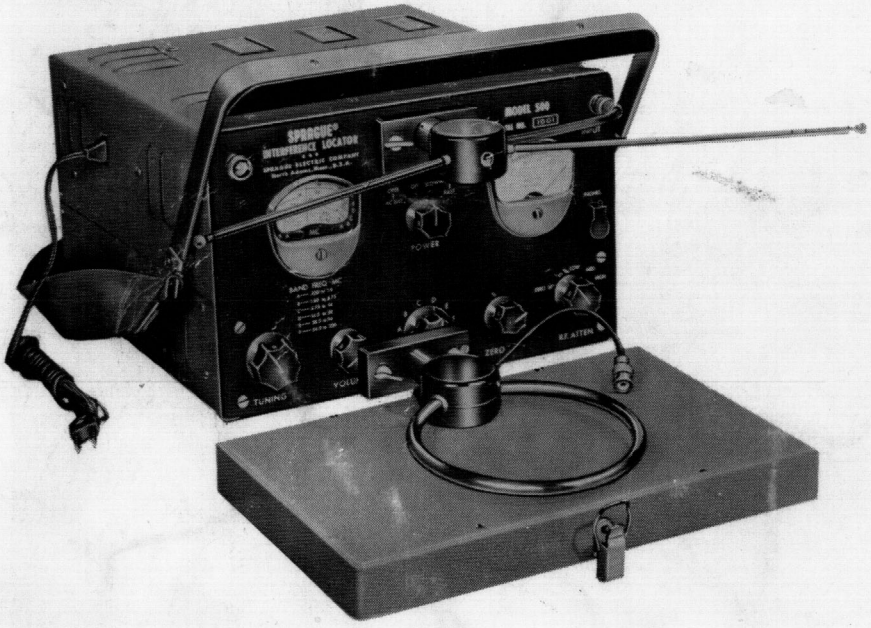
Serial N° 1059. IL-105

SPRAGUE

OPERATING MANUAL

Radio Inspectors P.O Box 293



MODEL 500 INTERFERENCE LOCATOR

SPRAGUE ELECTRIC COMPANY
North Adams, Mass.

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SPRAGUE®
INTERFERENCE LOCATOR
SPRAGUE ELECTRIC COMPANY
North Adams, Mass., U.S.A.
MODEL 500
SER. NO. 1001
IN-OUT
PHONES
POWER
BAND FREQ.-MC
A—— 550 to 16
B—— 1.60 to 4.75
C—— 4.75 to 14
D—— 14.0 to 28
E—— 28.0 to 54
F—— 54.0 to 220
LOW
MED
HIGH
ZERO SET
A
B
C
D
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F
ZERO
RF ATTEN
TUNING
VOLUME

OPERATING MANUAL

SPRAGUE

Model 500

Interference Locator

1. General Description

1.1 Purpose and Usefulness. The Sprague Model 500 Interference Locator is a rugged, portable instrument designed especially to meet the needs of electric utilities and others interested in "man-made" radio and TV noise location and reduction. Special attention has been given to the design details which contribute to reliability and convenience of use.

1.2 Basic Circuit. The Model 500 Locator is engineered around a superheterodyne circuit which provides a high degree of stability. Special circuitry has been incorporated to provide an instrument best adapted for interference location purposes. The frequency range covered is from 550 kilocycles to 220 megacycles. These frequencies include the standard broadcast, short wave, fm, and vhf television bands. The Locator operates from either 115/230 volt, 50-60 cycles a-c, or a self-contained 6 volt storage battery of leak-proof construction. Provision has been made for the use of various antennas to suit the particular application.

2. Electrical Characteristics

2.1 Frequency Range. 550 kc to 220 mc

2.2 Number of Tuning Bands. 6

2.3 Frequency Range of Each Band.

Band A —.550 to 1.60 mc
Band B —1.6 to 4.75 mc
Band C —4.75 to 14 mc
Band D —14 to 28 mc
Band E —28 to 54 mc
Band F —54 to 220 mc

2.4 Sensitivity. The Model 500 Locator has a sensitivity of 5 microvolts over the entire tuning range. This is based upon the input signal required to produce a 5% meter deflection. The meter reading is proportional to the quasi-peak value of the input signal.

3. Mechanical Characteristics

3.1 Size. The Model 500 Locator is 13 1/8" high (exclusive of handle) by 12 5/16" long by 7 13/16" wide.

3.2 Weight. The instrument weighs 28 pounds.

3.3 Provisions for Carrying. There is a permanently attached handle as well as a removable shoulder strap with snap-hooks to attach to built-in carrying eyes.

3.4 Access for Servicing.

3.4.1 Four quick-action fasteners are used to provide easy access to the tubes and battery. The chassis is easily removable for access to under-chassis components.

3.5 Controls on Front of Panel. These are identified in the photo on the inside front cover. They include:

3.5.1 Tuning Control.

3.5.2. Volume Control.

3.5.3 Band Selector Switch.

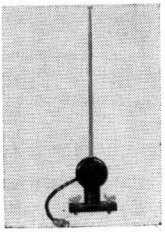
3.5.4 Zero Set.

3.5.5 R-F Attenuator.

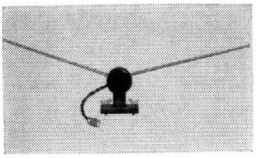
3.5.6 Power Switch.

3.6 Control Cover. A separate cover is furnished for protection of the instrument panel when the Locator is not in use.

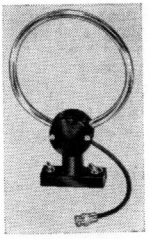
4. Description of Available Antennas

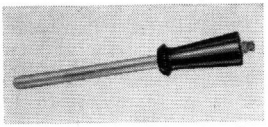


4.1 Telescoping Rod — Dipole Antenna. A single base is provided for the all-wave telescoping rod antenna, and the "rabbit-ears" type of dipole provided especially for Band F. The antenna base contains three threaded inserts. The center insert is used with one of the telescoping rods to make an all-wave antenna. The two outside inserts with the two telescoping rods assemble into the "rabbit ears" type of dipole. Both of these antennas may be used remotely by means of an accessory extension coaxial cable. The base attaches to the panel by means of two quick-action fasteners. The illustration above shows the base and rod as an all-wave antenna while the assembled dipole antenna is on the left.



4.2 Detachable Loop Antenna. This antenna is provided for use as a direction finder. It operates on Band A only. It can be mounted on the panel in the same manner as the rod antenna, or used remotely and connected to the Locator by means of an extension cable. It is shown in the photo at the right.

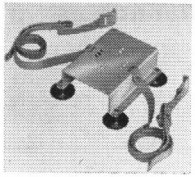




4.3 R-F Probe. An insulated r-f probe is available as an accessory item. It is used with an extension cable to pinpoint each interference source in areas where many such sources may be located. This probe is usable on all bands and is shown at the left.

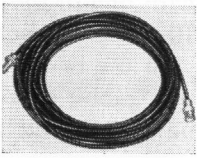
4.4 Other Accessory Items for Use With Model 500 Locator.

