3(814)	Fil.	Fil.	10 AC	At socket; TRANSMIT-STANDBY switch at STANDBY
Fil. of V_{13}, V_{14} (866)	Fil.	Fil.	2.5 AC	At socket; TRANSMIT-STANDBY switch at STANDBY
Fil. of V_4 (5Z3)	Fil.	Fil.	5 AC	At socket; TRANSMIT-STANDBY switch at STANDBY
Fil. of V_{12} (5Z3)	Fil.	Fil.	5 AC	At socket; TRANSMIT-STANDBY switch at STANDBY
Fil. of V_{11} (80)	Fil.	Fil.	5 AC	At socket; TRANSMIT-STANDBY switch at STANDBY
Heater of V_1, V_2 (6L6)	H	H	6.3 AC	At socket; TRANSMIT-STANDBY switch at STANDBY
Heater of V_7, V_8, V_9, V_{10} (6L6)	H	H	6.3 AC	At socket; TRANSMIT-STANDBY switch at STANDBY
Heater V_6 (6J5)	H	H	6.3 AC	At socket; TRANSMIT-STANDBY switch at STANDBY
Heater V_5 (6SJ7)	H	H	6.3 AC	At socket; TRANSMIT-STANDBY switch at STANDBY
Plate V_3	Tuning condenser frame	Ground	1080 DC	P.A.PLATE meter at 150 ma.; TRANSMIT-STANDBY switch at TRANSMIT
Plate V_3	Tuning condenser frame	Ground	1160 DC	P.A. PLATE meter at 60 ma.; TRANSMIT-STANDBY switch at TRANSMIT (no load)
Screen V_3	Screen terminal on socket	Ground	380 DC	P.A.PLATE meter at 150 ma.; TRANSMIT-STANDBY switch at TRANSMIT
Screen V_3	Screen terminal on socket	Ground	260 DC	P.A.PLATE meter at 60 ma.; TRANSMIT-STANDBY switch at TRANSMIT (no load)
Grid bias V_3	Junction of L_3 and R_9	Ground	-45 DC	TRANSMIT-STANDBY switch at STANDBY
Grid bias V_3	Junction of L_3 and R_9	Ground	-150 DC	TRANSMIT-STANDBY switch at TRANSMIT; P.A.GRID current at 10 ma.
Exciter plate voltage	Red lead on V_{12} socket	Ground	435 DC	Transmitter operating (with load)
Plate V_2 as Osc.	Shorting ring on SW_{5D}	Cathode	380 DC	TRANSMIT-STANDBY switch at TRANSMIT; P.A. GRID current at 10 ma.

E-2. CHART OF VOLTAGE READINGS FOR SERVICE CHECKS - Cont'd.

Circuit	Reading taken		Volts	Remarks
	From	To		
Screen V_2 as Osc.	Screen terminal on socket	Cathode	175 DC	TRANSMIT-STANDBY switch at TRANSMIT; P.A. GRID CURRENT at 10 ma.
Cathode V_2 as Osc.	Cathode terminal on socket	Ground	-25 DC	" "
Plate V_2 as doubler	Shorting ring on SW_{5D}	Cathode	375 DC	" "
Screen V_2 as doubler	Screen terminal on socket	Cathode	180 DC	" "
Cathode V_2 as doubler	Cathode terminal	Ground	-22 DC	" "
Plate V_1	Shorting ring on SW_{5B}	Cathode	270 DC	" " (V_1 not in use below 8000 KC)
Screen V_1	Screen terminal on socket	Cathode	75 DC	" "
Cathode V_1	Cathode terminal on socket	Ground	-8 DC	" "
Plate $V_{7,8,9,10}$	Plate terminal on socket	Cathode	420 DC	" "
Screen $V_{7,8,9,10}$	Screen terminal on socket	Cathode	350 DC	" "
Cathode $V_{7,8,9,10}$	Cathode terminal on socket	Ground	-25 DC	" "
Plate V_6	Plate terminal on socket	Cathode	195 DC	" "
Cathode V_6	Cathode terminal on socket	Ground	-7 DC	" "
Plate V_5	Plate terminal on socket	Cathode	25 DC	" "
Screen V_5	Screen terminal on socket	Cathode	20 DC	" "
Cathode V_5	Cathode terminal on socket	Ground	-1 DC	" "

