PART OF TEST EQUIPMENT IE-46A

ARMY AIR FORCES
TECHNICAL ORDER No. 08-10-107

# INSTRUCTION BOOK

FOR

# OPERATION and MAINTENANCE

OF

# FREQUENCY METER BC-906-C

MANUFACTURED BY
PHILCO CORPORATION
PHILADELPHIA, PA.

ORDER No. 811-WF-42

# RESTRICTED

PUBLISHED BY AUTHORITY
OF
THE CHIEF SIGNAL OFFICER

NOVEMBER 25, 1942

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## REPORT OF MAJOR FAILURE

**In the event of major failure of any of the component units of this equipment a report shall be submitted in the form indicated below. Copies of this report shall be forwarded to the Chief, Signal Section, Air Service Command, Patterson Field, Fairfield, Ohio, and to the Director, Signal Corps Aircraft Signal Service, Wright Field, Ohio.**

1. Contract or order number . . . . . .
2. Organization and station . . . . . .
3. Nomenclature of equipment . . . . . .
4. Nomenclature of component unit . . . . . .
5. Date and nature of failure . . . . . .
6. Type of airplane in which installed . . . . . .

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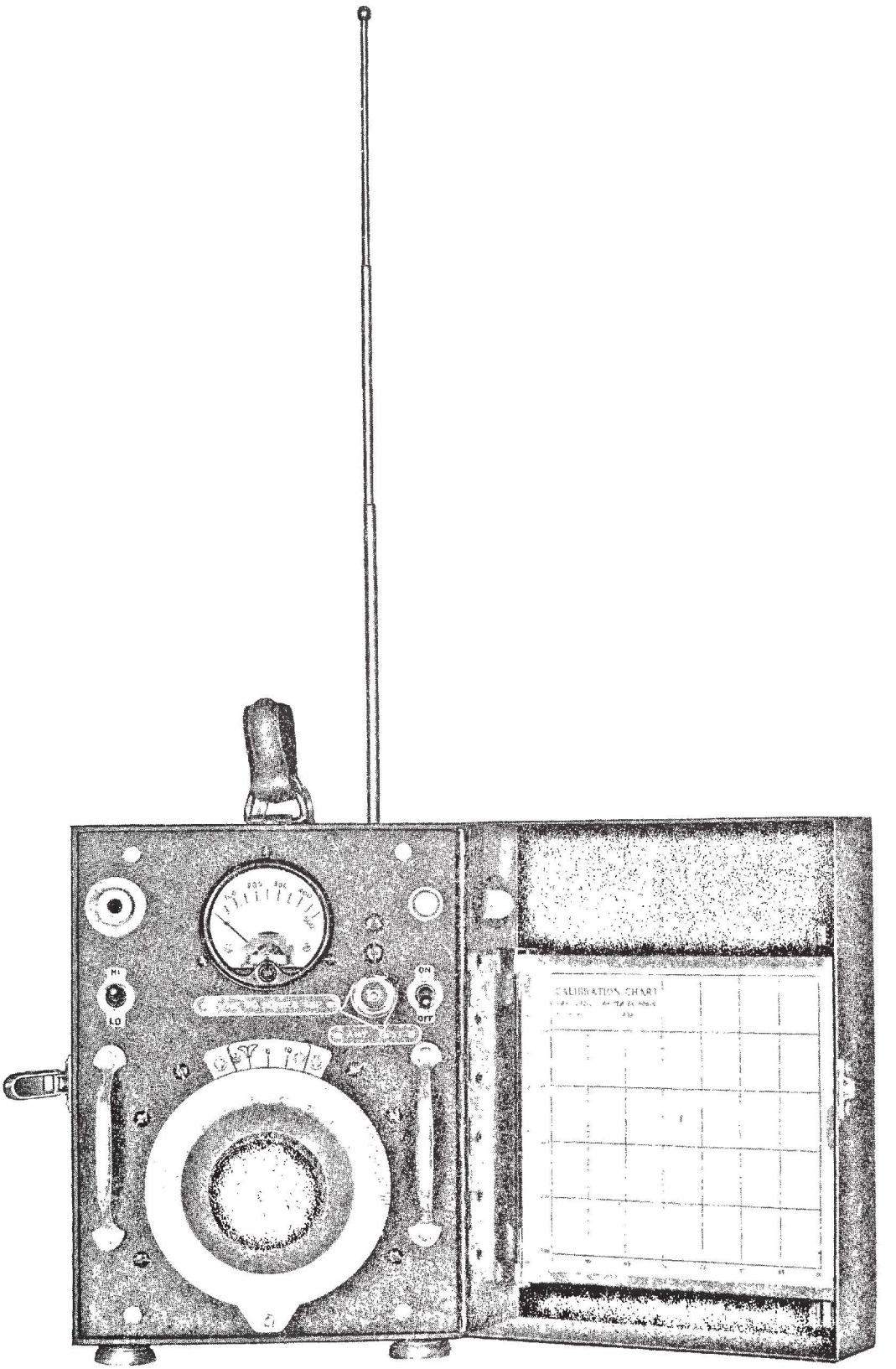