4.4.1 A detachable automobile roof top mounting is avail-

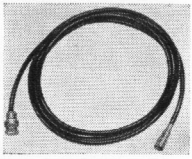


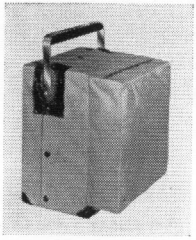
able for use with either the rod or loop antennas. This mounting attaches to the roof of the vehicle by means of rubber suction cups and is held down by two straps and hooks that fasten over the rain gutter along the edge of the car or truck. The hooks are rubber coated to avoid scratching the car finish. The roof top mounting is shown at the left.

4.4.2 A 25 foot coaxial extension cable is available for remote use of any of the antennas.



4.4.3 An eight foot coaxial cord is available with fittings to permit the use of an automobile radio rod antenna with the Model 500 Interference Locator. In those cases where a car radio antenna is equipped with a Delco bayonet-type connector, an adapter (General Cement Co. No. 1745 or equivalent) is available at most radio parts distributors.





4.4.4 A canvas protective case is available for use as a cover during storage and transportation. The case has a zipper-closure side pouch large enough to hold the rod antenna base, loop, and all accessory items used with the Locator. A photo of the Locator in its protective case is shown here.

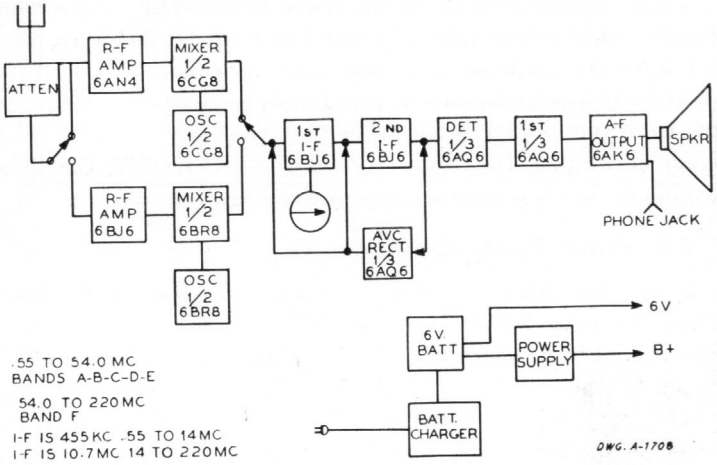
4.4.5 A set of high quality headphones, complete with the necessary plug, are available for use in high noise areas or in places where the use of the built-in loud speaker is not desired.

5. Theory of Operation—Circuitry

5.1 Description of Superheterodyne Circuit Used. The circuitry used in the Locator is that of a superheterodyne receiver with the necessary modifications and additions to adequately cover the frequency range intended, insure stable

operation under rugged conditions and long use, and minimize weight. Separate r-f front-ends are used for (1) the vhf television and fm bands, extending from 54 mc to 220 mc, and (2) the broadcast and short wave bands, extending from 550 kc to 54 mc. An i-f frequency of 455 kc is used for the frequency range of 550 kc to 14 mc (Bands A, B, C) and an i-f of 10.7 mc is used for 14 mc to 220 mc operation (Bands D, E, F). The same i-f stages are used for both front-ends. Each stage contains 2 transformers tuned to pass the two i-f frequencies.

A block diagram of the Locator circuit is shown below:



5.2 Circuit Operation.

5.2.1 VHF Operation (54 mc to 220 mc). From the antenna jack the signal is fed to the attenuator and then to the 6AN4 grounded grid r-f amplifier circuit. The amplifier output is mixed with the local oscillator (triode half of 6CG8) in the pentode section of the 6CG8 to produce a 10.7 mc i-f signal. This signal is fed to a double tuned i-f transformer, and then to the 6BJ6 first i-f amplifier. The output of this stage is then applied to the 6BJ6 second i-f stage through a second double tuned i-f transformer. The second stage feeds both diodes of a 6AQ6 through a third double tuned i-f transformer. One of the diodes is an agc rectifier. The second diode is the audio detector. The output from the agc rect-

ifier is fed into a quasi-peak filter having a time constant to provide rapid rise and slow decay on impulse type signals. The output of this filter provides agc bias for the i-f stages thereby producing a meter reading which is an approximate logarithmic function of the r-f input signal.

The audio detector feeds the volume control which in turn feeds the triode portion of the 6AQ6. This tube operates as an audio amplifier which drives the 6AK6 audio output stage. The output stage is coupled to the built-in loudspeaker and the headphone jack.

5.2.2 Broadcast and Short Wave Operation. Signals on Bands A, B, C, D, and E are handled in a similar fashion except for the different front-end used at these frequencies, and the use of 455 kc i-f transformers on Bands A, B, and C. The output of the attenuator is fed to the tuned r-f stage (6BJ6) which feeds the mixer (pentode section of 6BR8) while the local oscillator is the triode section of the 6BR8.

5.3 Power Supply-Battery Charging.

5.3.1 The Model 500 is designed to operate from either 115/230 volt, 50-60 cycles a-c or from the built-in 6 volt storage battery. The Locator is essentially a 6 volt battery operated device. In a-c operation, the self-contained charger charges the battery at approximately the same rate that the receiver drains it. A transformer with a double primary winding for either 115 or 230 volts and a full-wave selenium rectifier are used both for charging and a-c operation. The heater power is taken from the storage battery under all conditions, as is the B+ power which is obtained from a transistorized dc-dc inverter. A transformer steps up the output voltage of the inverter which is then rectified by the full-wave bridge-connected silicon rectifiers. A shorting bar link mounted on an insulated strip adjacent to the power transformer permits changing the primary connection on the transformer to provide for both line voltages. The POWER switch has a SLOW and FAST CHARGE position. The charge rate to be used is explained in detail in paragraph 7.2.3 on page 12.

6. Output Indications

6.1 The output of the Locator is available in three forms. These include:

6.1.1 A meter calibrated in terms of r-f input.

6.1.2 A built-in loudspeaker.

6.1.3 A phone jack on the control panel for use of headphones. Plugging in the headphones, automatically disconnects the loudspeaker. The use of headphones is recommended where the output of the loudspeaker would be masked by external noise, or in locations where the aural output of the loudspeaker would be objectionable.

7. Operation

7.1 Battery Preparation. When delivered to the user, the battery will be found installed in the Locator, but without any electrolyte. The electrolyte (concentrated sulphuric acid) will be found in a polyethylene bottle, packed and shipped in a separate carton. A black stopper-and-filling tube electrolyte dispenser will be found in the Locator shipping carton, packed with the directional antennas, carrying strap and 115 volt line cord.

To fill the battery with the electrolyte, proceed as follows:

7.1.1 Remove and unhinge the half of the Locator case containing the battery, unplugging the speaker and power cables. Some units of the Model 500 contain a separate ground strap, connecting the two chassis. If present, one end of the strap must be disconnected.

7.1.2 Place the battery half of the Locator case in a level and upright position on a work bench, allowing plenty of room to give easy and uncramped access to the filling holes of the battery.

