

INSTRUCTIONS

COLLINS Type 32RA

RADIO TRANSMITTER

**MODEL 8**

**Output 75 Watts Radiotelegraph**

**Output 50 Watts Radiotelephone**

**Frequency Range**

**1.5 TO 15.0 MC**

**Manufactured By**

**COLLINS RADIO COMPANY**

**CEDAR RAPIDS, IOWA, U.S.A.**



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**BOOK NO. 346-3174**



## W A R N I N G

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL SHOULD AT ALL TIMES OBSERVE ALL THE SAFETY RULES LISTED BELOW. DO NOT CHANGE TUBES WITH HIGH VOLTAGE SUPPLY ON. WHEN MAKING ADJUSTMENTS WITHIN THE EQUIPMENT EXTREME CARE SHOULD BE EXERCISED TO PREVENT TOUCHING HIGH VOLTAGE CIRCUITS. ALL TUNING ADJUSTMENTS WITHIN THE TRANSMITTER SHOULD BE MADE USING AN INSULATED SCREWDRIVER. ALWAYS TURN OFF HIGH VOLTAGE AND DISCHARGE CIRCUITS BY GROUNDING BEFORE TOUCHING THEM.

Since the use of high voltages which are dangerous to human life is necessary to the successful operation of the radio transmitting equipment covered by these instructions, certain precautionary measures must be carefully observed by the operating personnel during the adjustment and operation of the equipment.

**KEEP AWAY FROM LIVE CIRCUITS:** When testing circuits of the transmitter it is preferable to make continuity and resistance checks rather than directly checking voltages at points in the circuit when high voltage is applied. Under no circumstances should tuning adjustments be made within the transmitter with an uninsulated screwdriver.

## GUARANTEE

This equipment is guaranteed against defects in material, workmanship or manufacture, for a period of one year from the date of delivery. Our obligation under this guarantee is limited to repairing or replacing any item which shall prove, by our examination, to be thus defective, provided the item is returned to the factory for inspection with all transportation charges paid. Before returning any item believed to be of defective material, workmanship or manufacture, a detailed report must be submitted to the company giving exact information as to the nature of the defect. The information shall include, in as much detail as possible, all subject material listed under instructions for replacement of parts. Upon receipt of the report by the company, a returned equipment tag will be forwarded to the shipper without delay. The returned equipment tag must accompany all shipments of defective parts. No action will be taken on any equipment returned to the company unless the shipment includes the return tag.

## THE COLLINS RADIO COMPANY

### REPLACEMENT OF PARTS

In case a replacement under the guarantee is desired, a full report must be submitted to the company. This report shall cover all details of the failure and must include the following information:

- (A) Date of delivery of equipment.
- (B) Date placed in service.
- (C) Number of hours in service.
- (D) Part number of item.
- (E) Item number (obtain from Parts List or Schematic Diagram).
- (F) Type number of unit from which part is removed.
- (G) Serial number of unit.
- (H) Serial number of the complete equipment.
- (I) Nature of failure.
- (J) Cause of failure.
- (K) Remarks.

When requisitioning replacement parts, the following information must be furnished:

- (A) Quantity required.
- (B) Part number of item.
- (C) Item number (obtain from Parts List or Schematic Diagram).
- (D) Type number of unit.
- (E) Serial number of unit.
- (F) Serial number of equipment.

NOTE: Blank Service Report forms will be found in the appendix of this instruction book.

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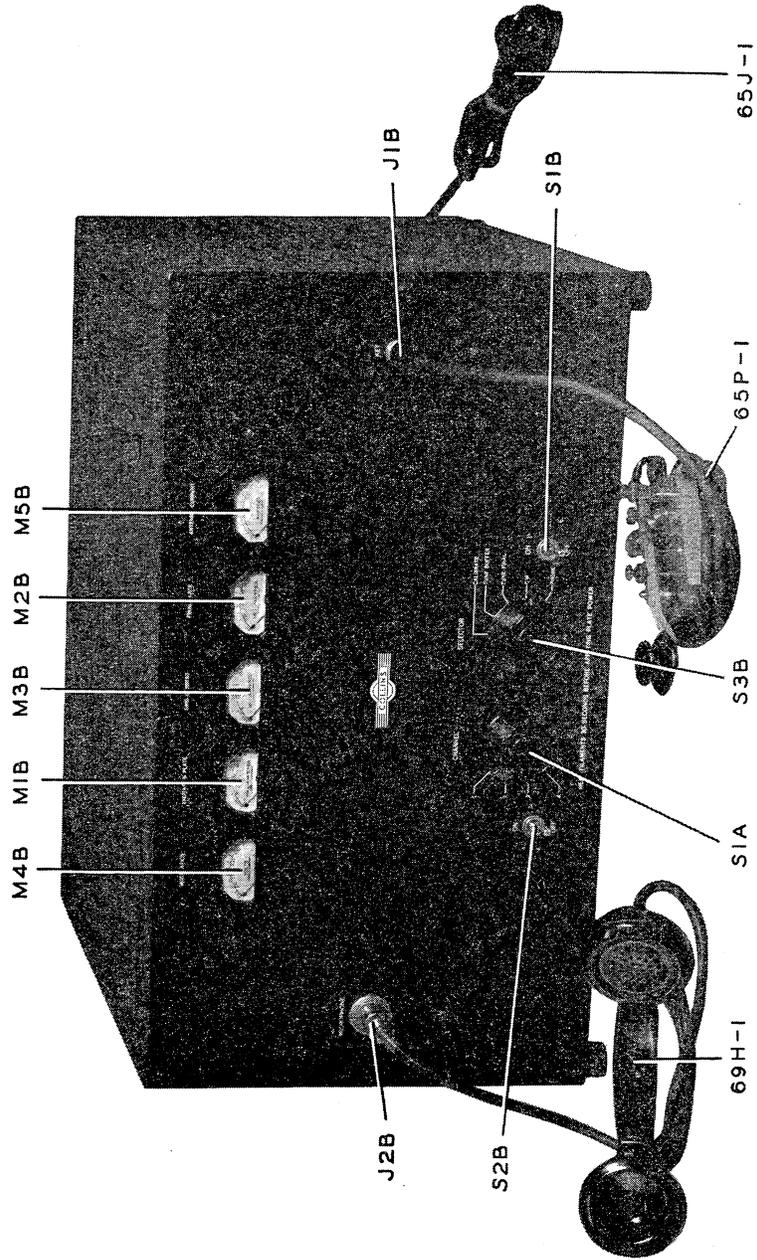


FIG. 1 32RA TRANSMITTER & ACCESSORIES  
FRONT VIEW

Figure 1

## I GENERAL CHARACTERISTICS

**1. EQUIPMENT.**—The Type 32RA Transmitter is completely contained in one unit. The complete installation consists of the transmitter unit, microphone, key and power cord. The transmitter components are housed in a cabinet 12" high, 22" wide, and 18" deep. The height is exclusive of mounting feet. The weight of the complete transmitter ready for operation is approximately 120 pounds.