FIGURE 1—FREQUENCY METER BC-906-C, FRONT VIEW, DOOR OPEN AND ANTENNA IN PLACE

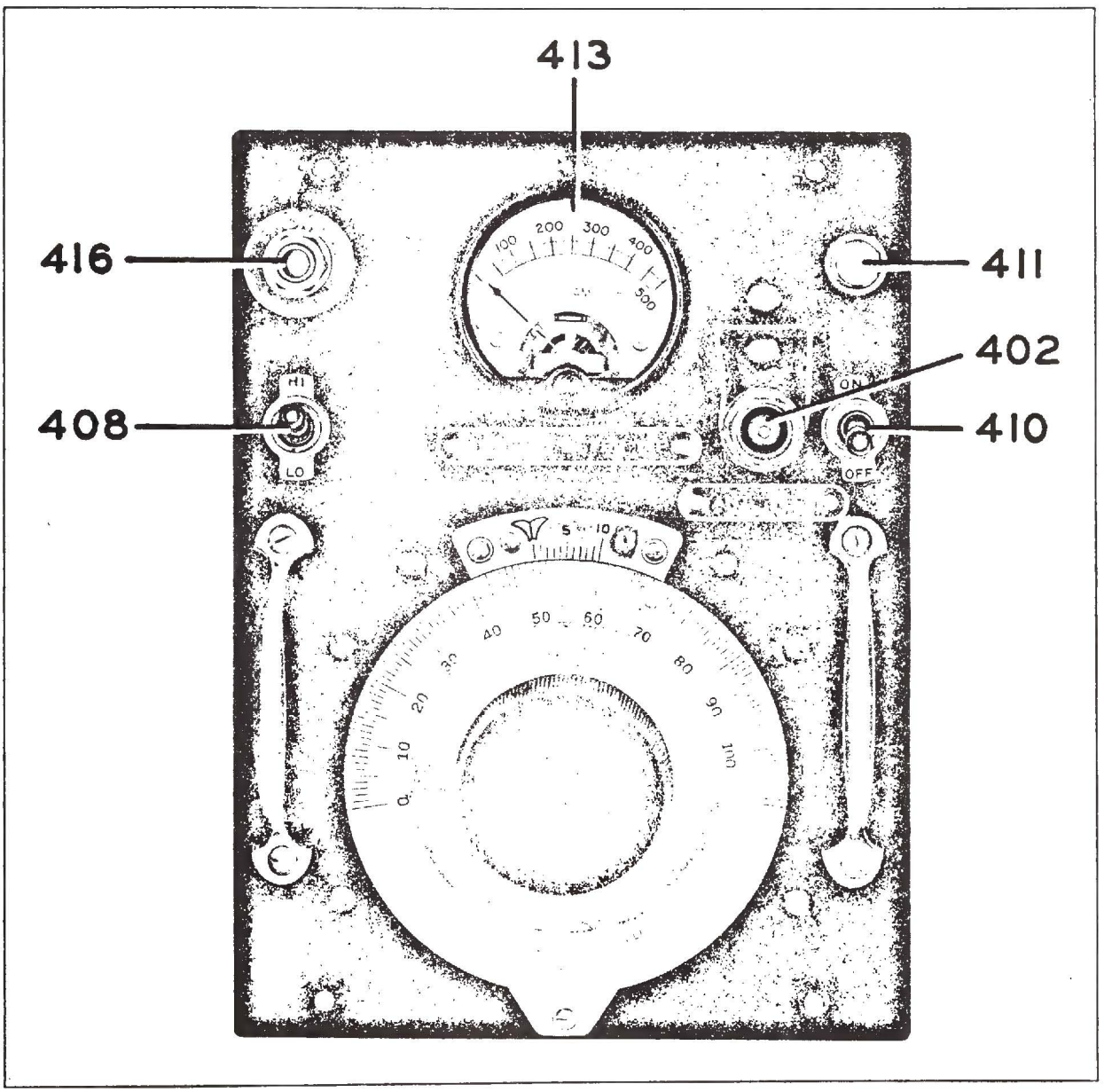


FIGURE 2—FREQUENCY METER BC-906-C, PANEL VIEW, CASE REMOVED

# SECTION I

# GENERAL DESCRIPTION OF FREQUENCY METER BC-906-C

## 1. Use

Frequency Meter BC-906-C is an absorption-type frequency meter intended for use with Radio Receiver BC-1066-A. It may be used either to determine the frequency of an oscillating receiver or a signal generator, or it may be used to tune a signal generator or an oscillating receiver to a desired frequency.

## 2. Case

The instrument is housed in a black, wrinkle-finished metal cabinet fitted with a door. When closed, this door not only protects the dial, meter, etc., which are mounted on the panel, but through the action of an automatic push-button switch, assures the operator that the power is turned off.

## 3. Antenna

Mounted inside the door is a calibration chart and the extendible type ANTENNA, which is used with Frequency Meter BC-906-C. When the frequency meter is being operated, the antenna is plugged into its socket through a hole in the top of the instrument case. It may be extended to its entire length or it may be used only partially extended. The sensitivity of this meter varies with antenna length. If necessary adjust the length of the antenna for maximum sensitivity.

## 4. Panel

Mounted on the panel is a friction, vernier-drive DIAL, which is equipped with a vernier attachment enabling the scale to be read in tenths of a division. Also mounted on the panel are: a microammeter which shows a minimum reading when the instrument is at resonance with a source of radio-frequency energy; a SOCKET for a co-axial connector (Terminal TM-201), which is wired in parallel with the antenna socket mentioned above; an "OFF" "ON" switch; and a "HI" "LO" switch, used to vary the sensitivity of the frequency meter.

## 5. Batteries

Frequency Meter BC-906-C is completely self-contained, for the batteries used in the operation of the instrument are contained in a battery compartment located within the meter. Two batteries are required: one 1½ volt "A" battery (Battery BA-35) and one 45-volt "B" battery (Battery BA-53-A).

## 6. Installation of Batteries

These batteries are installed in the battery box as follows:

**a.** Loosen the DZUS fastener at the rear of the meter housing.

**b.** Remove the four screws at the four corners of the panel.

**c.** Slide the frequency meter out of its case.

NOTE: THE ANTENNA MUST BE REMOVED FROM ITS SOCKET ON THE TOP OF THE FREQUENCY METER BEFORE THE CASE CAN BE REMOVED.

**d.** Remove the cover of the battery box (the black box located on the top of the instrument).

**e.** Connect the **green** "+1.5" volt lead to the "+" terminal on Battery BA-35, and the **blue** "−1.5" volt lead to the "−" terminal on Battery BA-35.

**f.** Insert Battery BA-35 into the battery box with the terminals toward the front of the meter as shown in Figure 4.

**g.** Connect the **red** "+45" volt lead to the "+45" terminal on Battery BA-53-A.

**h.** Connect the **yellow** "–45" volt lead to the **negative** terminal on Battery BA-53-A.

**i.** Slide Battery BA-53-A edgeways into the battery box (in the position shown in Figure 4). Do not force. If it is necessary to force Battery BA-53-A into place, then Battery BA-35 has not been correctly installed.