7.1.3 Remove the three red plastic filler plugs using a wide-bladed screwdriver.

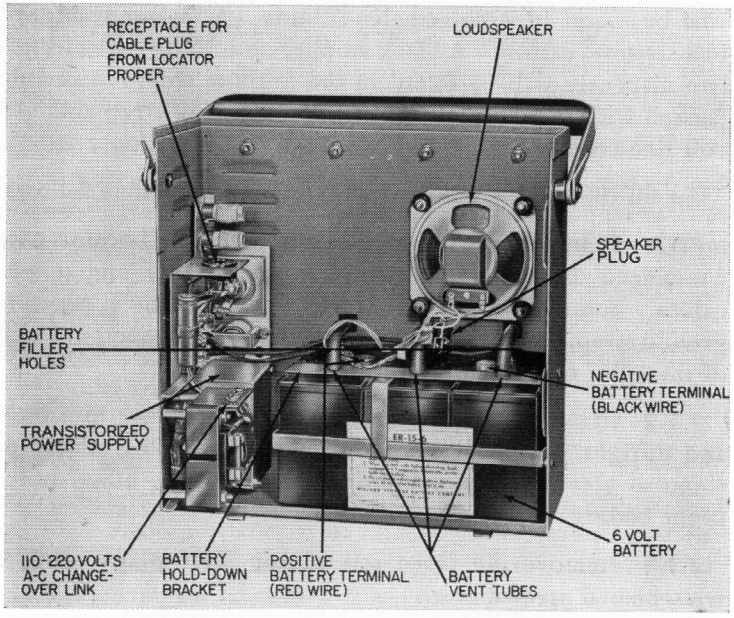
7.1.4 Unpack the polyethylene bottle containing the battery electrolyte. Remove the screw cap and insert the stopper-and-filling tube electrolyte dispenser. *Fit the stopper tightly into the bottle.* CAUTION: USE EXTREME CARE TO AVOID SPILLING THE ACID IN THE BOTTLE.

7.1.5 Note the position of the yellow colored breather hole in the rubber stopper. In pouring the electrolyte into the battery, *this breather hole MUST be positioned above the filler tube to avoid dripping acid through the breather hole.*

7.1.6 Fill each cell to a level approximately 1/8" above the level line. *Do not overfill.*

7.1.7 Allow the battery to stand for approximately 4 hours. If the electrolyte is low, add more acid to bring the electrolyte back to the level line.

7.1.8 Replace the filler hole plugs and any of the vent tubes removed during the filling process. Also reconnect all cables.



7.1.9 Set up the Locator for operation and battery charging as described in Section 7.2.3, using the FAST charge position of the Power Switch.

7.1.10 Charge the battery for 20 hours to form the battery plates.

7.1.11 Two hours after completion of the 20 hour charge, check the level of the electrolyte. If it is higher than the level line as marked on the battery windows, remove some of the electrolyte, using an eye dropper. If the electrolyte is lower than the level line, add distilled water to bring it back to the marked level.

7.2 Energizing and Battery Charging.

7.2.1 115/230 Volt, 50-60 Cycle Operation. All units as shipped from the factory are connected for 115 volt operation. To convert to 230 volt operation, loosen the two screws holding the link on the three terminal strip, rotate the link to the screw terminal labeled "230 volts". Tighten all three screws. A ½ ampere fuse should be substituted for the 1 ampere fuse contained in the Locator. CAUTION: THIS OPERATION MUST ONLY BE PERFORMED WITH THE POWER PLUG REMOVED FROM THE POWER SOURCE.

7.2.1a Assuming a 115 volt, 50-60 cycle a-c power source, insert the power cord plug into the socket on the side of the case and plug the other end of the cord into the source of power. Place the POWER switch in the "operate" position. The pilot light should light, showing that the unit is energized.

7.2.2 Battery Operation. For portable use in the field, place the POWER switch in the "operate" position. The pilot light should light, showing that the unit is energized.

7.2.2a The condition of the charge of the three unit cells which make up the 6 volt battery is displayed through windows on the housing of the Locator. Each cell has three floating ball indicators suspended in the battery electrolyte. If all of the balls are at the Liquid Level line, the cell is fully charged. If the green ball is down, the cell is at least 10% dis-

charged. If the green and white balls are down, the cell is at least 50% discharged, and if all three balls are down, the cell is at least 90% discharged.

7.2.3 Battery Charging. To charge the self-contained battery, set up the Locator for battery charging as follows:

7.2.3a Connect the Locator to a source of 115 or 230 volt, 50-60 cycle power.

7.2.3b Select the charge rate by placing the Power Switch in the proper position. To recharge a fully exhausted battery overnight, use the FAST position. If the battery is less than 50% discharged, use the SLOW position for overnight recharging.

7.3 Selection of Antennas.

7.3.1 Bands A-E. Signals on Band A can be picked up with either the rod antenna or the loop antenna. On Bands B, C, D, and E, the rod or dipole antennas are operable. On Band A, the rod antenna may be used initially to tune in on the desired signal due to its high sensitivity. However, the rod is not directional so that the loop should be used if directional indications are desired. The r-f probe may also be used on all bands if the source of interference has been localized to a small area. External antennas can also be used with the Locator by connecting the antenna to the INPUT jack by means of a coaxial cable and appropriate connector.

7.3.2 Band F. Television and fm broadcast signals that fall within this band are horizontally polarized in the United States and Canada. Since the dipole antenna supplied with the Locator is more sensitive to horizontally polarized signals, it should be used at these frequencies. The dipole should be adjusted in length for maximum signal. Some utility radios operate in these frequencies and their signals are generally vertically polarized. For detection of these signals, the rod antenna may be used. External antennas such as Television or fm arrays, or automobile antennas, can also be used with the Locator by connecting the antenna to the INPUT jack.

7.4 Function of Controls.

7.4.1 Band Switch. Select the band in which the desired frequency falls. Band A is the broadcast band; Bands B, C, D, and E are the short-wave bands; and Band F contains the fm broadcast and vhf television bands. To conserve battery power, only one front end is energized at one time. Therefore, when switching to or from Band F, it is necessary to allow approximately 30 seconds for the tubes to heat.

7.4.2 R-F Attenuator Switch. The zero set position is used for the adjustment of the zero set control to bring the meter pointer to the zero position on the meter scale. The "0" position provides maximum sensitivity of the instrument, while the "LOW", "MEDIUM", and "HIGH" position provide increasing degrees of attenuation of the input signal.

7.4.3 Zero Set. When the instrument is first turned on, the meter pointer will swing from the right end of the scale to the left end. The ZERO SET control is used to adjust the position of the pointer to the zero point on the scale after the Locator has warmed up. This operation is performed with the RF ATTENuator in the "ZERO SET" position. The zero point on the meter should be occasionally rechecked during operation, and especially when changing bands.