The 32RA Transmitter is designed for table mounting. An area 22" wide by 18" deep on the table top is required. At least 2" clearance at the rear of the transmitter should be allowed for antenna and power connections.

**2. TUBE COMPLEMENT.**—Tubes are employed as follows in the 32RA Transmitter:

Tube Type	Quan.	Circuit Function	Unit Type
6L6G	1	H.F. Oscillator and Multiplier	33K
6L6G	1	Buffer and Multiplier	33K
807	3	Power Amplifier	33K
6C5	1	Audio Input Amplifier	9Z
6L6G	4	Modulator	9Z
80	1	Exciter Power Rectifier	411B
866A	2	Amplifier and Modulator Power Rectifier	411B

**3. GENERAL DESCRIPTION**—The Type 32RA equipment is a low power, general purpose radiotelephone and radiotelegraph transmitter. It is especially applicable in services where up to four frequency channels must be quickly available.

The transmitter cabinet is of the console type, suitable for table mounting. Ventilating louvers are provided in the top, back, and two sides, assuring adequate ventilation for all heat producing elements. The construction is of heavy gauge, electrically welded sheet steel with a durable gray crinkle finish outside and a flat gray enamel finish inside.

The components of the transmitter are so arranged that unit construction is possible and are broken down in four units as follows:

101L Panel and Cable Assembly  
 33K Radio Frequency Unit  
 9Z Speech Amplifier and Modulator  
 411B Power Supply

All wiring is entirely independent of the cabinet and all units may be readily removed from the cabinet for inspection or replacement.

**4. TYPE OF EMISSION.**—A1 telegraph and A3 telephone emission are available with the 32RA Transmitter. Keying of the carrier for telegraph operation is accomplished by interruption of the cathode circuit of the buffer and final amplifier stages. Keying speeds up to 60 words per minute may be employed. The audio frequency response of the transmitter in telephone operation is uniform within plus or minus 2 db from 400 to 5000 cycles per second and the audio frequency amplitude distortion is less than 5% rms total harmonics at any modulation level. The residual noise level is more than 50 db below 100% modulation.

**5. FREQUENCY RANGE.**—The frequency range of the 32RA Transmitter is normally 1.5 mc to 15 mc. The equipment is designed to work into unbalanced antennas or transmission lines having an impedance of 30 to 1200 ohms.

**6. FREQUENCY CHANGE METHOD.**—Four separate and unrelated frequencies within the range 1.5 to 15 mc may be set up. Any one of the four frequencies may be selected instantaneously by means of a single rotary switch. No retuning of any circuit is required when changing from one frequency to another. The oscillator may be either crystal controlled or self-excited depending upon the use of crystals or plug-in master oscillator tuning units. All tuning elements are of the plug-in type and may be changed at will. Tuning controls are located inside the cabinet and require the use of an insulated screwdriver for making adjustments.

**7. POWER OUTPUT.**—The nominal rated power output of the 32RA Transmitter is 50 watts radiotelephone and 75 watts radiotelegraph delivered into a 70 ohm artificial load at

ADDENDUM

Collins Type 32RA-8 Radio Transmitter  
Instructions

Refer to paragraph: "18. COILS AND CRYSTALS", page 13. The information given regarding coils and crystal frequencies is essentially correct, however, it should be noted that the crystal frequencies are NOT restricted to the range 1500 kc to 3750 kc. The only factors limiting the fundamental frequencies of crystals used in this equipment are the activity and reliability of the crystals. The use of active crystals in the range 3750 to 5000 kc should prove entirely satisfactory. In consideration of reliability of operation, it is recommended that no crystals above 5000 kc fundamental frequency be used.

3-22-43.

On Page 34, under the 9Z-8 Modulator Parts List, C3D should be listed "Same as C2D" instead of "same as C3C" as shown in the list.

On Page 35, a resistor should be added as follows:

R18D Resistor, Audio Gain Control      Same as R2D

On Page 38, the 7th line from the bottom, showing R2D, should read as follows:

1 R2D, R18D    10,000 ohm WW Pot.    377N225A    05M    M

9-25-43.

## GENERAL CHARACTERISTICS

any frequency within the specified range. The transmitter is capable of 100% modulation for telephone operation.

**8. POWER SOURCE AND INPUT REQUIREMENTS.**—The 32RA Transmitter is designed to operate from a 115 volt, single phase, 50/60 cycle a-c power source. The maximum input power requirement is 390 watts at 0.9 power factor.

**9. CONTROLS.**—A simplified system of control is employed in the 32RA Transmitter. Two heavy duty toggle switches control the filament and plate power circuits. The switches are so

interlocked that the plate power cannot be turned on until after the filament power switch has been operated. A press-to-talk button associated with the microphone may be used to turn on the plate power instead of the plate power switch when transmissions of short duration are contemplated. A selector switch provides for the application of plate power to successive r-f stages as well as the selection of proper circuits for telephone or telegraph emission.

**10. ACCESSORIES.**—A Type 65J-1 Power Cord, a Type 65P-1 Telegraph Key (with cord and plug), and a Type 69H-1 Handset are the only accessories required for the 32RA Transmitter.



## II INSTALLATION

11. **UNCRATING.**—Open packing cases with care. When cases are marked with arrows to indicate upright position, remove covers of cases only and lift units out carefully. Search all packing material for small packages. Remove wrapping from equipment and blow or lightly brush away packing dust and shavings. In case of damage, file all claims promptly with the transportation company. It is necessary to preserve the original packing box and packing material in case a claim is to be filed with the transportation company.