**j.** Replace the top of the battery box.

**k.** Replace Frequency Meter BC-906-C in its cabinet.

**l.** Fasten the DZUS fastener at the rear of the cabinet and replace the four screws through the panel.

**m.** Be sure to get the meter right-side up in its cabinet so that the antenna socket will be on top.

## 7. Weight

The weight of Frequency Meter BC-906-C, complete, is 17.8 pounds.

## 8. Components

Principal components of Frequency Meter BC-906-C include the following:

Extendible type antenna
Tube VT-172 (IS5)
Battery BA-35
Battery BA-53-A
Calibration Chart

# SECTION II

# PREPARATION FOR USE

## 9. Procedure

In attempting to operate this equipment, the following instructions should be followed:

**a.** Open the door to Frequency Meter BC-906-C.

**b.** Remove the extendible-type antenna from its clip just inside the door, extend it to its full length and insert it through the hole in the top. Be sure that the base of the antenna is firmly in the socket.

**c.** Throw the "OFF" "ON" switch to the "ON" position.

**d.** **For use with low-power signal generators and oscillating receivers, set the "HI" "LO" switch on "HI."**

**e.** Check the meter deflection; it should be around 400 to 450 divisions on the microammeter scale. If deflection is not well above 250 on the meter scale, check the battery voltages with a 1,000 ohms-per-volt voltmeter in accordance with paragraph 10 of SECTION III. If the microammeter reads low, but the battery voltage is satisfactory, the tube should be replaced in accordance with paragraph 11 of SECTION III.

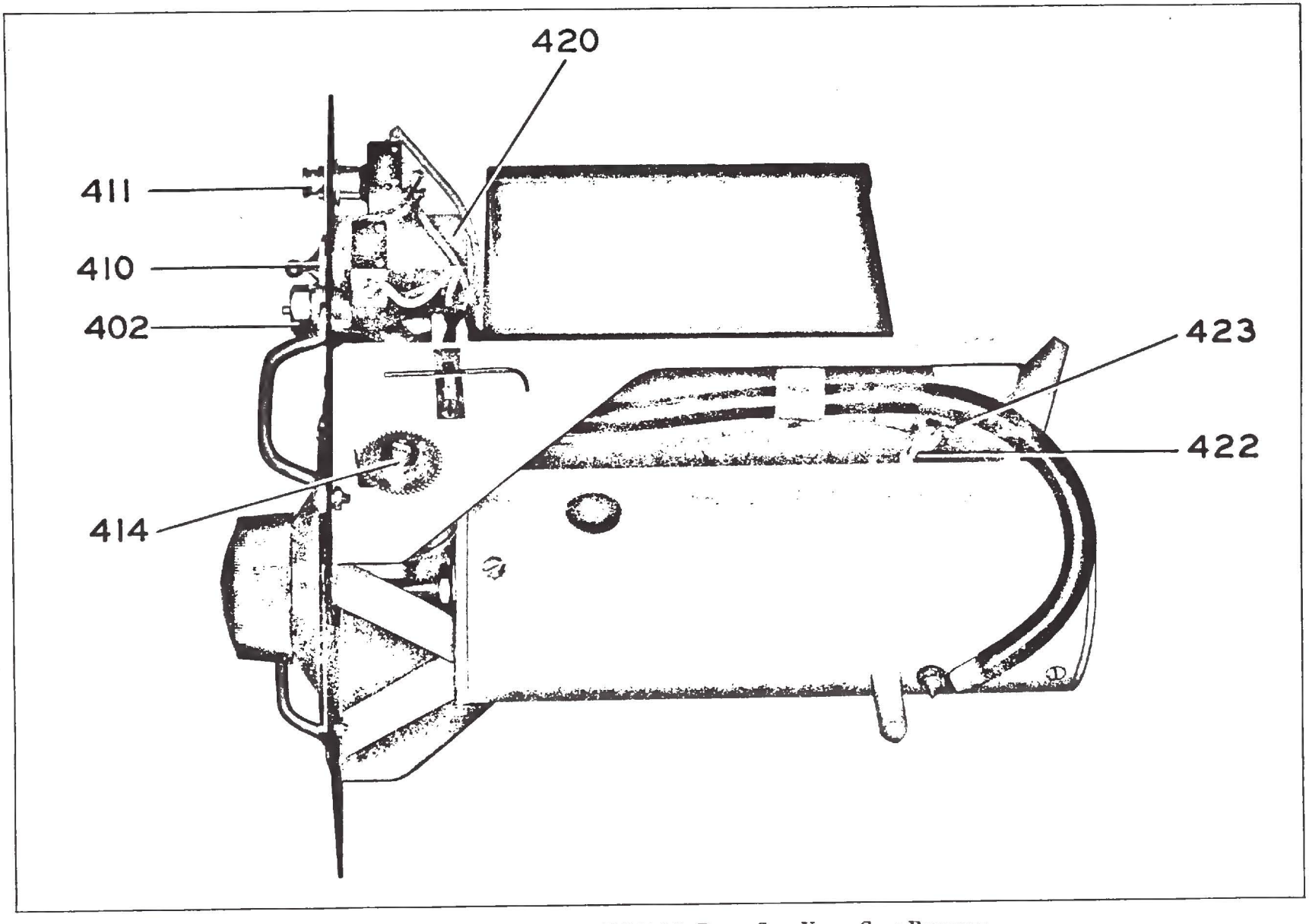


FIGURE 3—FREQUENCY METER BC-906-C, RIGHT-SIDE VIEW, CASE REMOVED

# SECTION III

# MAINTENANCE

## 10. Checking Batteries

The battery voltages should be checked as follows:

**a.** The frequency meter should be turned on 5 or 10 minutes before carrying out the subsequent procedure.

**b.** Remove the frequency meter from its case (see a, b, c, of paragraph 6, SECTION I).

**c.** Note switch terminals in upper right-hand corner behind panel. The red-coded lead is connected to "+45" terminal of the "B" battery; the green-coded lead is connected to "+1.5" terminal of the "A" battery.