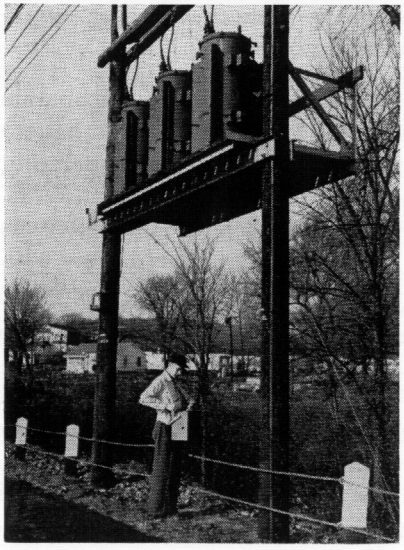
7.4.4 Power Switch. With the power switch in the operate position, the instrument is energized for both a-c and battery operation. The OFF position de-energizes both the operating and charging functions of the Locator. The SLOW and FAST CHARGE positions select the charging rate for the battery as discussed in section 7.2.3. The pilot light should glow with the switch in all positions except OFF, under a-c operating conditions.

As discussed in section 5.3.1, the Model 500 is essentially a battery operated device. If the instrument is plugged into a "dead" power receptacle, the unit will function on the self-contained battery. To check the a-c operation of the Locator, set the power switch to either of the charge positions. If the pilot light glows, the power line is energized.

7.4.5 Volume Control. Clockwise rotation of the volume control increases the audio output of the Locator. Set the Volume Control at a normal listening level.

7.4.6 Tuning Control. Tune the set for the frequency desired and adjust the r-f attenuator so as to keep the meter reading on the lower half of the scale. The volume control should then be adjusted to give a satisfactory audio level.

7.5 Meter Readings. As discussed in section 5.2, the meter is located in the plate circuit of the first i-f tube. The reading on the meter is directly proportional to the quasi-peak of the received r-f signal, and is independent of modulation. Meter indications are also independent of the setting of the volume control. The meter has an upper scale with an approximately logarithmic distribution. Therefore, the higher the meter reading, the greater the r-f input. The logarithmic meter characteristic plus the r-f attenuator used to cut down the r-f input signal, allows the Locator to be used over a tremendous range of input signal strengths. For the convenience of the operator, a linear 0-100 scale has also been provided under the "log" scale. This scale will prove helpful in duplicating readings, and as a general reference scale.



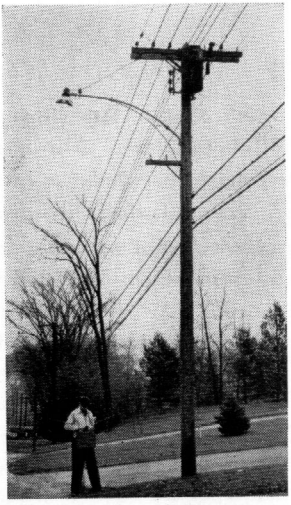
8. Location of Sources of Interference

8.1 Use of Antennas.

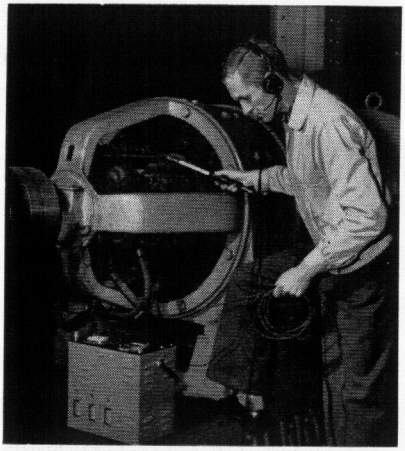
8.1.1 Rod. The rod antenna gives maximum sensitivity to signals in Bands A, B, C, D, and E, but is non-directional. However, the direction of the source of interference can be found by using a triangulation procedure — taking interference readings at several

points and noting the direction of increasing signal strength. When locating interference by this method, the controls on the Locator once set, must be maintained in the same position.

8.1.2 Loop. The loop is a directional antenna used on Band A to determine the direction from which interference is radiating. This is done by turning the Locator to the direction of weakest signal as indicated on the meter. The direction of the noise source will be perpendicular to the plane of the loop.



8.1.3 Dipole. The dipole antenna should be used wherever horizontally polarized signals are to be traced. The dipole is also directional and may therefore be used in the same manner as the loop is used for the broadcast band. However, when the dipole is turned to the direction of *maximum* signal strength, then the source of that signal is in a direction at right angles to the plane of the dipole. The length of the dipole may be adjusted for maximum signal strength at any one frequency.



8.1.4 R-F Probe. The R-F Probe is used on all bands when the source of interference has been localized to a small area. The probe's sensitivity is very low, requiring a strong signal to obtain an indication on the meter. This permits pinpointing of the source of noise after the loop or dipole has localized the interference to a specific area such as a substation. The probe is used at the end of the 25 foot long coaxial extension cable and the other end connected to the INPUT jack of the Locator. For maximum protection to users, the probe is tested to withstand a voltage of 35 KV 60 cycles a-c. However, the probe should never be used in direct contact with circuits energized above 550 volts. As a safety precaution, the Locator should always be placed on the ground when probing near energized equipment.

8.2 Interference Location Procedure.

8.2.1 General. There are three methods of detecting a signal from which interpretations may be made: (a) listening to the audio output of the speaker, (b) using earphones connected to the phone jack, and (c) observing the deflection of the meter. The use of the meter is preferred since the ear is sensitive to only relatively large changes in audio level. In cases where turning the directional antenna produces only small changes in audio output, the meter reading must be used in determining the direction of the signal.

8.2.2 Initial Readings. First attempts to locate the source of an interfering signal will probably start a long distance away from the noise source. Therefore a signal from a radio

or TV station may be considerably greater than the interfering signal, resulting in a maximum meter reading when the antenna is directed toward the radio or TV station, rather than toward the noise source. However, interference signals are generally very broad and you can hear them above or below the frequency of the desired signal. By slightly detuning the Locator, the signal from the radio or TV station will be eliminated, leaving only the noise signal on the meter. It should now be possible to determine the direction of maximum noise signal by turning the directional antenna and noting the change in meter readings. When using the loop, as discussed in section 8.1.2, the interfering signal source will be in a direction perpendicular to the plane of the loop. If the dipole is used, the direction of the interfering source is also at right angles to the plane of the dipole. *If the noise signal increases as you patrol along a line, you are headed in the right direction. If it decreases, turn around and go the other way.*

8.2.3 Final Readings. When the Locator is very close to the noise source, the directional antennas lose their effectiveness because the received signal will be strong in all directions. For precise location of the actual source of trouble, the r-f probe should be used.

9. Causes and Elimination of Radio Interference

9.1 General. Once a source of interference has been pinpointed to a particular item on a power line or to a particular

appliance, the job of the Interference Locator is completed. However, the final job, elimination of the interference, is yet to be done. Each source of interference will present its own particular problem in attempting to suppress it. In most cases, the solution to the problem is obvious. Where the problem is more difficult, there are numerous publications available on radio and TV interference suppression to assist in determining corrective measures.