12. **INSPECTION.**—Inspect cables and wiring for possible broken or displaced wires. Make sure that all terminal connections are tight. Inspect each unit for loose screws or bolts. Make certain all controls such as switches, dials, etc., operate properly.

13. **PLACING TRANSMITTER.**—The console type cabinet is designed to be placed on the operating table along with the receiving apparatus. It occupies a space 22" wide by 18" deep. At least two inches should be allowed at the rear for making antenna and power input connections. Sufficient clearance at the sides should be provided for free circulation of air.

14. **FUSES.**—All fuses should be examined and their ratings checked. Correct fuse positions are shown in the top view photograph of the transmitter. The fuses employed in this equipment with corresponding parts list item numbers are tabulated below:

<u>Fuse Item</u>		
<u>Number</u>	<u>Circuit</u>	<u>Fuse Rating</u>
F1C	A.C. Power Line Fuse	10 amp.
F2C	H.V. Primary Fuse	6 amp.
F3C	L.V. & Bias Primary Fuse	3 amp.

15. **EXTERNAL CONNECTIONS.**—Place all power switches in the OFF position before attempting to make any external connections. The external connections for the 32RA Transmitter are as follows:

- (1) A.C. Power Line
- (2) Microphone and Key
- (3) Radiation System

a. **Power Line.**—The 32RA Transmitter is designed to operate from a 115 volt, single phase, 50/60 cycle power source. The supply line should be checked for these specifications before connections are made. The maximum power required from the line by this equipment is 390 watts. The power line is connected to the transmitter by means of a convenience cord supplied with the equipment. One end of the cord is plugged into the flush receptacle on the transmitter and the other end is placed in a standard outlet.

b. **Microphone and Key.**—The microphone plug is inserted in the MICROPHONE jack, J5B, on the front of the transmitter. It is very important, in order to avoid radio frequency feedback problems, to make sure the clamping ring on the microphone plug is tightly turned up on the threads around the input receptacle. Push-to-talk control connections are made as a part of the microphone circuit connections.

The telegraph key is plugged into the KEY jack, J4B, on the panel.

c. **Radiation System.**—The 32RA Transmitter is designed for use with unbalanced antennas only. The antenna and ground terminals are located on a terminal strip on the rear of the cabinet. The antenna terminals are arranged so that a separate antenna may be used for each of the four channels. By use of jumper wires one antenna may be used for several channels if desired.

A good, low resistance ground should be connected to the ground terminal. If the ground is poor the audio system may develop feedback. The output of the transmitter will also be seriously impaired by a poor ground system.

Several types of antennas are suitable for use with the 32RA Transmitter. One of the most simple and easily installed types is the inverted "L" antenna. This consists of a horizontal flat top section with a single wire lead-in connected to one end. The antenna length

## INSTALLATION

should be considered as the combined length of the flat top and lead-in sections.

For portable or mobile service a self-supporting telescope type vertical antenna is very useful. However, due to its limited length, the use of this antenna should be confined to the higher frequencies.

Perhaps the most efficient type of antenna is the guyed vertical antenna composed of concentric metal pipes or of structural sections such as used for rural wind-powered generators. This type of antenna is more permanent but also more expensive to install than most other types. The height of this type of antenna can usually be made great enough for maximum efficiency on the lower frequencies. Locate the transmitter as near the base of the antenna as possible so the lead-in will be short.

The electrical length of any antenna including the lead-in, used with this equipment, should preferably be not less than one-quarter wavelength on the lowest operating frequency. Avoid the vicinity of half wavelength antennas

or multiples thereof, since it is very difficult to load antennas of this length. Where one antenna is to be used for several frequency channels, the length should be chosen to avoid the regions of half wavelengths or multiples thereof. Allowing for end effects,

$$\text{Length of quarter-wave antenna (feet)} = \frac{240}{\text{Operating frequency (mc)}}$$

For example, if the lowest operating frequency will be 2.0 mc (2000 kc), the antenna and lead-in might be made approximately 120 feet long. If there were no operating frequencies near 4.0, 8.0 or 12.0 mc, the antenna would probably be suitable to all four channels. If an antenna proves troublesome to load on one operating frequency, it may be lengthened or shortened a small amount. This will usually clear the trouble. If one antenna is not satisfactory for all frequencies, a separate antenna can always be connected to any channel on which loading trouble occurs.

### III PRELIMINARY ADJUSTMENT

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL SHOULD AT ALL TIMES OBSERVE ALL OF THE SAFETY RULES. DO NOT CHANGE TUBES WITH HIGH VOLTAGE SUPPLY ON. WHEN MAKING ADJUSTMENTS WITHIN THE EQUIPMENT EXTREME CARE SHOULD BE EXERCISED TO PREVENT TOUCHING HIGH VOLTAGE CIRCUITS. ALL TUNING ADJUSTMENTS WITHIN THE TRANSMITTER SHOULD BE MADE USING AN INSULATED SCREWDRIVER. ALWAYS TURN OFF HIGH VOLTAGE AND DISCHARGE CIRCUITS BY GROUNDING BEFORE TOUCHING THEM.

16. PRELIMINARY.—Be certain the filament and plate power switches are in the OFF position. Turn the AUDIO GAIN control, located on the 9Z Modulator Unit, to the full off (counterclockwise) position. Place the SELECTOR switch in the CALIBRATE position.

17. TUBES.—Each of the units requires tubes in accordance with the list shown on page one. Each tube position is engraved with the proper tube type designation. All tubes may now be inserted, using the engravings and the top view photograph as a guide. When placing plate leads on the plate cap connections of tubes, use care so as to avoid putting any mechanical strain on the glass.

18. COILS AND CRYSTALS.—Although the 32RA is a four channel transmitter designed for rapid frequency changing, plug-in coils and crystals are used so that it is possible to place any channel on any frequency within the service range with a minimum of effort.