**d.** A prod from a voltmeter may be touched to these terminals and the circuit completed to the panel for measuring the battery voltages. The "A" battery voltage should not be less than 1.2 volts; the "B" battery voltage should not be less than 40 volts. If voltages are lower than these values, the battery should be replaced in accordance with SECTION I, paragraph 6.

## 11. Replacing the Tube

**a.** Replace the questionable tube by one known to be good.

**b.** Note Item 414 of Figure 3, a rheostat used as a shunt for the meter. This rheostat has a screw for screw driver adjustment. When the frequency meter is removed from its case, this adjusting screw can be seen by looking at the side of the frequency meter. With the frequency meter turned on, and with no signal input to the frequency meter, this screw should be adjusted so that a deflection of 450 is obtained on the meter.

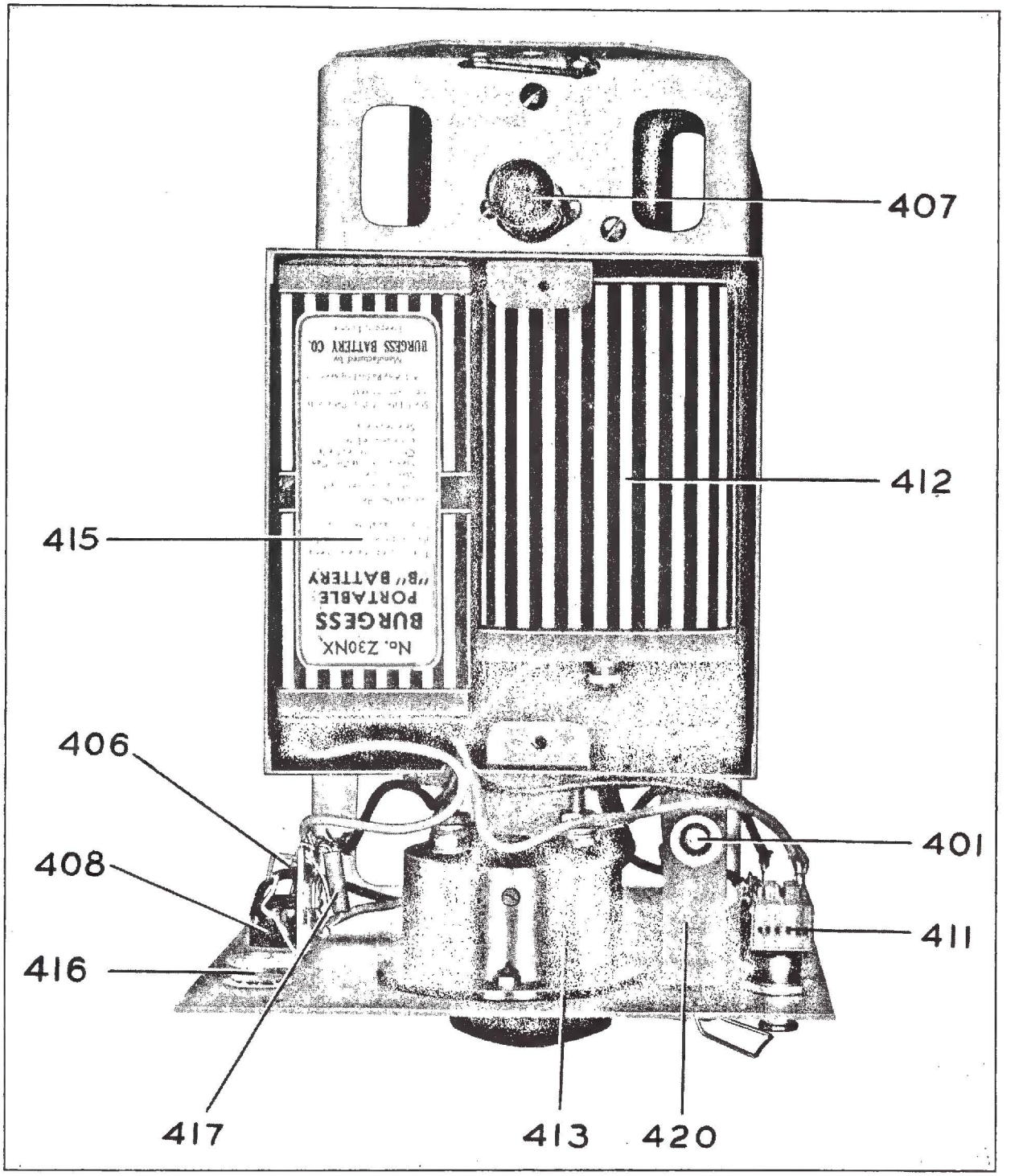


FIGURE 4—FREQUENCY METER BC-906-C, TOP VIEW, CASE REMOVED

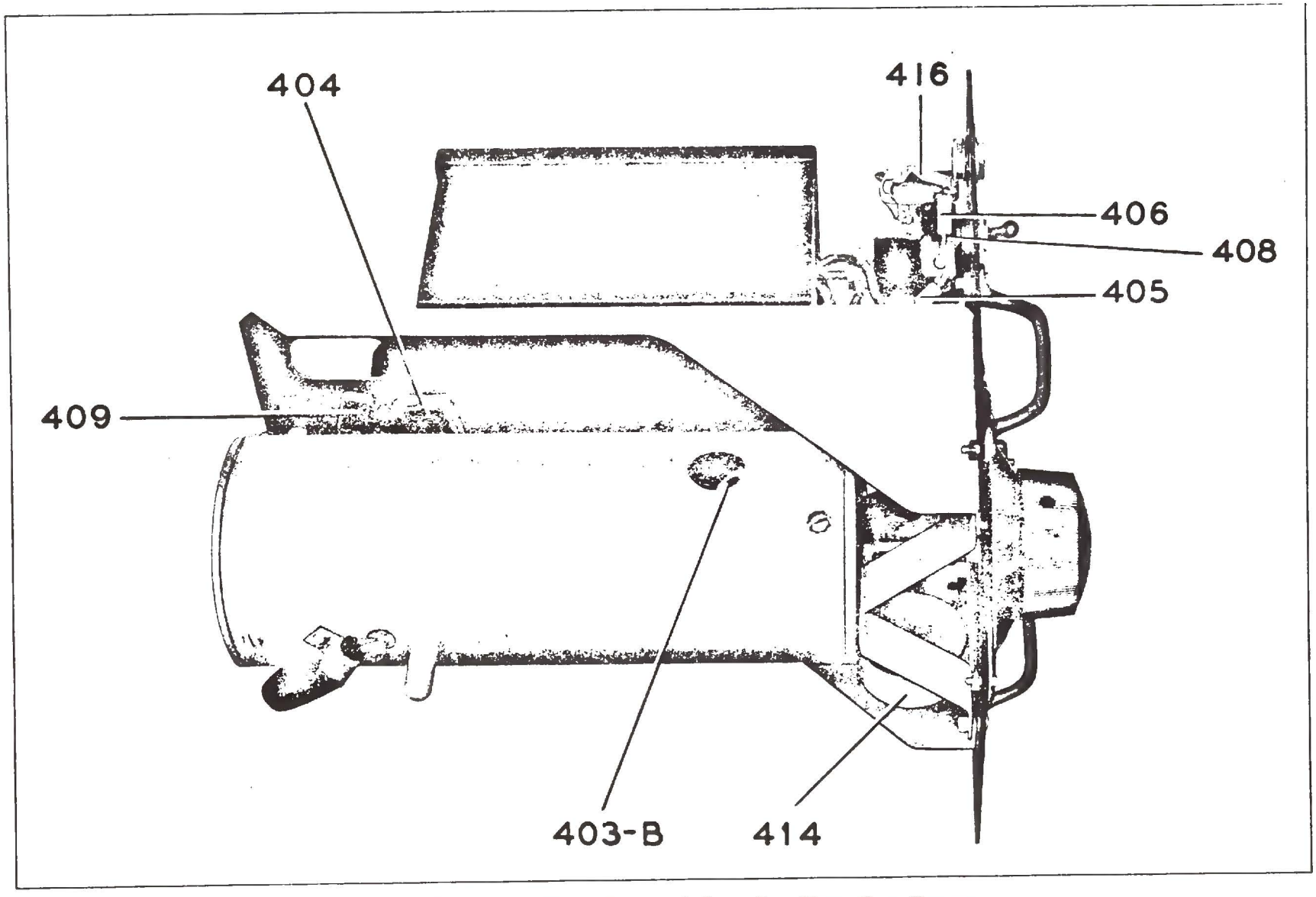


FIGURE 5—FREQUENCY METER BC-906-C, LEFT SIDE VIEW, CASE REMOVED

# SECTION IV

# SUPPLEMENTARY DATA

## 12. Tube Characteristics

### TUBE VT-172 (Commercial Type IS5)
### (Pentode Unit)

| | |
|---|---|
| Filament voltage | 1.4 |
| Filament current (amps.) | 0.05 |
| Plate voltage (max.) | 90 |
| Screen voltage (max.) | 90 |
| Grid voltage | 0 |
| Plate current (ma) | 1.2 (with 45 volts plate supply) |
| Screen current (ma) | 0.3 (with 45 volts screen supply) |
| Plate resistance (ohms) | 500,000 (approximate) |
| Transconductance (micromhos) | 525 (with plate and screen supplies at 45 volts) |

NOTE: The diode is located at the negative end of the filament and is independent of the pentode unit except for the common filament.

BASING: Looking at the bottom of the tube—(pins are numbered in the following beginning with Pin No. 1, the first in a clockwise direction from the blank space, and continuing about the base in a clockwise direction).

Pin No. 1 Filament –
Pin No. 2 No Connection