9.2 Interference Caused by Transmission and Distribution Lines. The causes of radio interference on transmission and distribution lines can be broken down into four general classifications:

9.2.1 Overstressed Insulation. Every insulator, including air, has a critical voltage limit above which corona will be formed. Local spots, such as the area around the edges of a suspension insulator cap near the porcelain surface, may be overstressed and show corona even though the complete insulator will pass all required tests. This corona formation will be a very troublesome source of interference. There is no real cure for corona troubles, however, using adequate insulation in construction will minimize it. Where corona develops from deteriorating insulation, it may actually serve a useful purpose in that it is a warning of future failure of the power circuit.

9.2.2 Defective Porcelain Insulators. Poor voltage distribution on the surfaces of porcelain due to cracks, pin holes or chips will cause a great amount of interference. The cure for this is obviously to replace the defective insulators. The use of new ruggedized insulators will help minimize these occurrences.

9.2.3 Loose Hardware and Tie Wires. Loose hardware such as pole pins, line clamps, guy wire clamps, disconnects, insulator pins, and tie wires are a common source of interference. Tightening of the offending items will eliminate the trouble.

9.2.4 Dirt and Smog. The accumulation of dirt or de-

posits from smoke or smog between live parts and line hardware can cause interference. Normally rain washing will prevent this from becoming serious. However, if difficulty does occur it is desirable to clean insulators where possible.

9.2.5 Other causes of interference on power lines include:

Tree or brush rubbing lines and guy wires.
Poor ground connections.
Conduits touching transformer cases.
Defective lightning arresters.
Guy wires touching each other.
Water in conduits.
Loose connections.
Grounded objects or conductors too close to energized wires or surfaces.

9.3 Interference on Customer's Premises.

9.3.1 Frequently the tracking down of interference leads to sources within a customer's home. Some common sources of interference found in or around the home are:

Fluorescent lights
Air conditioners
Defective wall outlets
Appliance motors
Carbon filament or looped tungsten lamps
Oil furnaces
Electronic medical equipment
Flashing signs
Neon signs
Thermostats
Kilowatt-hour meters
Germicidal lamps
Small motors
Other TV sets or radio sets
Office machines
Electric fences
Incubators
Farm lighting plants

9.3.2 Noise coming from these sources may be carried to the radio or TV receiver in two ways: by direct radiation or by conduction on the power line and leakage into the receiver through its power supply. The interference may be transmitted by either one of these methods or by a combination of both. Usually, however, the majority of noise picked up is from radiation. Therefore, it is desirable to limit the radiation of the interference at its source. There are three methods to do this:

9.3.2a Eliminate or reduce the basic cause of interference.

9.3.2b Prevent the interfering signals from leaving the disturbing device either by shielding or using filters or both.

9.3.2c Prevent the various interfering signals from reaching and effecting the radio receiver.

9.3.3 Stopping the interference at its source is the best procedure. If you cannot do this, use the second method rather than the third, since this prevents conduction on the power line and limits the radiation as well. However, there may be cases where it is impractical to either shield the device or install a filter at the source of interference. In these cases, a filter in the power line of the receiver should be used. It may also be possible to shield the input to the receiver from the radiated noise without hurting the desired signal reception. This can be done by installing the antenna at right angles to the power line and as far away from it as possible. The use of directional antennas, lead-in filters, or shielded lead-in wires will also help in cutting down interference.

9.4 Tracing Interference on Customer Premises.

9.4.1 Start at the customer's receiver by placing the Locator near it and operating it from the internal battery. Short circuit the antenna and ground connections or the loop antenna terminals on the receiver, depending on the set design. If interference ceases to be heard on the customer's receiver but continues to be heard on the Locator, this indicates that the interference is of the radiated type.

9.4.2 If the interference did not stop in the customer's receiver when its antenna was short-circuited, the interference may be arriving through the power line. Connect the Locator to the same line outlet and operate it with the rod antenna removed from its base. If interference is still present on the Locator, then it is reaching the receiver in part via the power line. If there is no interference on the Locator, then all the interference is arriving by radiation.

9.4.3 Again operate the Locator from its battery supply and with rod antenna extended, open the main switch on the premises at the electric meter. If the noise stops, then it originates on the premises. If the noise abates only partially or remains constant, then the noise source is elsewhere in the vicinity. Line-conducted noise may be reduced to a tolerable level or effectively eliminated in many cases by installing a properly designed interference filter between power source and receiver. This is not as efficient, however, as installing a filter at the noise source between the power line and the appliance or apparatus causing the interference.

9.4.4 Isolating Noise Sources. In small residences, this is done most easily by switching suspected appliances or equipment off while the customer's receiver is in operation. In larger homes and small business establishments, it may be necessary to have an assistant or the customer listen to the receiver while each electrical circuit is de-energized in turn by opening circuit breakers, throwing switches or removing fuses. Once the noise source is localized to a particular circuit, each appliance on the circuit as well as connections, switches, etc. should be checked. The following procedure has been found useful in isolating circuit noises:

9.4.4a Check the receiver antenna, lead-in and ground for loose or poor connections or rubbing branches, etc.

9.4.4b Be sure that none of the service wires which enter the house are rubbing against tree branches or against the building.

9.4.4c Make certain that the service conduit containing the supply wires leading into the house is grounded.

9.4.4d The house wiring should be grounded as provided by the accepted local electrical code. Have a licensed electrician check this if there is any doubt.

9.4.4e Be sure that all switches in the distribution system make firm contact. All line fuses should be firmly in place, with clean contacts. Temporary fuses should be eliminated. Fuses should be checked, as a loose connection between the fusing material and the contact cap will create interference.

9.4.4f Inspect all connections in switch boxes, distribution boxes and fuse boxes for looseness, tightening terminal screws where necessary.

9.4.4g Examine all lamp bulbs used in the house, making sure they are firmly screwed into their sockets. Turn on each lamp and tap it on the side for loose elements and poor base connections. Question the socket. Obsolete straight wire filament types of lamp bulbs are prolific sources of interference.

9.4.4h Check all lamp extensions and attachment plugs to every appliance, looking for loose contacts. Shake extension cords, listening to the receiver for signs of poor internal connections while the device connected to the cord is turned on. Extension cords with knots and kinks, as well as worn cords, should be examined carefully.

9.4.4i Repair or replace snap switches which do not open quickly.

9.4.4j Water and gas pipes or electric conduit pipes rubbing against each other may discharge electrostaticly. Bond the pipes together at the rubbing joint or insulate the contact surfaces. Quite often the turning on of a water faucet, walking through the house, use of household appliances or the operation of oil burners or refrigerators will start such electrostatic interference. With experience, you will be able to distinguish electrostatic noises from those produced by electrical apparatus.

9.4.5 In larger commercial establishments or where it is not feasible to de-energize circuits or equipment when making tests, use the Locator with the r-f probe on suspected noise sources. If the probe is not available, the loop antenna connected to the coaxial extension cable may be used as a probe. In doing this, take proper safety precautions since the loop is not insulated. In these cases, the Locator should be operated from the internal battery.