The frequency of the oscillator may be controlled by either master oscillator coils or quartz crystals. Each channel requires two additional coil units, one for the exciter plate tank circuits and one for the output network.

a. Crystals.—Crystal control may be employed on any frequency within the service range. The equipment has been designed for crystals in the frequency range of 1500 to 3750 kc. The operating frequency is twice crystal fre-

quency in the range 3750 to 7500 kc, and four times crystal frequency in the range 7500 to 15,000 kc. The transmitter should never be operated on the *third* harmonic of the crystal frequency, since this harmonic frequency is generally unreliable.

b. Master Oscillator Coils.—When it is desired to operate the 32RA Transmitter with a self-controlled master oscillator circuit, it is necessary to place a type 145J Master Oscillator Frequency Control Unit in the crystal socket corresponding to the CHANNEL control switch position. This frequency control unit consists of a low loss tank coil with a fixed tuning capacity forming a high Q tank circuit which serves in place of the quartz crystal. The frequency of operation of this tank circuit may be varied over a frequency range of approximately 1.25 to 1 by means of an adjustable core. The position of this core may be adjusted by means of a screw protruding from the top of the unit.

The transmitter may be operated on the first, second, third or fourth harmonic of the *master oscillator* coils. The operating range of the master oscillator coil group for each harmonic is as follows:

Oscillator Freq. Range	Operating Harmonic	Operating Freq. Range
1500-3750 kc.	1st	1500-3750 kc.
1500-3750 kc.	2nd	3000-7500 kc.
1500-3750 kc.	3rd	4500-11250 kc.
1500-3750 kc.	4th	6000-15000 kc.

From the above list it may be seen that in some ranges between 3000 and 11,250 kc, the transmitter may be operated on any one of several harmonics of the master oscillator coils.

c. Exciter Coils.—The type 7000C-5 plug-in exciter coil units employed in the oscillator and buffer stages on each channel consist of one or two tank coils and two variable capacitors mounted in an aluminum shield 2" x 2" x 4½". The windings are placed on a grooved ceramic form supplied with pins to fit a medium seven prong socket.

The coil units employed in the exciter stages on frequencies from 1.5 to 9 mc, are constructed with one tank coil only. These coils (#1, 2, 3

## PRELIMINARY ADJUSTMENT

and 4) are tapped to provide two frequency ranges which may be selected as desired by placing the knurled screw at the top of each coil can in the screw holes adjacent to the range desired. The frequency ranges covered by the two tank circuit arrangements of each coil are designated RANGE-A and RANGE-B. Coils #5 and #6 have only one frequency range which is shown under RANGE-B. In coils #1, 2, 3, and 4, the tank capacitor designated TUNING is employed in the buffer plate tank circuit, and the capacitor designated EXCITATION is employed as the excitation control for the power amplifier stage. In coils #5 and 6 the capacitor designated EXCITATION is employed with a separate tank coil in the oscillator plate circuit. Coils #5 and 6 are used for all frequencies above 9 mc.

The frequency range of each coil is as follows:

Coil No.	Range	Frequency Range
1	A	1.5 - 2.1 mc
	B	2.0 - 2.7
2	A	2.5 - 3.4
	B	3.2 - 4.5
3	A	4.0 - 5.5
	B	5.2 - 7.0
4	A	6.0 - 8.2
	B	8.0 - 10.0
5	A	None
	B	9.0 - 12.0
6	A	None
	B	12.0 - 15.0

**d. Output Network Coils.**—The two Type 190 series coils employed in the output network cover the entire frequency range of the transmitter. These coils are wound on threaded ceramic forms with tinned wire. A rider is provided on each coil for selecting any number of turns desired. The 190F coil has 56 turns and should be used in the range below 5.0 mc. The 190E coil has 25 turns and should be used in the range above 5 mc.

**e. Tuning Charts.**—Tuning charts are shown on page 25 to assist the operator in selecting the proper coils for any desired output fre-

quency. The Exciter Tuning Chart indicates the proper master oscillator coil for any frequency and also shows which harmonic of the coil should be used. The approximate setting of the antenna coil may also be determined from the Antenna Coil Tuning Chart.

An important function of the Exciter Tuning Chart in connection with the 7000C-5 exciter coils is to indicate the approximate settings of the TUNING and EXCITER capacitors for either RANGE-A or RANGE-B of any coil. This will assist the operator in selecting the proper harmonic when frequency multiplying is employed. Some of the exciter coils will tune to either the third or fourth oscillator harmonic in a single coil range.

Examples of the use of these charts are given as follows:

**Example (a) Crystal controlled operation on 3810 kc:**

As previously mentioned under Crystals, the operating frequency is twice crystal frequency in the range 3750 kc to 7500 kc. Therefore, a 1905 kc crystal will be required. Referring to the Exciter Tuning Chart, it may be seen that, for an operating frequency of 3810 kc, buffer coil #2, Range B or coil #3, Range A may be used in the buffer tank circuit. The approximate TUNING dial setting for either coil may be noted from the chart.

The antenna coil tuning chart indicates that the 190F coil will be required for 3810 kc, and that the coil should be set at approximately 18 turns.

**Example (b) Master Oscillator Operation on 8412 kc:**

Referring to the Exciter Tuning Chart, buffer coil #4, Range B will be required. The approximate TUNING dial settings will be 35. The bar graph of the frequency range of the master oscillator coils shows that there are two coils which may be used. The 145J-4 coil will be suitable with frequency quadrupling in which case the oscillator frequency will be one-fourth 8412 kc, or 2103 kc. The 145J-6 coil will be suitable with frequency tripling, in which case the oscillator frequency will be one-third of 8412 kc, or 2804 kc.

## PRELIMINARY ADJUSTMENT

The 190E antenna coil will be required for 8412 kc operation and the tap should be set at approximately 11 turns.

**19. RADIO FREQUENCY CIRCUIT ADJUSTMENT.**—In general, when complete sets of coils are supplied for one or more channels and the frequency is specified, the coils will be shipped from the factory pre-tuned except for the power amplifier coil. The exciter coil unit should not require adjustment. However, when a set of coils is supplied for a general tuning range and no specified frequency is ordered, it will be necessary to adjust each tuning control beginning with the oscillator. When returning of the exciter stages is required, the procedure outlined below should be followed.

**a. Transmitter Tuning Procedure.** — **CAUTION:** The plate voltage employed in this equipment may exceed 550 volts and is therefore dangerous to life. Always turn the PLATE switch off before making any adjustments inside equipment, except when using an *insulated screwdriver*. Do not touch the antenna coils or the plate caps on the tubes when the PLATE switch is on.

