

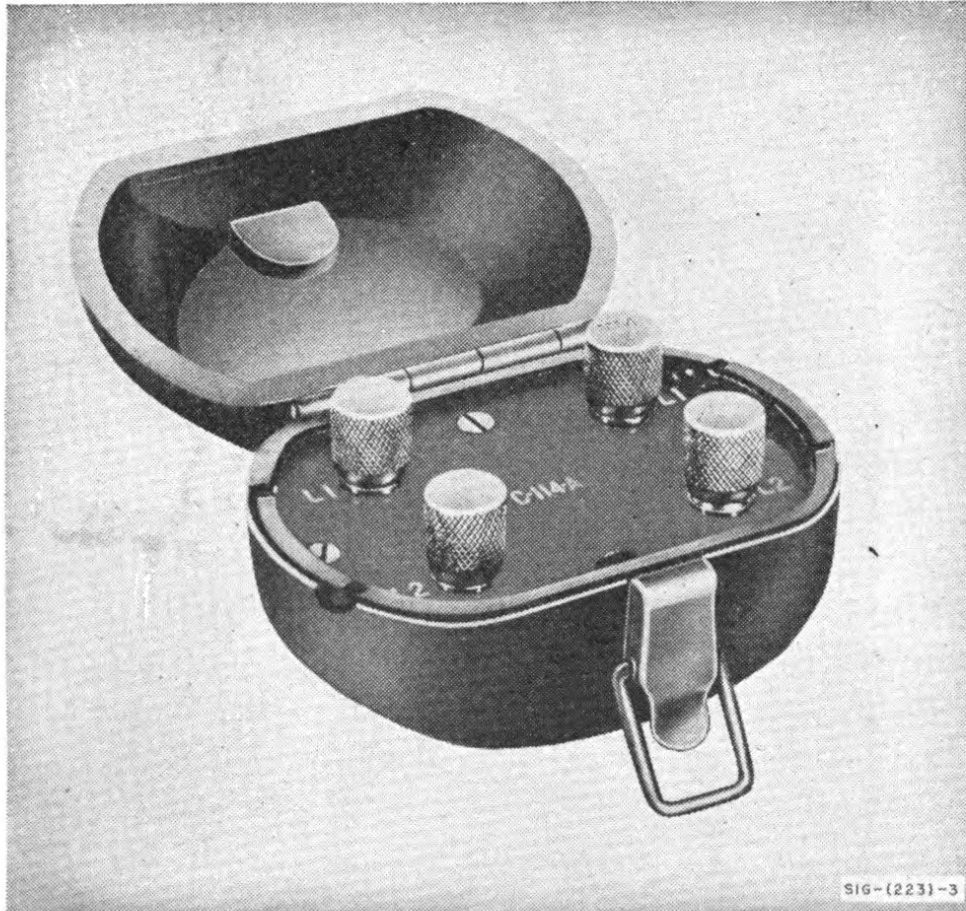
Figure 2. Spiral-4 cable, using repeating Coil C-161.

7. COIL C-114-A (fig. 3). Coil C-114-A (stock No. 3C114A) is an 88-millihenry loading coil for use on field wire lines to extend the talking range. Install this coil at 1-mile intervals on Wires W-110-B (stock No. 1B110B) and WD-1/TT (stock No. 1B190-1) and at  $\frac{5}{8}$ -mile intervals on Wire W-143 (stock No. 1B143). The comparative talking ranges of loaded and unloaded wire lines are given in table II. If the insulation between wires or between the wires and ground is poor (due to leaky splices, for

Table II. Talking range in miles (30-db circuit)

Wire	Unloaded		Loaded with C-114-A	
	Wet	Dry	Wet	Dry
W-110-B.....	11	18	19	33
WD-1/TT.....	12	20	22	40
W-143.....	25	25	90	90

instance), loading of the line will not increase the talking range and may, in extreme cases, actually *decrease* the talking range. Therefore, use Coil C-114-A only on lines that are in good condition; install the coils carefully. FM 24-20 provides detailed information concerning Coil C-114-A.