E-3. REPLACEMENT PARTS LIST FOR RADIO TRANSMITTER MODEL HT-9

REF. NO.	DESCRIPTION	HALLICRAFTER'S PART NUMBER	LIST PRICE PER COMPONENT
	CAPACITORS		
C-1,3	6800 mmf; ± 10%; 1200 vdcw;mica	CM 35A682K	.57
C-2,4,5,26,27	2200 mmf; ± 10%; 500 vdcw;mica	CM30A222K	.33
C-6	220 mmf; ± 20%; 2500 vdcw; mica	CM45A221M	1.00
C-7,8	0.01 mfd; ± 20%; 600 vdcw; mica	CM45A103M	1.08
C-9	2200 mmf; ± 10%; 1200 vdcw; mica	CM45A222K	1.34
C-10	Tank condenser; air; 2 gang; 50 to 150 mmf.	48-099	6.38
C-11	2200 mmf; ± 10%; 2500 vdcw; mica	CM50A222K	2.23
C-12,13,21	8 mfd; 600 vdcw; tubular electrolytic	45A043	1.40
C-14,18	10 mfd; -10 ± 65%, 25 vdcw, tubular electrolytic	42A033	.35
C-15	0.1 mfd; -10 ± 40%; 400 vdcw; tubular electrolytic	46AV104J	.10
C-16	0.01 mfd; -10 ± 40%; 600 vdcw; tubular electrolytic	46AY103J	.10
C-17,30	Electrolytic; dual unit; 4-4 mfd; -10 ± 40% tubular	45A037	1.55
C-19,31	Electrolytic; dual unit; 8-8 mfd; -10 ± 40%; 475 vdcw; tubular	45A030	1.63
C-20	20 mfd; -10 ± 65%; 50 vdcw; electrolytic	45A040	.36
C-22	4 mfd; 1500 vdcw; oil filled; metal case with special mtg. bracket	45B039	6.13
C-28,39	100 mmf; ± 10%; 500 vdcw; mica	CM20A101K	.15
	PILOT LAMP		
LM-1	6/8 v @ 250 cms; blue bead; GE type 44	39A003	.10
	METERS		
M-1	0 to 300ma, d-c ± 2%, milliameter	82A117	*
M-2	0 to 20ma, d-c ± 2%, milliameter	82A119	*
M-3	0 to 200ma, d-c, ± 2%, milliameter	82A118	*

REPLACEMENT PARTS LIST FOR RADIO TRANSMITTER MODEL HT-9 - Continued

REF. NO.	DESCRIPTION	HALLICRAFTER'S PART NUMBER	LIST PRICE PER COMPONENT
	R-F CHOKES		
L-1	1mh ± 10%; 4 pi; universal winding; ceramic core	53A026	*
L-2,3	2.5mh ± 5%; 4pi; universal winding; ceramic core	53A033	.61
L-5	Harmonic Suppressor choke	53A111	*
	PLUGS		
PL-1	AC line cord with two prong plug at one end	87A481	*
	FILTER CHOKES		
CH-1	12h @ 100ma; d-c resistance 300 ohms	56C028	3.43
CH-2	5h @ 40ma; d-c resistance 400 ohms	56C029	2.10
CH-3	30h @ 150 ma; d-c resistance 270 ohms	56C027	7.48
	FUSES		
F-1	10 amperes @ 25v; type 3AG	39A309	.10
F-2	3 amperes @ 250v; type 3AG	39A301	.10
	BATTERY		
BA-1	45v. type Z-30N	27A124	2.20
	RESISTORS		
R-1	390 ohm; ±5%; 2 watt; wire wound	24BV391D	.15
R-2	5000 ohm; ±5% 10 watt; wire wound	24BG502D	.48
R-3,8	2000 ohm; ±10%; 20 watt; wire wound	24BH202E	.43
R-4,23	22,000 ohm; ±20%; 2 watt; carbon	RC41AE223M	.10
R-5	500 ohm; ±5%; 10 watt; wire wound	24BG501D	.33
R-6,7	20,000 ohm; ±5%; 10 watt wire wound	24BG203D	.45
R-9	10,000 ohm; ± 5%; 10 watt; wire wound	24BG103D	.45
R-10	30,000 ohm; ± 10%; 75 watt; adjustable wire wound	24A817	1.80
R-11	2.2 megohm; ± 20%; ½ watt; carbon	RC21AE225M	.10