A dummy antenna may be used in place of the regular antenna for preliminary adjustments. This type of load will be especially helpful to the operator who is not familiar with this equipment since the dummy antenna is much easier to load than an actual antenna. An ordinary 100 or 150 watt tungsten lamp will be suitable for this purpose.

After the crystal or master oscillator unit has been plugged into the five-prong socket of the channel on which operation is desired, the following procedure should be used to tune the transmitter:

(1) Place the CHANNEL switch in the position of the channel on which operation is desired.

(2) Place the SELECTOR switch in the CALIBRATE position.

(3) Referring to the Exciter Tuning Chart on page 25 select the proper type 7000C-5 coil for the desired output frequency. If the coil

has a dual range, place the knurled shorting screw into the hole on the coil nameplate which is adjacent to the range desired. Tighten the knurled screw down well by hand.

(4) Plug the coil into the medium seven-prong socket of the channel desired. (Refer to Fig. 5.)

(5) Referring to the Antenna Coil Tuning Chart on page 25 select either the 190E or 190F antenna coil, depending upon the output frequency, and adjust the rider on the coil to give the number of turns indicated for the operating frequency.

(6) Turn the FILAMENT switch ON.

(7) After allowing 30 seconds for the filaments to heat, turn the PLATE switch ON. *Note:* This operation applies 550 volts d.c.

(8) A reading of 30-35 ma should be observed on the EXCITATION PLATE meter. This is the oscillator plate current.

(9) If master oscillator unit is being used, the frequency of the unit should be adjusted as follows:

(a) Remove PLATE voltage.

(b) Loosen the lock nut on the large adjustment screw.

(c) Restore PLATE voltage.

(d) Using a suitable frequency standard such as a multivibrator and receiver, adjust the frequency of the master oscillator by adjusting the screw on the top of the unit: *Note:* If a power absorbing device such as a wavemeter is to be used, the frequency should be adjusted after the final amplifier has been tuned. In this case, a receiver may be used to obtain an approximate setting of the master oscillator.

(e) Remove PLATE voltage and carefully tighten the friction type lock nut so that vibration will not disturb the adjustment of the master oscillator unit.

(f) Check the frequency after restoring PLATE power.

(10) Remove PLATE voltage and set SELECTOR to the TUNE BUFFER position.

## PRELIMINARY ADJUSTMENT

(Note: *Always* remove plate voltage before changing the position of the SELECTOR or CHANNEL dials. This will prevent burning switch contacts.)

(11) Again apply PLATE voltage and, after setting the EXCITATION dial at about 50, adjust the TUNING dial for maximum GRID CURRENT. The curves on page 25 may be used as a guide for setting the TUNING dial. Note: If either coil #5 or #6 is used, it may be necessary to set the EXCITATION dial at some other point than 50 to get any appreciable grid current when the TUNING dial is adjusted.

(12) Now adjust the EXCITATION dial to give approximately 7 ma of GRID CURRENT and readjust the TUNING dial for maximum GRID CURRENT. Note: If coil #5 or #6 is used, adjust both dials for maximum GRID CURRENT.

(13) Remove PLATE power and set SELECTOR switch to the TUNE FINAL position.

(14) Reapply PLATE power and if coil #1, 2, 3, or 4 is used, readjust the GRID CURRENT to approximately 7 ma by means of the EXCITATION DIAL, peaking it with the TUNING dial.

(15) Set the ANTENNA TUNING capacitor at maximum capacity and adjust the FINAL AMP. TUNING capacitor for minimum FINAL PLATE current.

(16) If the FINAL PLATE current is less than 140-150 ma, decrease the number of turns on the tank coil. CAUTION: *Always remove PLATE power before making any adjustments inside equipment.* Add turns if the FINAL PLATE current is above 140-150 ma. Retune FINAL AMP. TUNING capacitor for minimum FINAL PLATE current.

(17) Remove PLATE power, set the SELECTOR to the CW operating position and restore PLATE power.

(18) Adjust the ANTENNA TUNING capacitor to bring the FINAL PLATE current up to 300 ma and retune the FINAL AMP. TUNING capacitor for minimum FINAL PLATE current. If the tubes cannot be loaded

to 300 ma, decrease the number of turns on the tank coil slightly.

(19) Repeat step (18) if necessary until the tubes are loaded to 300 ma with the FINAL AMP. TUNING capacitor tuned for minimum FINAL PLATE current.

(20) After the transmitter has been properly adjusted, the settings of the 7000C-5 coil should be checked against the curves on page 25 so as to avoid the possibility of being on the wrong harmonic of the oscillator. It may be found that the coil selected will tune equally well on either the third or fourth harmonic of the oscillator frequency, therefore care must be used to obtain the desired output frequency.

(21) Remove the PLATE voltage.

b. Audio Adjustments.—After the transmitter has been properly tuned on a given channel, the audio adjustments may be completed. The following procedure is recommended:

(1) Plug the microphone into the MICROPHONE receptacle provided on the front panel. Be sure to tighten the locking ring well, since a poor contact may cause r-f feedback in the audio system.