*Figure 3. Coil C-114-A.*

8. TELEPHONE REPEATER EE-89-A (fig. 4). Telephone Repeater EE-89-A (stock No. 4B3289A) is a two-wire (21-type) voice-frequency intermediate repeater for use in extending the range of field wire, or in improving the performance of marginal circuits. It is battery operated; it uses one BA-40 (stock No.

D101.25:  
Sig 223

# TB SIG 223

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

## FIELD EXPEDIENTS FOR WIRE AND RADIO

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Figure 4. Telephone Repeater EE-89-A.

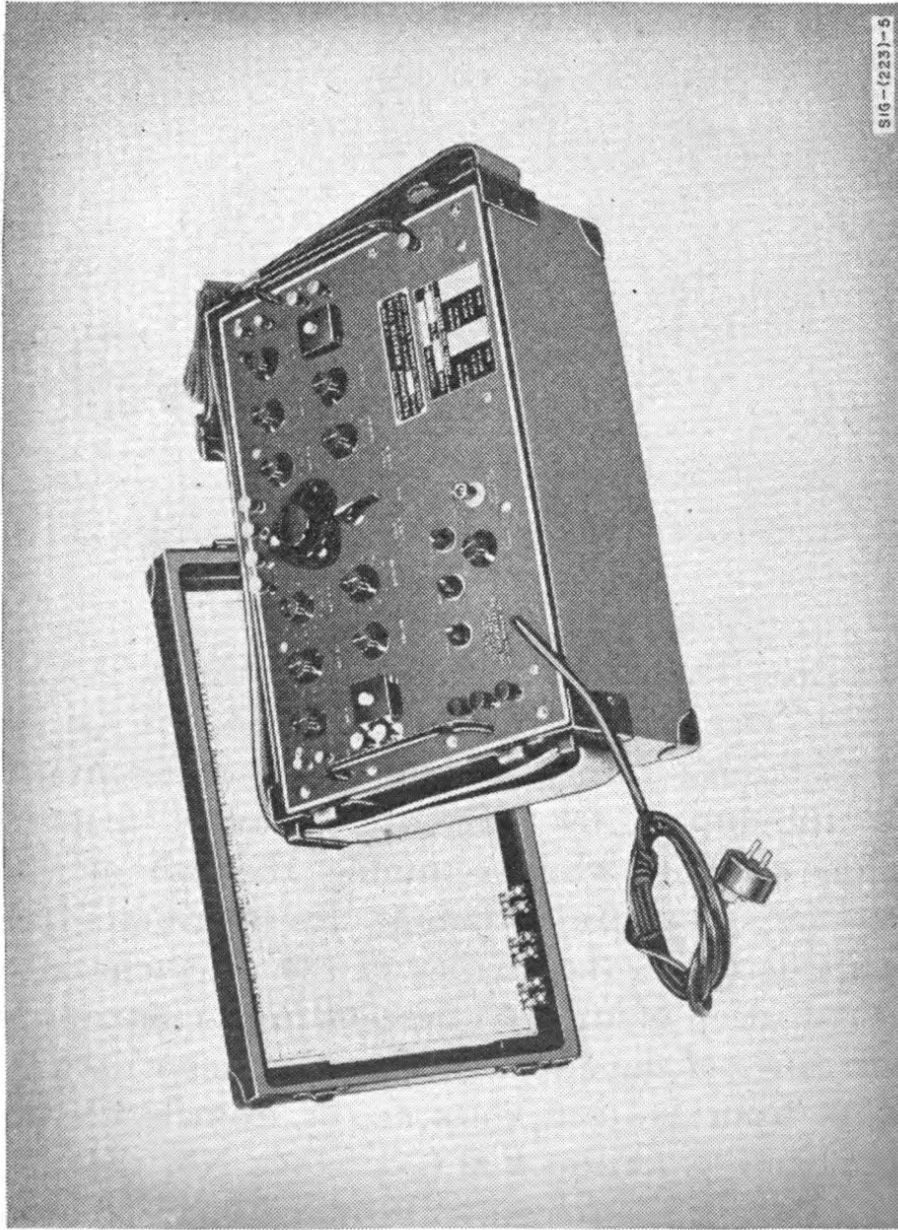
4A40); and it will operate continuously for about 1 week on a fresh battery. It is used to best advantage on unloaded W-110-B (stock No. 1B110B) and WD-1/TT (stock No. 1B190-1) circuits which are 10 to 20 miles long or on unloaded W-143 (stock No. 1B143) circuits which are 25 to 40 miles long. Its principal limitations are that it can be used *only* on a