Pin No. 3 Diode Plate
Pin No. 4 Pentode Screen
Pin No. 5 Pentode Plate
Pin No. 6 Pentode Grid
Pin No. 7 Filament +

## TABLE OF REPLACEABLE PARTS

| Ref. No. | Signal Corps Stock No. | Name of Part | Description | Function | Supplier | Drawing Numbers | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Supplier | Philco | Signal Corps |
| **FREQUENCY METER BC-906-C** | | | | | | | | |
| 401 | | Antenna Socket | Threaded-mounting; single spring contact. Spring, beryllium copper; shank, brass; nickel plated. 4-36 threads for 7/16"; spring, 25/32". Spring when compressed to fit 0.169" diameter hole. (Ucinite Type 152063, or equal.) | Attach extendible type antenna | UCIN | 152063 | 258-6190 | |
| 402 | | Terminal TM-201 | Co-axial socket. For Coupling MC-320, or Coupling MC-277 (British Type 10H/528) panel mounting. | For attachment of external antenna | AMPH | | 358-1615 | |
| 403-A | | Capacitor, variable | 4-plate; 2 stationary; 2 rotary, soldered to rotor shaft, silver plated, ceramic end plates. Single hole mounting, 3/8"-32 thread, 13/16" long. Hex. nut, 1/4" shaft, with 0.094" hole, 1.437" from mounting base. Length of shaft and mounting to front plate, 1 3/4". Connection lugs at rear. Capacity 4.3 mmf. minimum; effective maximum 13.6 mmf. ±0.5 mmf.; absolute maximum 17.9 mmf. Philco Part No. 351-1039. 2 3/4" x 1 27/64" x 1 3/64" overall. | Tuning resonant circuit | OAK | 676-S7 | Part of 358-2770 | |
| 403-B | | Capacitor, variable | 1.5 mmf. minimum, 7 mmf. maximum. Trimmer Type NP (Erie Resistor Corp. Style TS-2-A); 41/64" x 55/64" x 3/8" ceramic. Philco Part No. 351-1033. | Calibration of 403-A | ERIE | NPO-TS2A | Part of 358-2770 | |
| 404 | | Capacitor, | Mica, 5000 mmf. ±10%; XM262 bakelite molded case; pigtail terminals. Approx. dimensions, 3/4" x 3/4" x 1/4". 300 v d-c wo. v | Diode load by-pass | MCAM ELMO | WXM 502L | 60-250634 | |
| 405 | | Resistor | 1.5 megohms ±10%; 1/2 watt carbon, insulated; pigtail terminals. Approx. dimensions, 5/8" x 3/16". | Diode load | STAC IRC | MB-1/2 | 66-5153340 | |