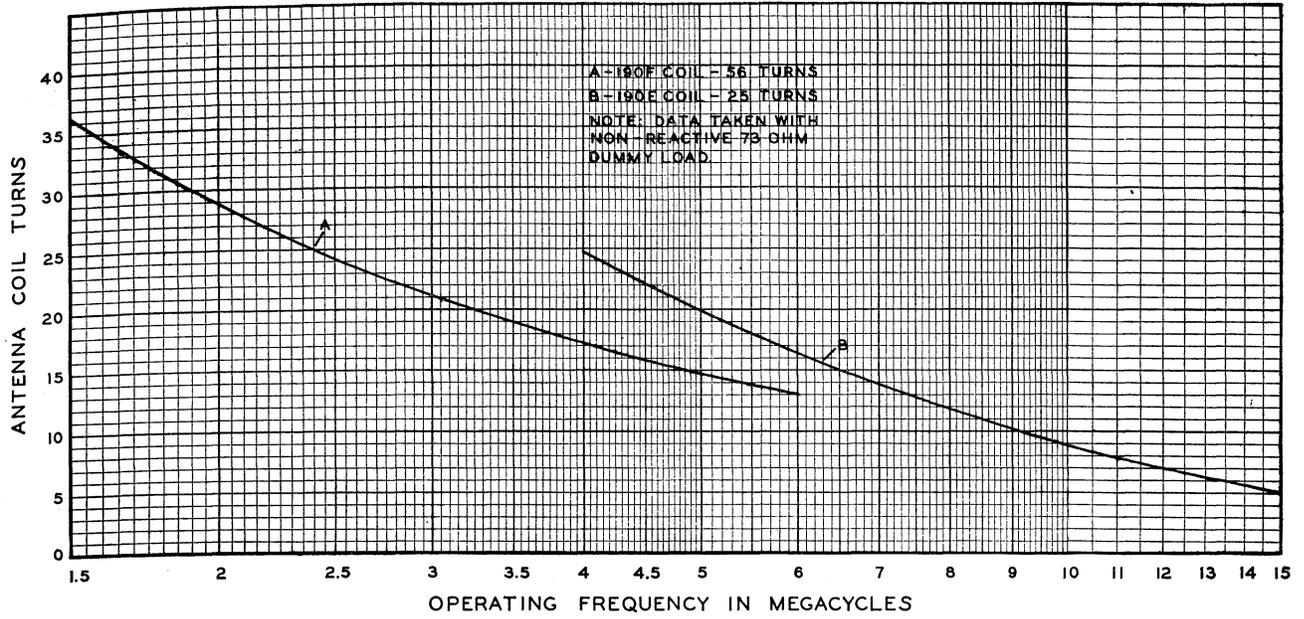
(2) Place the SELECTOR in the PHONE position.

(3) Place the switch on the front end of the 9Z Modulator Unit in the MOD. position. When the switch is in this position, the MODULATION meter will read to the red line at 400 volts when the transmitter is modulated 100% with a pure tone. (The adjusting potentiometer for this meter, located beneath the chassis, has been adjusted at the factory and will not require attention in the field.)

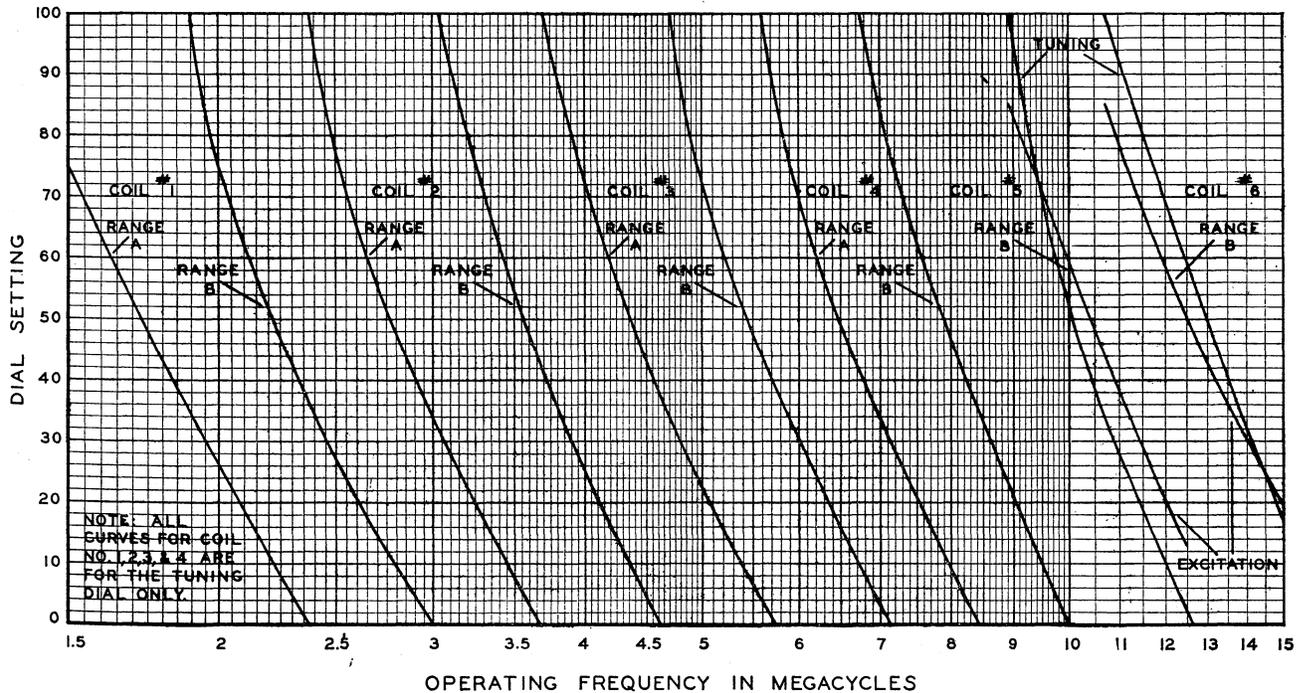
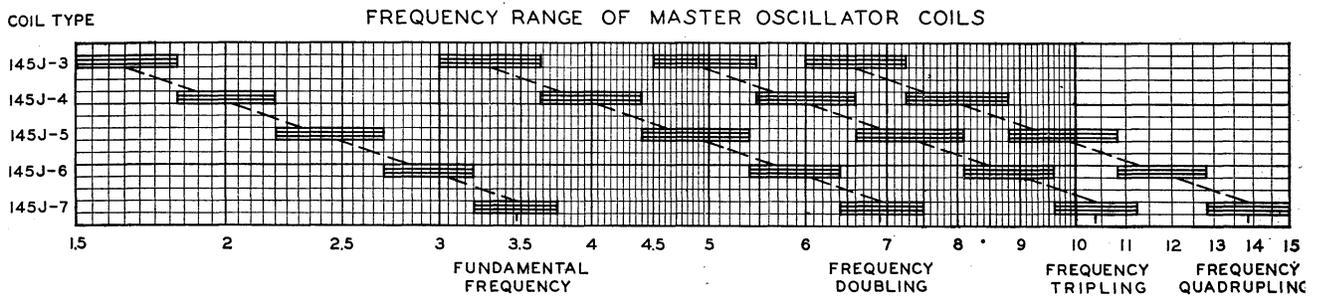
(4) Turn on the plate voltage by pressing the push-to-talk button on the microphone. The FINAL PLATE meter should read approximately 225 ma which is the normal reading for phone operation.