line consisting of *one type of wire* throughout its length and that it must be installed very near the center of the line. Some improvement in performance can be obtained by installing two repeaters, one at the  $\frac{1}{4}$  point and the other at the  $\frac{3}{4}$  point in the line, but the location and adjustments under these conditions are more critical than is the case when one repeater is used at the center. TM 11-2006 provides detailed information concerning Telephone Repeater EE-89-A.

9. TELEPHONE REPEATER TP-14 (fig. 5). Telephone Repeater TP-14 (stock No. 4B3250-14) is a two-wire (22-type) voice-frequency repeater which may be used on any type of wire line. It is considerably more flexible than Telephone Repeater EE-89-A (stock No. 4B3289A) and may be used on either loaded or unloaded lines and on lines made up of several sections of different kinds of wire, such as W-110-B (stock No. 1B110B), WD-1/TT (stock No. 1B190-1), W-143 (stock No. 1B143), spiral-4, and open wire. It may be operated from 115/230 volts ac, from a 12-volt storage battery, or from 12- and 135-volt dry batteries. Balancing networks are provided to adjust for differences in the lines on either side of the repeater and for unequal spacing of the repeaters. Several Telephone Repeaters TP-14 can generally be used on a long line, with the maximum distance between repeaters depending on the quality or stability of the line. They may be spaced up to 7 miles apart on reasonably good W-110-B lines. This repeater may also be used at the ends of a line (as a terminal repeater) and, by

proper wiring, it may be used as a 4-wire repeater on circuits which utilize a separate pair in each direction. Since it provides a great deal of flexibility, adjustment of the balancing networks and equalizers must be made with a great deal of care. Simplified operating instructions are provided in the cover of the repeater. TM 11-2007 provides detailed information concerning Telephone Repeater TP-14.

10. TELEPHONE TP-9 (fig. 6). Telephone TP-9 (stock No. 4B5500-9) is an amplifier-type telephone for use on very long or on marginal circuits. If this telephone is used on both ends of a circuit, a talking range of 30 to 40 miles over Wire W-110-B (stock No. 1B110B) or WD-1/TT (stock No. 1B190-1), or of 85 miles over Wire W-143 (stock No. 1B143) is provided. If this telephone is used on one end only, with Telephone EE-8 (stock No. 4B5008) at the other end, the talking ranges are about half those given above. This telephone requires the use of push-to-talk release-to-listen procedure, since the amplifier may be used in only one direction at a time. Use Telephone TP-9 only when Telephone EE-8 cannot be used satisfactorily. Telephone TP-9 provides a signal sufficiently strong to cause cross-talk on circuits adjacent to the one that includes the telephone. The above, plus the size and weight of TP-9, and its considerable battery requirement, suggest its use only when EE-8 will not serve. TM 11-2059 provides detailed information concerning Telephone TP-9.