9.5 Use of Filters. After you have found the source of interference, you will have to eliminate it. In some cases the procedure would be obvious, such as the repair of defective equipment or parts, replacement of worn or broken conductors or tightening up of loose components or connectors. In other cases, the interference is inherent in the offending device and is impossible to eliminate without actually de-energizing the unit. In these cases, an appropriate filter installed in the power line will often effectively suppress conducted interference. This filter should be installed as close to the offending device as possible, with maximum results obtained when the filter is built into the unit. In those cases where the interference is of the radiated type, an additional filter installed in the power line to the receiver will also be helpful. Sprague, through its nationwide network of electronic parts distributors, makes available a large selection of interference filters. These filters have been engineered to effectively suppress conducted interference in the circuits to which they are connected.

9.5.1 Sprague interference filters are available for use on 115 volt and 230 volt a-c or d-c circuits. Standard units with current ratings up to 35 amperes are maintained in stock. Special filters of all types are available with current ratings up to 200 amperes, if necessary. These filters are designed for interference suppression from any type of electrically operated device, such as motors, fluorescent fixtures, relays, buzzers, or any other apparatus which can generate such interference. Further information on these filters will be supplied on request to the Sprague Products Company, North Adams, Massachusetts.

10. Miscellaneous

10.1 Serial Number. The serial number of the Locator is stamped on the panel. Always give this number in any correspondence concerning the Locator.

10.2 Return of Locator for Servicing. Should it ever be necessary to return this instrument for factory servicing, write Sprague Electric Company, Industrial Capacitor Division, North Adams, Massachusetts for complete and exact shipping instructions. DO NOT RETURN ANY INSTRUMENT UNTIL THESE ARRIVE.

10.2.1 All instruments should be carefully packed to avoid damage and clearly labeled "fragile." THEY SHOULD BE SHIPPED ONLY BY RAILWAY EXPRESS, PREPAID. Experience has shown that no other transportation agency should be used.

10.2.2 MAKE SURE THE BATTERY IS REMOVED BEFORE SHIPPING A LOCATOR. SHOULD IT LOOSEN OR BREAK IN TRANSIT, IT CAN CAUSE SERIOUS DAMAGE.

LIST OF MAINTENANCE PARTS

Circuit Symbol	Replacement Part No.	Description
C1	1-888	Capacitor, tubular ceramic, 47 μμF, 500 vdc
C2	1-879	Capacitor, disc ceramic, .03 μF, 500 vdc
C3	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C4	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C4A	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C5	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C6	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C7	1-888	Capacitor, tubular ceramic, temp. comp., 47 μμF, 500 vdc
C8	1-887	Capacitor, disc ceramic, .005 μF, 500 vdc
C9	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C10	1-889	Capacitor, tubular ceramic, 10 μμF, 500 vdc
C11	1-871	Capacitor, tubular ceramic, 2μμF, 500 vdc
C11A	1-889	Capacitor, tubular ceramic, 10 μμF, 500 vdc
C12	1-890	Capacitor, tubular ceramic, 5 μμF, 500 vdc
C13	1-889	Capacitor, tubular ceramic, 10 μμF, 500 vdc
C13A	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C14	1-891	Capacitor, tubular ceramic, 1.0 μμF, 500 vdc
C14A	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C15	1-886	Capacitor, disc ceramic, .001 μF, 500 vdc
C15A	1-885	Capacitor, button ceramic, .001 μF, 500 vdc
C16	1-889	Capacitor, tubular ceramic, 10 μμF, 500 vdc
C17	1-889	Capacitor, tubular ceramic, 10 μμF, 500 vdc
C17A	1-885	Capacitor, button ceramic, .001 μF, 500 vdc
C18	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C19	1-895	Capacitor, silvered mica, 470 μμF, ±5%, 500 vdc
C19A	1-889	Capacitor, tubular ceramic, 10 μF, 500 vdc
C20	1-848	Capacitor, silvered mica, 1500 μμF, ±5%, 500 vdc
C21	1-896	Capacitor, silvered mica, 5000 μμF, ±5%, 300 vdc
C22	1-893	Capacitor, silvered mica, 200 μμF, ±5%, 500 vdc
C22A	1-890	Capacitor, tubular ceramic, 5μμF, 500 vdc
C23	1-894	Capacitor, silvered mica, 300 μμF, ±5%, 500 vdc
C23A	1-889	Capacitor, tubular ceramic, 10 μF, 500 vdc
C24	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C25	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C26	1-813	Capacitor, tubular ceramic, 100 μμF, 500 vdc
C27	1-681	Capacitor, tubular electrolytic, 40 μF, 150 vdc
C28	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C29	1-882	Capacitor, disc ceramic, 220 μμF, 500 vdc
C30	1-889	Capacitor, tubular ceramic, 10 μμF, 500 vdc
C31	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C32	1-884	Capacitor, disc ceramic, 1000 μμF, 500 vdc
C33	1-115	Capacitor, Difilm tubular, .22 μF, 200 vdc
C34	1-881	Capacitor, disc ceramic, 100 μμF, 500 vdc
C35	1-881	Capacitor, disc ceramic, 100 μμF, 500 vdc
C36	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C37	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C38	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C39	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C40	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C40A	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C41	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C42	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C43	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc

LIST OF MAINTENANCE PARTS

Circuit Symbol	Replacement Part No.	Description
C44	1-663	Capacitor, tubular electrolytic, 500 μF, 6 vdc
C45	1-883	Capacitor, buffer ceramic, .005 μF, 2 kv
C46	1-673	Capacitor, tubular electrolytic, 8 μF, 150 vdc
C47	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C48	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C49	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C50	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C51	1-878	Capacitor, disc ceramic, .01 μF, 500 vdc
C52	1-886	Capacitor, disc ceramic, .001 μF, 500 vdc
C53	1-886	Capacitor, disc ceramic, .001 μF, 500 vdc
Q1, Q2	2N301	Transistor, power type
R1	2-19	Resistor, composition, 56 ohms, 1/2 watt ±10%
R2, R3, R4	2-43	Resistor, composition, 560 ohms, 1/2 watt ±10%
R5, R6	2-21	Resistor, composition, 68 ohms, 1/2 watt ±10%
R6A	2-9	Resistor, composition, 22 ohms, 1/2 watt ±10%
R7	2-97	Resistor, composition, 100K ohms, 1/2 watt ±10%
R8	2-17	Resistor, composition, 47 ohms, 1/2 watt ±10%
R9	2-29	Resistor, composition, 150 ohms, 1/2 watt ±10%
R10	2-73	Resistor, composition, 10K ohms, 1/2 watt ±10%
R11, R12	2-51	Resistor, composition, 1200 ohms, 1/2 watt ±10%
R13	2-113	Resistor, composition, 470K ohms, 1/2 watt ±10%
R14	2-17	Resistor, composition, 47 ohms, 1/2 watt ±10%
R15	2-49	Resistor, composition, 1K ohms, 1/2 watt ±10%
R16	2-73	Resistor, composition, 10K ohms, 1/2 watt ±10%
R18	2-115	Resistor, composition, 560K ohms, 1/2 watt ±10%
R18A	2-51	Resistor, composition, 1200 ohms, 1/2 watt ±10%
R19	2-73	Resistor, composition, 47K ohms, 1/2 watt ±10%
R20	2-73	Resistor, composition, 10K ohms, 1/2 watt ±10%
R21	2-63	Resistor, composition, 300 ohms, 1/2 watt ±10%
R22, R23	2-51	Resistor, composition, 1200 ohms, 1/2 watt ±10%
R24	2-17	Resistor, composition, 47 ohms, 1/2 watt ±10%
R25	2-73	Resistor, composition, 10K ohms, 1/2 watt ±10%
R26	2-500	Resistor, composition, 10 ohms, 2 watts
R27	2-109	Resistor, composition, 330K ohms, 1/2 watt ±10%
R28	2-43	Resistor, composition, 560 ohms, 1/2 watt ±10%
R29	2-139	Resistor, composition, 5.6 megohms, 1/2 watt ±10%