REPLACEMENT PARTS LIST FOR RADIO TRANSMITTER MODEL HT-9 - Continued

REF. NO.	DESCRIPTION	HALICRAFTER'S PAR NUMBER	LIST PRICE PER COMPONENT
	RESISTORS - Continued		
R-12	2200 ohm; ± 20%; ½ watt; carbon	RC21AE222M	.10
R-13	1 megohm; ± 20%; ½ watt; carbon	RC21AE105M	.10
R-14	220,000 ohm; ± 20%; 1 watt; carbon	RC30AE224M	.10
R-15	47,000 ohm; ± 20%; ½ watt; carbon	RC21AE473M	.10
R-16	Microphone gain control; 550,000 ohm; with switch on rear plate	25C055	.56
R-17	1000 ohm; ± 10%; ½ watt; carbon	RC21AE102K	.10
R-18	110 ohm; ± 5%; 10 watt; wire wound	24BG111D	.36
R-19,20,21,22	47 ohm; ±20%; ½ watt; wire wound	24BX470F	.10
R-24	82,000 ohm; ± 10%; 2 watt; carbon	RC41AE823K	.10
R-25	20,000 ohm; ±5%; 20 watt; wire wound	24BH203D	.58
R-26	100,000 ohm; ±20%; ½ watt; carbon	RC21AE104M	.10
R-27	22,000 ohm; ±20%; 1 watt; carbon	RC31AE223M	.10
R-28	27 ohm; ±10%; ½ watt; carbon	RC21AE270K	.10
R-29	1000 ohm; ±20%; ½ watt; carbon	RC21AE102M	.10
	SPECIAL SOCKETS		
SO-1	5 prong, mica filled bakelite and mark-XTAL	6A117	.15
SO-2	6 prong, mica filled bakelite, unmarked	6A118	.15
SO-3	5 contact, ceramic jack bar	8A089	1.28
SO-4	Shorting type shielded connector	29A043	.40
	SWITCHES		
SW-1,2,3,4	FIL PWR, PLATE PWR, TRANSMIT-STANDBY and CATHODE CURRENT-EXC-MOD switch; DPDT toggle; current rating 3 amperes @ 250v	60A274	.74
SW-5	BAND SWITCH; six sections, five positions	60B041	2.00
SW-7	High voltage interlock switch; toggle; press to close; current rating 3 amperes @ 250v steel with bakelite casing	60A091	.72
SW-8	C.W.-PHONE; SPST toggle switch; current rating 10 amperes @125v; 5 amperes @ 250v; black bakelite	60A088	.54

REPLACEMENT PARTS LIST FOR RADIO TRANSMITTER MODEL HT-9 - Continued

REF. NO.	DESCRIPTION	HALICRAFTER'S PART NUMBER	LIST PRICE PER COMPONENT
	TRANSFORMERS		
T-1	Filament transformer for exciter stage tubes, power amplifier tube V-3 and rectifier tubes V-13 and V-14	52C122	8.18
T-2	Filament transformer for audio amplifier tubes	52C123	6.45
T-3	High voltage plate supply transformer for class C power amplifier stage	52C060	10.13
T-4	Interstage coupling transformer between preamplifier and modulator stages	55C039	4.56
T-5	Modulator transformer	55C038	8.55
T-6	Plate transformer for exciter stage	52C120	8.55
T-7	Plate transformer for audio amplifier and modulator	52C121	10.45
	PLATE TANK COILS		
L-4	1.5 to 2.5 megacycles	51B530	4.75
L-4	2.5 to 4.5 megacycles	51B260	5.00
L-4	4.5 to 7 megacycles	51B520	4.75
L-4	7 to 9 megacycles	51B261	4.88
L-4	9 to 13 megacycles	51B534	4.75
L-4	13 to 19 megacycles	51B262	3.75
L-4	19 to 28 megacycles	51B884	4.45
L-4	28 to 30 megacycles	51B263	4.45
	OSCILLATOR COIL UNITS		
	1.5 to 2 megacycles	51B517	*
	2 to 3 megacycles	51B518	*
	3 to 4.5 megacycles	51B516	*
	4.5 to 7 megacycles	51B519	*
	7 to 10 megacycles	51B508	*
	10 to 16 megacycles	51B872	*
	16 to 22 megacycles	51B873	*
	22 to 28 megacycles	51B874	*
	28 to 30 megacycles	51B512	*

REF. NO.	DESCRIPTION	HALICRAFTER'S PART NUMBER	LIST PRICE PER COMPONENT
	DOUBLER COIL UNITS		
	10 to 16 megacycles	51B877	*
	16 to 22 megacycles	51B875	*
	22 to 28 megacycles	51B876	*
	28 to 30 megacycles	51B510	*

* - Prices available on request
Prices subject to change without notice.
When ordering parts specify part number and description given in above list, also model number of set.