*Figure 5. Telephone Repeater TP-14.*

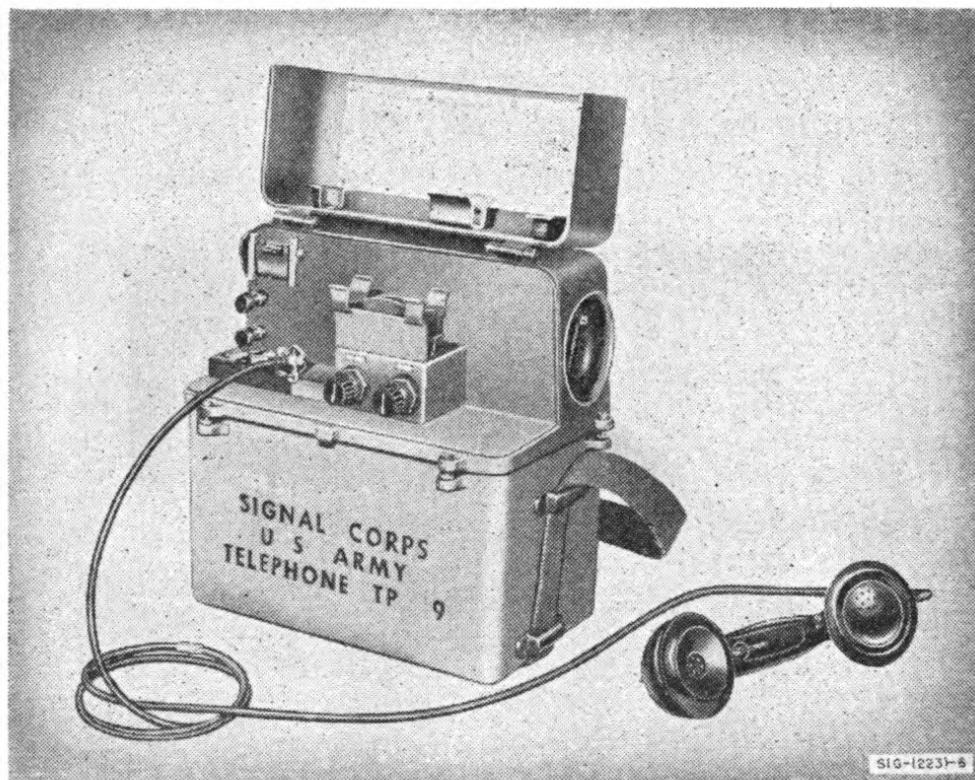
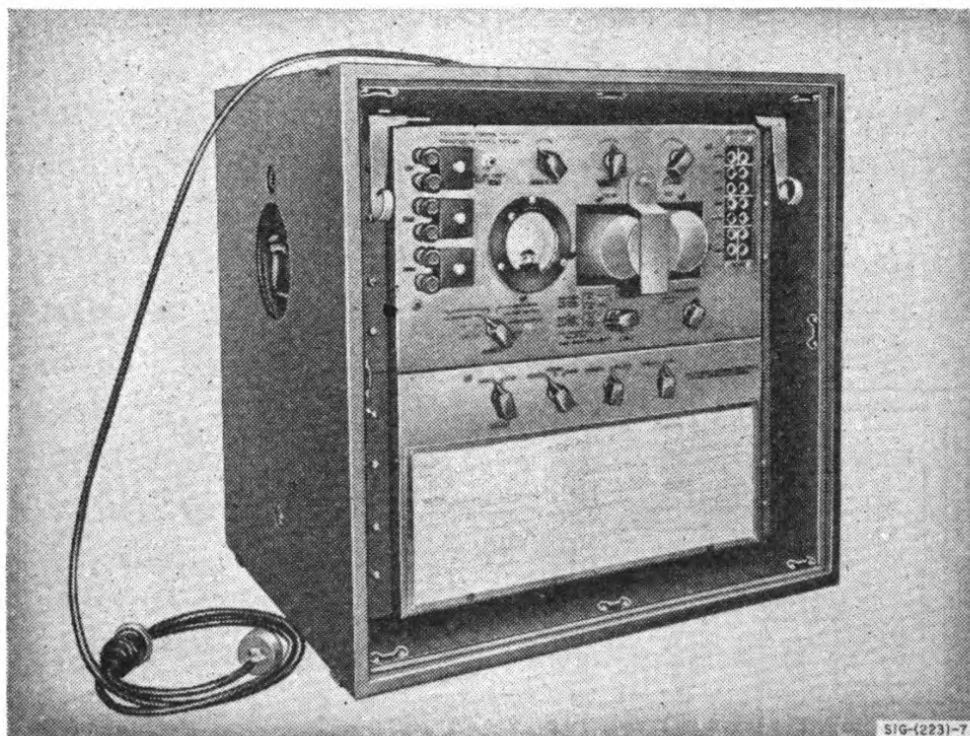


Figure 6. Telephone TP-9.