| Ref. No. | Signal Corps Stock No. | Name of Part | Description | Function | Supplier | Drawing Numbers | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Supplier | Philco | Signal Corps |
| **FREQUENCY METER BC-906-C—Continued** | | | | | | | | |
| 406 | | Resistor | 0.47 megohms ±10%; ½ watt carbon, insulated; pigtail terminals. Approx. dimensions, 5/8" x 3/16" | Diode load | STAC<br>IRC | MB-½ | 66-4473340 | |
| 407 | | Tube VT-172 | Diode-pentode "button" base (IS5) | Rectifier, amplifier | KENR<br>SYLV<br>TUNG | IS5<br>IS5<br>IS5 | 453-1368 | |
| 408 | | Sensitivity switch | Toggle switch, SPDT. similar to Arrow-Hart & Hegeman Elec. Co. Type 21349, except threaded mounting bushing to be 11/32" long. To be supplied with hex. nut and knurled ring nut. (As made by The Arrow-Hart & Hegeman Electric Co., Hartford, Conn. or equal) ½" single-hole mounting, 1 9/16" x 5/8" x 1 5/16" overall | Vary sensitivity of instrument | AH & H | 21349 | 452-1045 | |
| 409 | | Capacitor | Mica, 50 mmf. ±10%; XM262 bakelite molded case; pigtail terminals. Approx. dimensions, 7/16" x 1 1/16" x 3/16". 300 v d-c wo. v | Filament r-f by-pass | MCAM | | 60-050637 | |
| 410 | | Switch | Toggle, DPST. Similar to Arrow-Hart & Hegeman Electric Co. Type 20902, except threaded mounting bushing to be 11/32" long. To be supplied with hex. nut and knurled ring nut. (As made by Arrow-Hart & Hegeman Electric Co., Hartford, Conn., or equal) ½" single hole mounting, 1 9/16" x 1 5/8" x 1 5/16" overall. | "OFF" "ON" switch | AH & H | 20902 | 452-1035 | |
| 411 | | Switch | "Push-to-break" DPST; both circuits normally on. To be supplied with hex. nut, one knurled ring nut, and one lockwasher. (The Arrow-Hart & Hegeman Electric Co., Type 20908 or equal). ½" single hole mounting. 1 5/16" x 5/8" x 1 11/16" overall | Automatic switch (opens battery circuit when door is closed) | AH & H | 20908 | 452-1036 | |

| Ref. No. | Signal Corps Stock No. | Name of Part | Description | Function | Supplier | Drawing Numbers | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Supplier | Philco | Signal Corps |
| **FREQUENCY METER BC-906-C—Continued** | | | | | | | | |
| 412 | | Battery BA-35 | 1½ volt dry cell Burgess 4 FH or equivalent | Heat filament | BURG GEND | 4FH | 461-1001 | |
| 413 | | Meter | 0 to 500 microammeter; 2¼" round flush bakelite case; $1\frac{31}{32}$" scale length. Terminals to be $\frac{23}{32}$" in length. De Jur Type 210. (As made by De Jur Amsco Corp., Sheldon, Conn., or equal.) 2¾" x 2⅛" overall. 60 degree mounting holes, one on vertical axis at top, ⅛" in from edge | Show resonance point | DEJA | 210 | 455-1015 | |
| 414 | | Rheostat, gear and detent assembly | 500 ohms +30% −10%, carbon, linear. 280 degrees rotation. ¼" slotted shaft. Length of shaft and mounting, $1\frac{3}{16}$". Single hole mounting ⅜"-32 thread. ⅜" long, $1\frac{13}{16}$" length x $1\frac{9}{32}$" diameter. (Philco Part No. 353-5069.) Rheostat and detent mounted together as one item | Vary meter reading | PC | | 358-2769 | |
| 415 | | Battery BA-53-A | 45 volt dry cell Burgess Z-30-N or approved equivalent | Supply plate voltage | BURG GEND | Z-30-N | 461-1002 | |
| 416 | | Phone jack | Mallory Midget Type A-2, or equal; to fit Plug PL-55; 1" x $1\frac{19}{32}$"; ⅜-32 thread mounting $\frac{5}{16}$" long, equipped with hex. nut. Single contact break, contact insulated | Phone connection | MALLO CHIT | A-2 | 358-1195 | |
| 417 | | Resistor | 2200 ohms ±10%; ½ watt; carbon, insulated, pigtail terminals. Approx. dimensions ⅝" x $\frac{3}{16}$" | Load across output | IRC STAC | MB-½ | 66-2223340 | |
| 418 | | Tube socket | Miniature (for "button" base tube) mica filled bakelite with riveting plate. Mounting holes ⅞" between centers; ⅝" hole for mounting. Amphenol Type 64-7PT (as made by The American Phenolic Corp., 1250 W. Van Buren St., Chicago, or equal). 1⅛" x ¾" x ¾" overall | Hold Tube VT-172 | CINCH AMPH | 64-7PT | 257-6038 | |

| Ref. No. | Signal Corps Stock No. | Name of Part | Description | Function | Supplier | Drawing Numbers | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Supplier | Philco | Signal Corps |
| **FREQUENCY METER BC-906-C—Continued** | | | | | | | | |
| 419 | | Antenna | Extendible type; 8 3/8" collapsed, 20" extended. Base hole 0.171" dia., 13/16" deep. Mounting 0.375" dia., 1 1/8" long. 1st section 7 5/8" long; 0.218" diameter; 1/4" diameter ball on top of third section. Brass; copper nickel chromium bright finish. Telescopic sections to be smooth sliding | Pick up radiations | BSNY | | 358-1667 | |
| 420 | | Antenna socket support | Laminated phenolic Grade C or L; length 1 13/16"; Width, 5/8"; depth, 1". Hole for mounting antenna socket 3/4" deep in one end, 0.377" diameter. Mounting holes 0.5" apart in one end threaded 8-32 for 3/8". All cut edges to be coated with bakelite varnish | Hold antenna socket | SYNTH | | 257-7342 | |
| 421 | | Handle | Black leather with 3/4" nickel plated rings; 7" long. Gralnick Bros., Inc., Type 415. (As made by Gralnick Bros., Inc., 10th & Diamond Sts., Philadelphia, or equal.) | Carry instrument | GRAL | | 358-2017 | |
| 422 | | R-F choke | 25 turns #34 DSC copper wire, 68 turns per inch. Ceramic form 0.250" x 13/16". Pigtail terminals 1.25" long. Wax impregnated and dipped. Using standard test jig, capacity difference between 6 and 12 megacycles is 223.25 mmf. ±5%. 1000 cycle inductance is 2.66 mh. | R-f isolating impedance | PC | | 352-1042 | |
| 423 | | Wiring panel | 2-lug, 1 ground and mounting. Lugs plated, and riveted to insulating strip, which is 3/32" XXX bakelite or A.S.T.M. Grade 5 canvas bakelite, or equal, 7/8" long, 3/8" wide. 1/2" between lugs. | Wiring r-f choke | CINCH | | 358-2622 | |