E-4. TUNING CHART

OPERATING FREQUENCY	BAND SWITCH POSITION	CATHODE CURRENT METER READING		P.A. GRID METER READING	P.A. PLATE METER READING	PLATE TUNING DIAL READING	REMARKS
		EXC.	MOD.				
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		
KC.		MA.	MA.	MA.	MA.		

E-5. CHART OF TUNING UNITS AND COILS UNIT FOR MODEL HT-9 TRANSMITTER

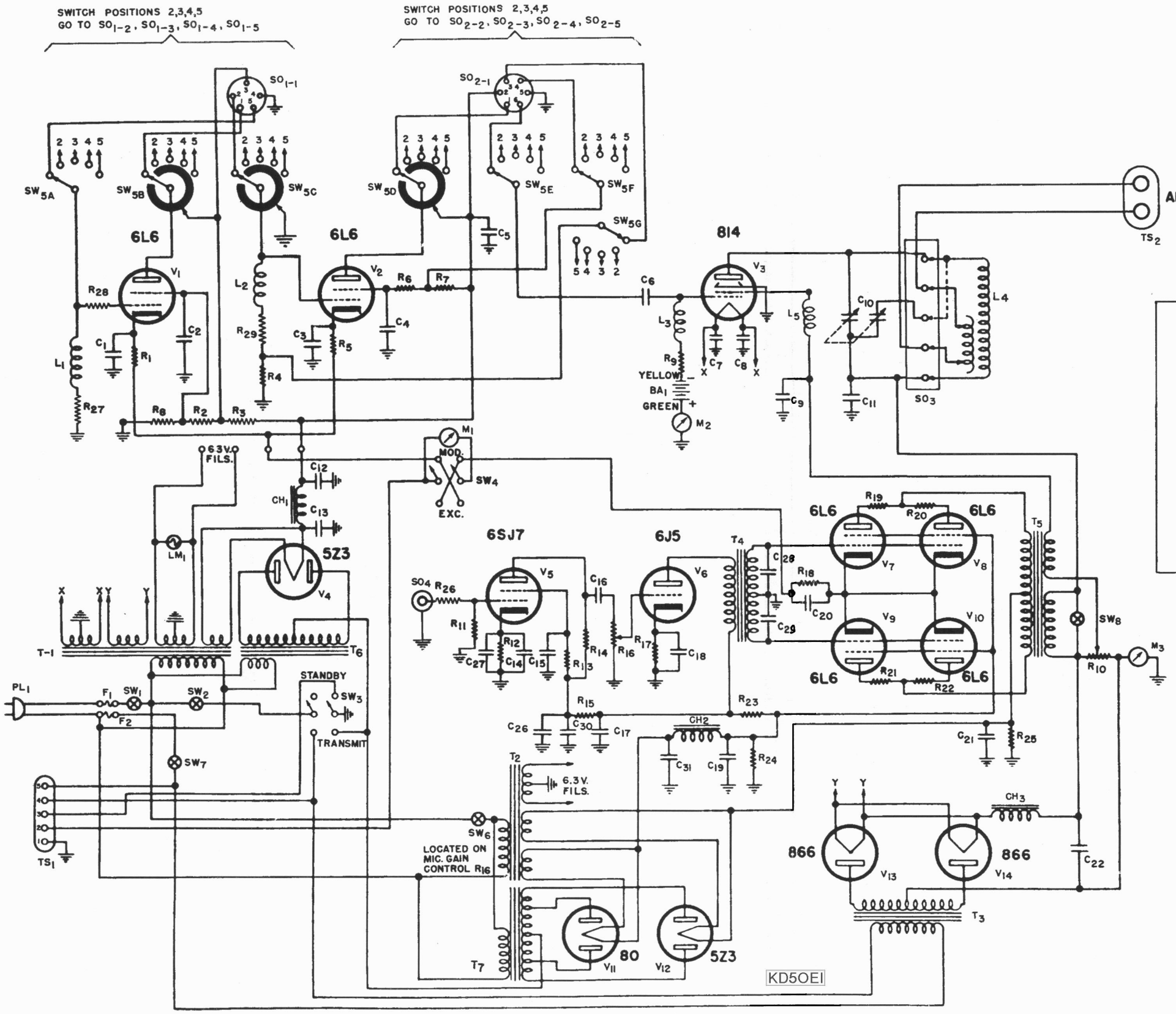
AMATEUR FREQUENCY RANGES

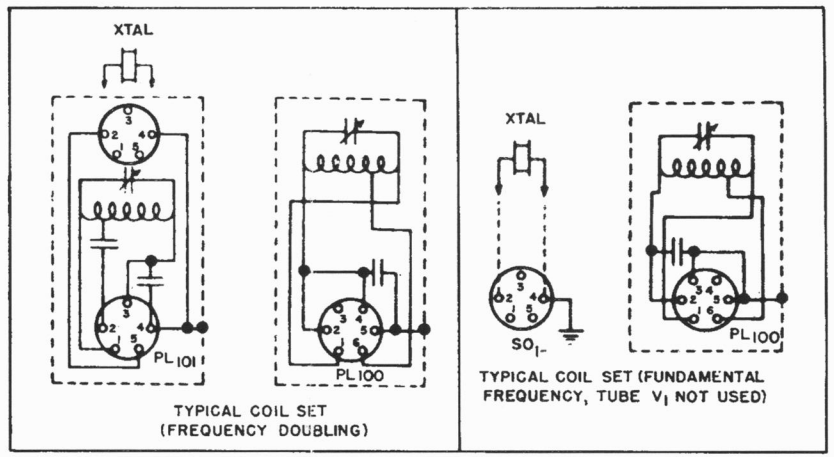
OPERATING FREQUENCY	TUNING UNIT IN SOCKET SO-1	TUNING UNIT IN SOCKET SO-2	TANK COIL UNIT IN SOCKET SO-3
160 meters, 1.75 to 2.05MC	Crystal (1.75 to 2.05MC)	Osc. Coil #51B517	#51B530
80 meters, 3.5 to 4. MC	Crystal (3.5 to 4. MC)	Osc. Coil #51B516	#51B260
40 meters, 7.0 to 7.3MC	Crystal (7.0 to 7.3MC)	Osc. Coil #51B508	#51B261
20 meters, 14 to 14.4MC	Osc. Coil #51B872 with 7 to 7.2MC Crystal	Doub. Coil #51877	#51B262
15 meters, (not allocated)	Osc. Coil #51B872 with 10.5 to 11MC Crystal	Doub. Coil #51B875	#51B884
10 meters, 28 to 30MC	Osc. Coil #51B512 with 14 to 15MC Crystal	Doub. Coil #51B510	#51B263
GENERAL COVERAGE			
1.5 to 2. MC	Crystal (1.5 to 2. MC)	Osc. Coil #51B517	#51B530
2.0 to 3. MC	Crystal (2.0 to 3. MC)	Osc. Coil #51B518	#51B530 1.5 to 2.5MC #51B260 2.5 to 4.5MC