(5) While talking in a normal tone of voice, advance the AUDIO GAIN control, located on the front of the 9Z Modulator Unit, in a clockwise direction until the MODULATION meter reads approximately 250 volts on peaks. This

## PRELIMINARY ADJUSTMENT



### ANTENNA COIL TUNING CHART



### EXCITER TUNING CHART

## PRELIMINARY ADJUSTMENT

reading represents the 100% modulation level for voice input. It would be well to check the modulation by means of a cathode-ray oscilloscope.

The audio adjustments are now complete and will not require further attention when operating on other channels. Always be sure that the FINAL PLATE current is approximately 225 ma when operating on phone.

c. Routine Operation.—After the transmitter has been properly tuned on all frequencies, changing from one channel to another will merely involve the rotation of the CHANNEL selector dial to the desired channel. Do not forget to remove PLATE power before changing channels.

To shift from phone to CW, remove the PLATE power while changing the SELECTOR dial from the PHONE to the CW position.

#### IV CIRCUIT DESCRIPTION

20. **CONTROL CIRCUITS.**—The transmitter power circuits are controlled from the front panel by means of two switches. When both switches are in the OFF position, all power circuits are open. When the FILAMENT switch is ON, power for heating all filaments is supplied. When the PLATE switch is in the ON position, the transformers supplying the plate and bias voltages are energized. The switches are interlocked so that the high voltage cannot be turned on unless the FILAMENT switch is in the ON position. A push-to-talk button associated with the microphone may be used to turn on the plate power of the transmitter instead of the PLATE switch when transmissions of short duration are contemplated. When this is desired, it is necessary to place the PLATE power switch in the OFF position. The SELECTOR switch provides for application of plate power to successive r-f stages as well as the selection of the proper circuits for Phone or CW emission. Provision is made for application of the plate voltage to the final amplifier through a dropping resistor to facilitate tuning.

21. **KEYING CIRCUIT.**—Keying is accomplished in the 32RA Transmitter by interruption of the cathode circuit of the buffer and final amplifier tubes.

22. **CHANNEL SELECTOR SYSTEM.**—Four frequency channels are available in the 32RA Transmitter. The tuning elements on each channel are made up of individual, pre-tuned tank circuits. These elements are of the plug-in type and may be readily changed. Channel selection is obtained by means of the CHANNEL switch, which selects the required group of tuned elements for the frequency desired.

23. **POWER SUPPLIES.**—Two plate power supply systems are employed in this equipment. One supply employs a Type 80 rectifier tube in a full wave circuit with a capacitor input filter. This supply has a total output voltage of approximately 470 volts, and furnishes 380 volts to the r-f oscillator, buffer/doubler and speech amplifier stages. It also supplies 90 volts bias to the final amplifier grids.

The main plate power supply employs two 866A rectifier tubes in a full-wave circuit with a two section choke input filter. This supply furnishes 540 volts to the final amplifier in CW operation, and supplies 450 volts to the final amplifier and modulator in phone operation. The plate transformer is provided with a tapped primary for reducing the output voltage for phone operation.

The rectifier tubes of the two power supplies are supplied with filament power from the same transformer that energizes the r-f and audio tube filaments. The plate transformer for each supply is individually fused.

24. **AUDIO SYSTEM.**—A two-stage speech amplifier-modulator unit is employed in the 32RA transmitter. The input consists of a single 6C5 tube and microphone transformer designed to be used with a single button carbon microphone. This stage drives the Class AB modulator stage. The modulator stage consists of four 6L6G tubes operating in a push-pull-parallel circuit. The modulator stage modulates the Class C r-f amplifier directly.

Microphone current for the single button carbon microphone is obtained from bridging resistors in the cathode circuit of the modulator stage. An audio gain control adjusts the input level to the 6C5 tube grid circuit. This stage is transformer coupled to the modulators. The bias for each stage is obtained from a cathode resistor. A push-to-talk button associated with the microphone operates a relay in the power supply which turns on the plate power of the transmitter for push-to-talk operation.

25. **RADIO FREQUENCY SECTION.**—

a. **Oscillator.**—The 32RA Transmitter employs a beam power type oscillator tube which is controlled by a low temperature coefficient quartz crystal or a master oscillator coil unit, providing an oscillator having high frequency stability. The oscillator is designed so that power output may be obtained on its harmonic frequencies as well as its fundamental frequency. The control grid and the screen grid of the tube together with the cathode constitute the primary oscillator circuit which is allowed to oscillate at all times voltage is applied to the

## CIRCUIT DESCRIPTION

screen grid. The primary oscillator circuit is coupled to the plate circuit by means of the electron stream. This circuit feature performs an isolation function, thus providing further stabilization of the oscillator frequency.

**b. Buffer Amplifier.**—This stage employs a 6L6G beam power tube and is operated either as an intermediate amplifier or as a frequency doubler. The grid circuit is capacitively coupled to the plate circuit of the oscillator tube and employs a combination of cathode resistor and grid leak bias. Cathode bias prevents excessive plate current should the excitation fail. Approximately 380 volts is applied to the plate of the tube. Screen potential is obtained by means of a dropping resistor in series with the plate voltage.

**c. Final Amplifier.**—The final radio frequency amplifier employs three type 807 tubes operating in a parallel circuit. These tubes are operated as plate modulated Class C amplifiers.

A fixed grid bias of approximately 90 volts is employed. Approximately 450 or 540 volts d.c., depending on the type of emission, is applied to the plates of the tubes. Screen potential is obtained by means of a resistor in series with the plate voltage.

**d. Radio Frequency Output Circuit.**—The output circuit consists of a pi network capable of operating into an unbalanced antenna or transmission line. Use of this type of output network greatly simplifies the tuning procedure. As this network is a low pass filter, harmonic attenuation is attained. The elements of the pi network are of such values that a large range of impedances may be matched. The output coils are provided with a coil tapping device which permits the choice of the number of turns at will. The input capacitor of the network is provided with a pair of jacks so that a bridging capacitor may be installed for operation on the lower frequencies when the range of capacitance of the variable plate tuning capacitor proves insufficient.