LIST OF MAINTENANCE PARTS

Circuit Symbol	Replacement Part No.	Description
R30	2-115	Resistor, composition, 560K ohms, 1/2 watt ±10%
R31	2-97	Resistor, composition, 100K ohms, 1/2 watt ±10%
R32	2-36	Resistor, composition, 100 ohms, 1/2 watt ±10%
R33	2-29	Resistor, composition, 47 ohms, 1/2 watt ±10%
R34	2-134	Resistor, composition, 3.6 megohms, 1/2 watt ±10%
R35	2-97	Resistor, composition, 100K ohms, 1/2 watt ±10%
R36	2-51	Resistor, composition, 1200 ohms, 1/2 watt ±10%
R37	2-27	Resistor, composition, 120 ohms, 1/2 watt ±10%
R38	2-51	Resistor, composition, 1200 ohms, 1/2 watt ±10%
R39	2-97	Resistor, composition, 100K ohms, 1/2 watt ±10%
R40	2-51	Resistor, composition, 1200 ohms, 1/2 watt ±10%
R41	2-27	Resistor, composition, 120 ohms, 1/2 watt ±10%
R42	2-51	Resistor, composition, 1200 ohms, 1/2 watt ±10%
R42A	2-77	Resistor, composition, 15K ohms, 1/2 watt ±10%
R43	2-97	Resistor, composition, 100K ohms, 1/2 watt ±10%
R44	2-99	Resistor, composition, 120K ohms, 1/2 watt ±10%
R46	2-51	Resistor, composition, 1200 ohms, 1/2 watt ±10%
R46A	2-113	Resistor, composition, 470K ohms, 1/2 watt ±10%
R47	2-1	Resistor, composition, 10 ohms, 1/2 watt ±10%
R48	2-35	Resistor, composition, 270 ohms, 1/2 watt ±10%
R49	2-665	Resistor, wirewound, 0.2 ohm, 2 watt ±10%
R50	2-666	Resistor, wirewound, 1.0 ohm, 2 watt ±10%
R51	2-45	Resistor, composition, 680 ohms, 1/2 watt ±10%
R52	2-346	Resistor, composition, 100 ohms, 1 watt
R53	2-99	Resistor, composition, 120K ohms, 1/2 watt ±10%
R54	2-3	Resistor, composition, 12 ohms, 1/2 watt ±10%
R55	2-3	Resistor, composition, 12 ohms, 1/2 watt ±10%
R56	2-3	Resistor, composition, 12 ohms, 1/2 watt ±10%
R57	2-3	Resistor, composition, 12 ohms, 1/2 watt ±10%
R58	2-3	Resistor, composition, 12 ohms, 1/2 watt ±10%
R59	2-3	Resistor, composition, 12 ohms, 1/2 watt ±10%
R60	2-91	Resistor, composition, 56K ohms, 1/2 watt ±10%
R61	2-91	Resistor, composition, 56K ohms, 1/2 watt ±10%
R62	2-91	Resistor, composition, 56K ohms, 1/2 watt ±10%

LIST OF MAINTENANCE PARTS

Circuit Symbol	Replacement Part. No.	Description
	19-101	60" Standard Dial Cord
T1	3-329	Transformer, Ant., band 1
T2	3-330	Transformer, Ant., band 2
T3	3-331	Transformer, Ant., band 3
T4	3-332	Transformer, Ant., band 4
T5	3-333	Transformer, Ant., band 5
T6	3-334	Transformer, RF, band 1
T7	3-335	Transformer, RF, band 2
T8	3-336	Transformer, RF, band 3
T9	3-337	Transformer, RF, band 4
T10	3-338	Transformer, RF, band 5
T11	3-339	Transformer, Osc., band 1
T12	3-340	Transformer, Osc., band 2
T13	3-341	Transformer, Osc., band 3
T14	3-342	Transformer, Osc., band 4
T15	3-343	Transformer, Osc., band 5
T16	3-328	Transformer 1st 455 Kc IF
T17	3-327	Transformer, 2nd 455 Kc IF
T18	3-327	Transformer, 3rd 455 Kc IF
T19	3-326	Transformer 1st 10.7 Mc IF
T20	3-325	Transformer, 2nd 10.7 Mc IF
T21	3-325	Transformer, 3rd 10.7 Mc IF
T-22	3-344	Transformer, Audio Output
T-23	3-345	Transformer, Power Osc. 1500 cycle
T24	3-346	Transformer, Power, 50-60 cycle/120/240V
L1, B,C	1-1021	Inductuner, band 6 (Var)
L2	1-1022	Trimmer inductance, RF, band 6 (Var)
L4	1-1024	Trimmer inductance Osc., band 6 (Var)
L5	1-1025	Padder inductance, Osc., band 6 (Var)
L6	1-1026	Choke, RF cathode, band 6 (fixed)
L7	1-1027	Choke, pwr supply filter (fixed)
CT1	1-1023	Trimmer Capacitor, Ant., band 1
CT2	1-1023	Trimmer Capacitor, Ant., band 2
CT3	1-1023	Trimmer Capacitor, Ant., band 3
CT4	1-1023	Trimmer Capacitor, Ant., band 4
CT5	1-1023	Trimmer Capacitor, Ant., band 5
CT6	1-1023	Trimmer Capacitor, RF, band 1
CT7	1-1023	Trimmer Capacitor, RF, band 2
CT8	1-1023	Trimmer Capacitor, RF, band 3
CT9	1-1023	Trimmer Capacitor, RF, band 4
CT10	1-1023	Trimmer Capacitor, RF, band 5
CT11	1-1023	Trimmer Capacitor, Osc., band 1
CT12	1-1023	Trimmer Capacitor, Osc., band 2
CT13	1-1023	Trimmer Capacitor, Osc., band 3
CT14	1-1023	Trimmer Capacitor, Osc., band 4
CT15	1-1023	Trimmer Capacitor, Osc., band 5
CT16	1-1024	Trimmer Capacitor, RF, band 6
CT17	1-1024	Trimmer Capacitor, Mixer, band 6
CT18	1-1024	Trimmer Capacitor, Osc., band 6
CT19 A,B,C, D,E,F,	1-1022	Capacitor, tuning, bands 1-5 incl.