3.0 to 4.5MC	Crystal (3.0 to 4.5MC)	Osc. Coil #51B516	#51B260
4.5 to 7. MC	Crystal (4.5 to 7. MC)	Osc. Coil #51B519	#51B520
7.0 to 10MC	Crystal (7.0 to 10. MC)	Osc. Coil #51B508	#51B261 7.0 to 9. MC #51B534 9.0 to 13. MC
10.0 to 16. MC	Osc. Coil #51B872 with 5.0 to 8. MC Crystal	Doub. Coil #51B877	#51B534 9.0 to 13. MC #51B262 13.0 to 19. MC
16.0 to 22. MC	Osc. Coil #51B873 with 8.0 to 11. MC Crystal	Doub. Coil #51B875	#51B262 13.0 to 19. MC #51B884 10.0 to 28. MC
22.0 to 28. MC	Osc. Coil #51B874 with 11.0 to 14. MC Crystal	Doub. Coil #51B876	#51B884
28.0 to 30. MC	Osc. Coil #51B512 with 14.0 to 15. MC Crystal	Doub. Coil #51B510	#51B263

Note: Five separate exciter channels may be set up simultaneously and may be selected by means of the BAND SWITCH.

SWITCH POSITIONS 2,3,4,5
GO TO SO_{1-2}, SO_{1-3}, SO_{1-4}, SO_{1-5}

SWITCH POSITIONS 2,3,4,5
GO TO SO_{2-2}, SO_{2-3}, SO_{2-4}, SO_{2-5}





SWITCH AND FUSE IDENTIFICATION

SW_1	FIL. PWR.
SW_2	PLATE PWR.
SW_3	TRANSMIT STANDBY
SW_4	CATHODE CURRENT
SW_5	BAND SWITCH
SW_6	AUDIO GAIN (SWITCH ON BACK OF GAIN CONTROL R_{16})
SW_7	SAFETY INTERLOCK LOCATED AT LEFT REAR OF CABINET UNDER COVER.
SW_8	CW. PHONE
F_1	10 AMP.
F_2	3 AMP.

SCHEMATIC DIAGRAM – MODEL HT-9 TELEGRAPH-TELEPHONE TRANSMITTER