## LIST OF SUPPLIERS

| Supplier Code | Supplier's Name and Address |
|---|---|
| AMPH | American Phenolic Corp., 1830 S. 54th St., Chicago, Ill. |
| AROV | Aerovox Corp., New Bedford, Mass. |
| AH&H | Arrow-Hart and Hegeman Electric Co., Hartford, Conn. |
| BSNY | Ben Snyder Corp., Noble and Darien Sts., Philadelphia, Pa. |
| BURG | Burgess Battery Co., Freeport, Ill. |
| CINCH | Cinch Manufacturing Corp., 2335 W. Van Buren St., Chicago, Ill. |
| CHIT | Chicago Telephone Supply Co., Elkhart, Ind. |
| CORDU | Cornell Dubilier Electric Corp., Hamilton Blvd., South Plainfield, N. J. |
| CH | Cutler-Hammer, Inc., 1333 W. St. Paul Ave., Milwaukee, Wis. |
| DEJA | De Jur Amsco Corp., Sheldon, Conn. |
| DRAKE | Drake Manufacturing Co., 1713 W. Hubbard St., Chicago, Ill. |
| ELUT | Electric Utilities, 2900 S. Michigan Ave., Chicago, Ill. |
| ELMO | Electric Motive Co., Willimantic, Conn. |
| ERIE | Erie Resistor Co., Erie, Pa. |
| GEND | General Dry Battery, 13000 Athens Ave., Cleveland, Ohio |
| GE | General Electric Co., Bridgeport, Conn. |
| GENR | General Radio Co., 30 State St., Cambridge A, Mass. |
| GRAL | Gralnick Bros., Inc., 10th and Diamond Sts., Philadelphia, Pa. |
| HAML | Hammerlund Manufacturing Co., 424 W. 33rd St., New York, N. Y. |
| IRC | International Resistance Co., 401 N. Broad St., Philadelphia, Pa. |
| KENR | Ken-Rad Tube and Lamp Corp., Owensboro, Ky. |
| KURK | Kurz Kasch Corp., Dayton, Ohio |
| MALLO | P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis, Ind. |
| MASM | Massachusetts Machine Shop, 817 Albany St., Boston, Mass. |
| MCAM | Micamold Radio Corp., 1087 Flushing Ave., Brooklyn, N. Y. |
| NATC | National Co., Inc., Malden, Mass. |
| OAK | Oak Manufacturing Co., 1260 Claybourn Ave., Chicago, Ill. |
| PC | Philco Corporation, C and Tioga Sts., Philadelphia, Pa. |
| SPRA | Sprague Specialties Co., North Adams, Mass. |
| STAC | Stackpole Carbon Co., St. Marys, Pa. |
| STWS | Stewart Stamping Co., 621 E. 216th St., New York, N. Y. |
| SYLV | Sylvania Electric Products, Inc., Emporium, Pa. |
| SYNTH | Synthane Corporation, Oaks, Pa. |
| TELR | Teleradio Engineering Co., 484 Broome St., New York, N. Y. |
| TUNG | Tungsol Lamp Works, 95 Eighth Ave., Newark, N. J. |
| UCIN | Ucinite Manufacturing Co., 459 Watertown St., Newtonville, Mass. |
| WILM | Wilmington Fibre Co., Box #1028, Wilmington, Del. |