ALIGNMENT INSTRUCTIONS FOR MODEL 500 INTERFERENCE LOCATOR

Alignment of this equipment should not be attempted by inexperienced personnel since adjustments, particularly of the high frequency portions, are very critical and require a degree of familiarity with such equipment. The signal generator used should have an attenuator capable of reducing the output to 5 microvolts at all frequencies between 455 kc and 220 mc. The accuracy of the dial calibration after re-alignment will be determined by the calibration accuracy of the generator used. The input impedance of the Model 500 is approximately 50 ohms; therefore a generator with this output impedance should be used.

Since the meter on the Model 500 will be used as the tuning indicator, the signal generator may have either a modulated or a c-w output. Modulation will aid in identification of the signal, particularly if the Model 500 is badly misaligned.

Because the meter of the Model 500 is in the automatic gain control signal circuit of the Model 500, the generator output level should be kept small so that the meter reading will not exceed 10 on the linear scale.

All adjustments should be made so as to obtain maximum deflection of the tuning meter.

Before beginning the alignment procedure, the meter zero adjustment should be made, and the r-f attenuator returned to the 0 position (and left there for the duration of the procedure).

The position of the volume control has no effect if a c-w signal is used; however, if modulation is used (it should be approximately 30%), the control should be adjusted for a comfortable audio level.

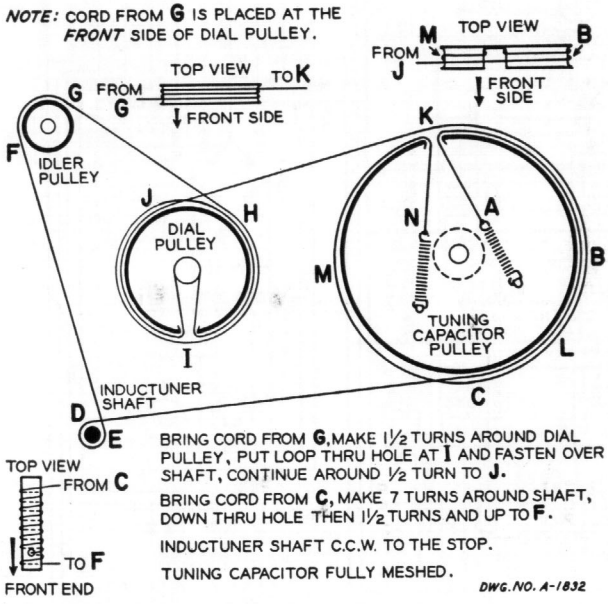
The Model 500 may be powered either by the internal battery or the power line.

ALIGNMENT PROCEDURE

Band	Dummy Antenna	Signal Generator Connection	Signal Generator Frequency	Band Switch Position	Dial Setting	Adjust
455kc IF	.01μF	Pin 9-V2	455kc	A	600kc	T16,T17, T18 Top and Bottom
10.7mc IF	.01μF	Pin 9-V2	10.7mc	D	14mc	T19, T20, T21 Top and Bottom
A	300Ω Non-Ind	Antenna	.55mc 1.6mc	A	.55mc 1.6mc	T11*, T6, T1 CT11*, CT6, CT1
B	300Ω Non-Ind	Antenna	1.6mc 4.75mc	B	1.6mc 4.75mc	T12*, T7, T2 CT12*, CT7, CT2
C	300Ω Non-Ind	Antenna	4.75mc 14mc	C	4.75mc 14mc	T13*, T8, T3 CT13*, CT8, CT3
D	300Ω Non-Ind	Antenna	14mc 28mc	D	14mc 28mc	T14*, T9, T4 CT14*, CT9, CT4
E	300Ω Non-Ind	Antenna	28mc 54mc	E	28mc 54mc	T15*, T10, T5 CT15*, CT10, CT5
F	300Ω Non-Ind	Antenna	54mc 220mc	F	54mc 220mc	L5*, CT16 L4*, L2
			If L4 will not set 220mc, adjust CT18*, then repeat low and high adjust			

*Indicates Calibration adjustments
Set RF ATTEN to "ZERO SET" for IF alignment.
Set RF ATTEN to "0" for RF alignment.
Tune all adjustments for maximum on RF level meter.
Adjust signal generator output for approximately 20% meter reading throughout alignment.
Rock receiver tuning knob when making high frequency adjustment on each band, except the calibration adjustment.
Repeat each alignment step before proceeding to next band.
Allow receiver to heat for 20 minutes before alignment.
The "F" Band tuner does not heat unless the band switch is set to "F".

DIAL CORD ASSEMBLY
FOR
MODEL 500 INTERFERENCE LOCATOR



MODEL 500 SCHEMATIC CIRCUIT
SERIAL NO. 503 AND UP

SW-2

SW-1 - RF ATTENUATOR

R2
R3
R4

VOLTAGE CHART

	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
*6AN4	RF Amp.	110	0	Fil.	0	0	0	110	–	–
*6CG8	Osc-Mixer	−.5	123	0	Fil.	0	122	80	0	−.8
†6BJ6	RF Amp.	0	1.5	0	Fil.	115	100	0	–	–
†6BR8	Osc-Mixer	−3.5	120	0	0	Fil.	120	110	+5	0
6BJ6	1st IF	−.4	1.3	0	Fil.	110	110	0	–	–
6BJ6	2nd IF	−.4	1.3	0	Fil.	110	110	0	–	–
6AQ6	Det ist Audio	−.5	0	Fil.	0	−.4	−.35	48	–	–
6AK6	Audio Out.	0	0	Fil.	0	120	125	5.8	–	–

*Band F Only
†Band B, 1.6 MC. Band F, 54 MC.
Measurements made with d-c vtvm having an input resistance of at least 11 megohms, and the Model 500 battery-operated on fully charged battery.

STANDARD WARRANTY
MODEL 500 INTERFERENCE LOCATOR

The Sprague Electric Company warrants each Interference Locator 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 intact, for our examination, with all transportation charges prepaid to our factory 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 Locator which has 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 units where the serial number thereof has been removed, defaced or changed.

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by us 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 products.

If the return of this instrument is deemed necessary, advise Industrial Capacitor Division, SPRAGUE ELECTRIC COMPANY, NORTH ADAMS, MASS., giving full details. Our reply and complete shipping instructions will reach you within five (5) days after receipt of your letter. NO ADJUSTMENTS WILL BE MADE UNLESS OUR CONSENT FOR THE RETURN OF THE INSTRUMENT IS OBTAINED BEFORE MAKING SHIPMENT.

NOTE: RETURNED INSTRUMENTS MUST BE PACKED CAREFULLY, WITH BATTERY REMOVED, MARKED FRAGILE, AND SHIPPED BY PREPAID EXPRESS.

SPRAGUE ELECTRIC COMPANY

NORTH ADAMS, MASS.

Model 500

Radio Interference Locator

- Designed Expressly For Utility Use.
- Rugged, Lightweight and Portable.
- Covers from 550 kc to 220 mc.
- Easy to Operate.

SPRAGUE ELECTRIC COMPANY

North Adams, Mass.

Form IL-105 E-7-62

Printed in U. S. Amer.