## V MAINTENANCE

*This radio equipment is constructed of materials considered to be the best obtainable for the purpose, and has been carefully inspected and adjusted using accurate test equipment. No one but an authorized and competent service man equipped with proper test facilities should be permitted to service this equipment.*

**26. ROUTINE INSPECTION.**—Routine inspection schedules should be set up for periodic checks of this equipment. This inspection should include examination of the mechanical system for excessive wear or binding and of the electrical system for electrical defects. Make a check of emission characteristics of all tubes. After the emission check, examine the prongs on all tubes to make sure that they are free from corrosion. See that all tubes are replaced correctly and fully in their sockets, and that good electrical contact is made between the prongs of the tube and the socket. Check the relay for proper operation and inspect the relay contacts to make certain that the contact surfaces are clean and free from pits and projections. Make certain that contacts of all receptacles and plugs such as microphone, key and cable connectors are clean and that these make firm mechanical connection between one another.

If the routine inspection of the equipment is carried out faithfully, the chances of improper operation of the equipment are greatly minimized. It is, therefore, important that this inspection be made frequently. It should be sufficiently thorough to include all major electrical circuits of the equipment as well as the mechanical portion.

**27. CLEANING.**—The greatest enemy to uninterrupted service in equipment of this type is corrosion and dirt. Corrosion itself is accelerated by the presence of dust and moisture on the component parts of the assembly. It is impossible to keep moisture out of the equipment in certain localities, but foreign particles and dust can be periodically removed by means of a soft brush and a dry, oil-free jet of air. Remove the dust as often as a perceptible quantity accumulates in any part of the equipment. It is very important that rotating equipment

such as variable condensers and tap switches be kept free from dust to prevent undue wear. Likewise, variable condenser plates should be kept free from dirt to avoid flashover on modulation peaks.

**28. RELAYS.**—In general the contact adjustment of the a-c type relay is not critical. Spare contacts and spare coils can be obtained and replacement made when necessary. Never use an abrasive on the contact surfaces. Relays which have excessive hum are usually not seating properly. Dirt on the pole faces is the most likely cause of this and may be removed by washing with gasoline.

**29. FUSES.**—This equipment requires three plug type fuses. Fuses which have failed should be replaced with spares only after the circuit in question has been carefully examined to make certain that no permanent fault exists. Be sure each replacement fuse has the proper rating as is engraved next to the socket in which it is to be placed.

**30. CRYSTALS.**—The low frequency-temperature coefficient quartz crystals as supplied in Collins Transmitters are extremely active and rugged. They should require little or no attention over long periods of time. The type 1 series crystal holders are sealed against moisture and dirt and should not be opened unless all tests of the oscillator circuit point to erratic condition in the crystal.

If required, the crystal and electrodes may be cleaned with carbon tetrachloride and a soft cloth. After reassembling the holder and before resealing with duco cement in the case of type 1 series holder, the holder with crystal in position should be heated to drive out any excess moisture. The temperature in the heating process should not exceed 60 degrees C.

It is recommended that crystals should not be examined unless a fault develops, since frequent cleaning and handling will in time change the frequency.

**31. REMOVAL OF UNITS.**—In order to remove the power, r-f or modulator units from the equipment, the front panel must be re-

## MAINTENANCE

moved. The power and modulator units cannot be removed until after the r-f unit has been removed. Care should be used to avoid damaging the wiring or component parts on the units.

The following procedure is recommended for disassembling the transmitter:

(1) Set the transmitter on its right side with the front panel forward.

(2) Carefully pull off the cable connector attached to each of the three units. Place the fingers on either side of the connector and work it back and forth gently until it pulls off. Caution: *Do not remove the connectors by pulling on the cable wires. This may cause the wires or connectors to break.*

(3) Using a #6 Bristo wrench, loosen the two set screws on the sleeve coupler of the CHANNEL switch. This coupler is located behind the detent mechanism.

(4) Remove the two screws on the ends of the row of meters and then remove the back plate behind the meters.

(5) Loosen the nuts on the ANTENNA CURRENT meter and remove the two lead wires.

(6) Remove the eight screws along the edges of the front panel and pull off the front panel assembly.

(7) Remove the three screws on the front edge and the two screws on the back edge of the r-f unit.

(8) Lift the front end of the r-f unit up and then pull the unit forward slightly to free the antenna bushings. Then lift the unit out the top of the cabinet being careful not to damage any of the switches, etc., beneath the chassis.

(9) The modulator and power units may now be removed as desired by removing the screws along the front and rear edges of the units. Note: To remove the screws in the rear corners of the cabinet (one on each of the modulator and power units) unscrew the rubber mounting feet and insert a slender screwdriver through the tapped holes to heads of the screws.

To reassemble the transmitter, simply reverse the foregoing procedure. Be sure to properly align the CHANNEL switch knob and shaft before tightening the set screws on the sleeve coupler.

32. TROUBLE SHOOTING.—A common cause of improper operation of radio equipment is tube failure. A complete set of tested spare tubes should be kept on hand at all times. If faulty operation of the transmitter is observed and tube failure suspected, each tube may be checked by replacing it with a like tube known to be in good condition. In case an open fuse is found, it is an indication of overload on some circuit in the transmitter. The overload may be caused by a short circuit. The short circuit may be due to a foreign article being dropped into the cabinet, a defective condenser, defective tubes or a high voltage arc. A direct short is most readily found by means of a continuity meter. The d-c resistance of the various circuits may be checked in order to locate the fault.

Defective tubes causing an overload in power circuits may usually be located by inspection. It will be found that excessive heating or sputtering within the vacuum tubes is a good indication of a fault in the tube circuit. High voltage arcs may be caused by bent condenser plates, corrosion or dust. It is well known that one of the greatest sources of trouble in equipment located in a salt atmosphere is corrosion. Corrosion resulting from salt spray or salt laden atmosphere may cause failure of the equipment for no apparent reason. In general, it will be found that contacts such as tap switches, tube prongs, cable plug connectors and relay contacts are most affected by corrosion. When it is necessary to operate the equipment in localities subject to such corrosive atmosphere, inspection of wiping contacts, cable plugs, relays, etc., should be made more frequently in order to keep the equipment in good condition.

The table of TYPICAL VOLTAGES, in the PERFORMANCE DATA section of the APPENDIX, is supplied to assist the operator in trouble shooting. Open and short circuits will usually be accompanied by a change in the voltages applied to one or more of the tubes. A check of the various tube voltages against the typical values shown in the table will assist in locating the source of trouble.