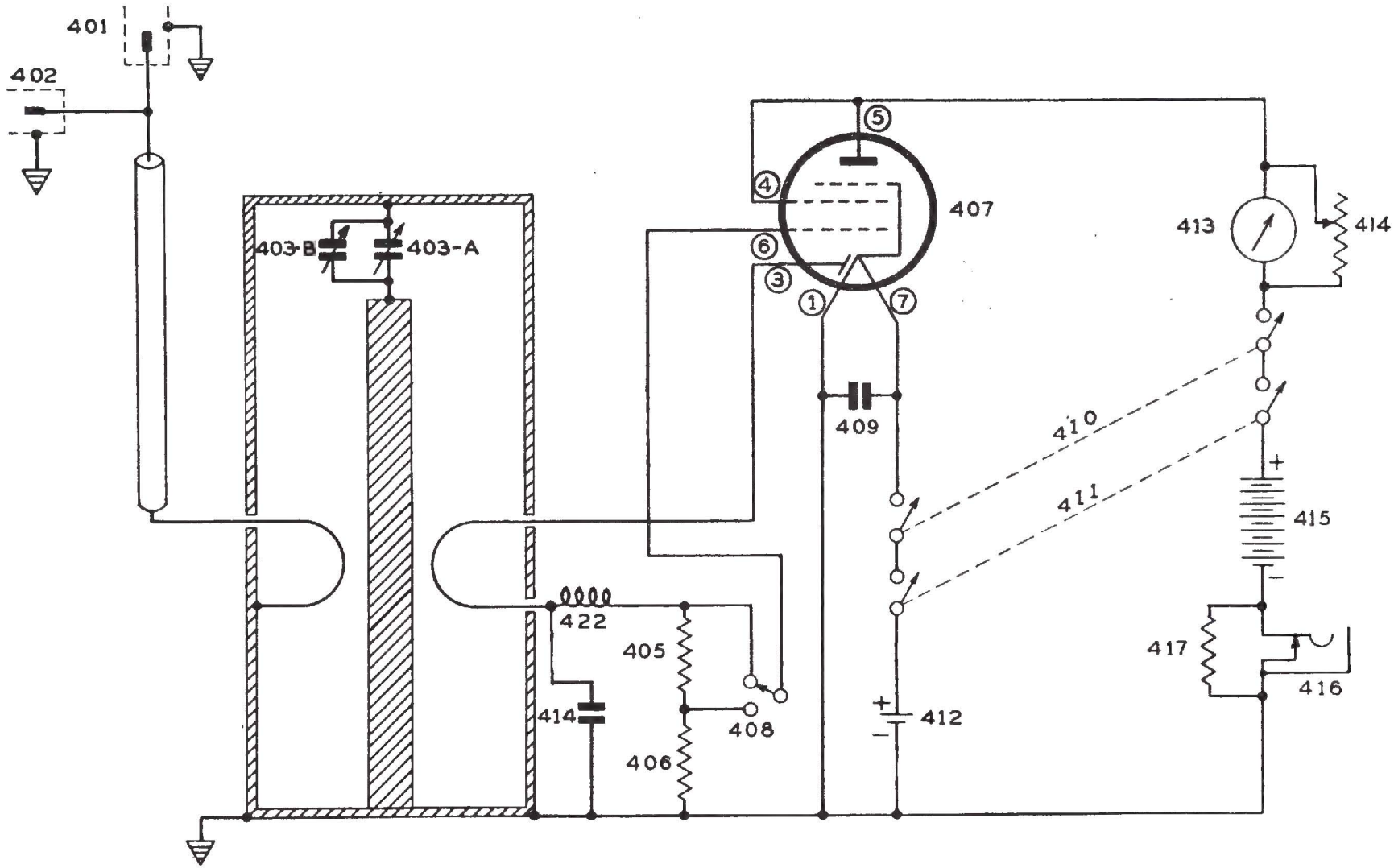


FIGURE 6—FREQUENCY METER BC-906-C, SCHEMATIC DIAGRAM

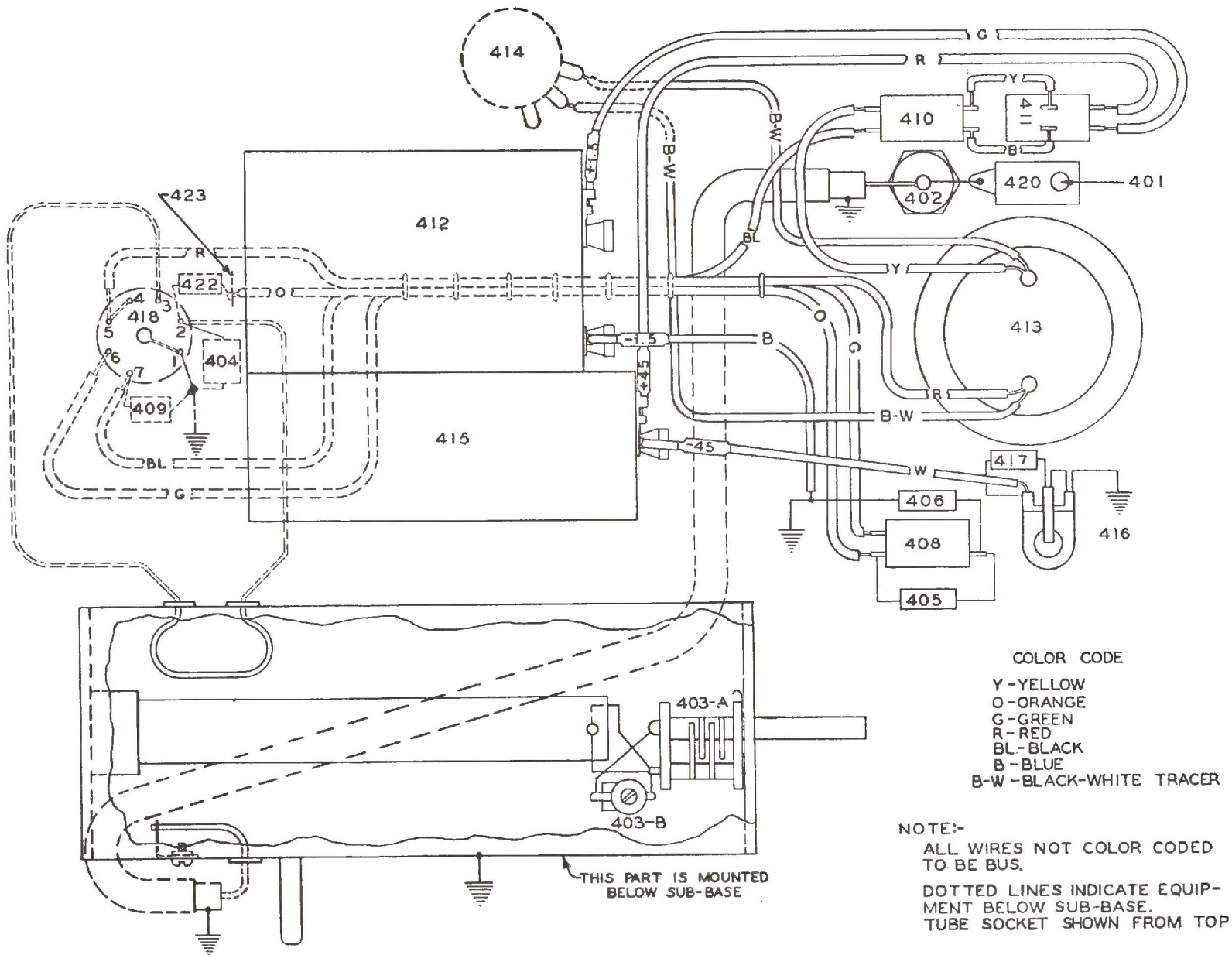


FIGURE 7—FREQUENCY METER BC-906-C, WIRING DIAGRAM