11. TELEGRAPH TERMINAL TH-1/TCC-1 (fig. 7). Telegraph Terminal TH-1/TCC-1 (stock No. 4A2895) is terminal equipment for use in obtaining a full-duplex teletypewriter channel from a telephone circuit, while retaining the use of the channel for speech transmission. Its use results in a slight reduction in the quality of the voice channel, and a reduction of 10 to 15 percent in the maximum talking range of the circuit. The equipment may be operated from 115/230 volts ac, or from a 12-volt storage battery. Filter F-2/GG (stock No. 3Z1893-10), not part of the telegraph terminal, may be used to patch the teletypewriter circuit from one telephone circuit to another, as shown in figure 8. Remember that when the terminal is used in this



manner, the over-all length of the two circuits must not exceed the normal talking range of a single circuit. TM 11-2206 provides detailed information concerning Telegraph Terminal TH-1/TCC-1 and Filter F-2/GG.



*Figure 7. Telegraph Terminal TH-1/TCC-1.*

12. VOICE FREQUENCY HYBRID TA-31(XC-3)/U. Voice Frequency Hybrid TA-31(XC-3)/U (see note below) is a compact field unit for the interconnection of two-wire and four-wire voice-frequency communication facilities. It consists primarily of a hybrid coil with balancing networks; it is also provided with a d-c remote control relay which permits a radio transmitter in the four-wire side to be controlled from a distance. Figures 9 and 10 show typical applications of this

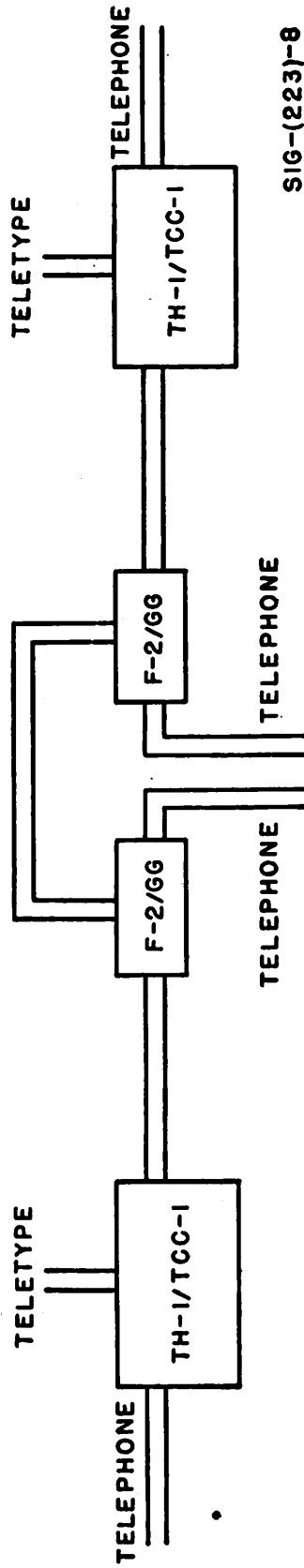


Figure 8. Telegraph Terminal TH-1/TCC-1, using Filter F-2/GG.

unit to various combinations of two- and four-wire circuits. When remote control of a radio transmitter is desired, the hybrid unit should be located near the radio, and the distance between the hybrid and the remote control point should be limited to not more than 5 miles of field wire. An external 45-volt dry battery is required when remote control is desired; otherwise no power supply is needed. Remote control of the radio transmitter may be accomplished by the use of Outpost Connecting Box BE-71 (stock No. 4G1741) and Switch SW-158-A (stock No. 3Z8158-A). If BE-71 is not available, a combination that consists of repeating Coil C-161 (stock No. 3C161), a 2-uf low-voltage capacitor, and a push-button switch, connected as shown in figure 11, may be substituted. Neither the hybrid unit nor the radio circuits to which this equipment may be connected pass a 20-cycle signalling frequency. Thus, if through signalling on circuits that have two-wire terminations at each end is required, it is necessary to use voice-frequency ringers such as Ringing Equipment EE-101-( ) (stock No. 4F2101). Low-frequency ringing (20 cycles) is limited to the local two-wire line section connected to the hybrid equipment. Low-frequency ringing may be used for maintenance purposes or for related signalling wherein the distant switchboard operator requests the local hybrid attendant to ring the local switchboard.

*Note.* Voice Frequency Hybrid TA-31(XC-3)/U is an experimental item not yet stocked in depots. Limited quantities are available only by special requisition.

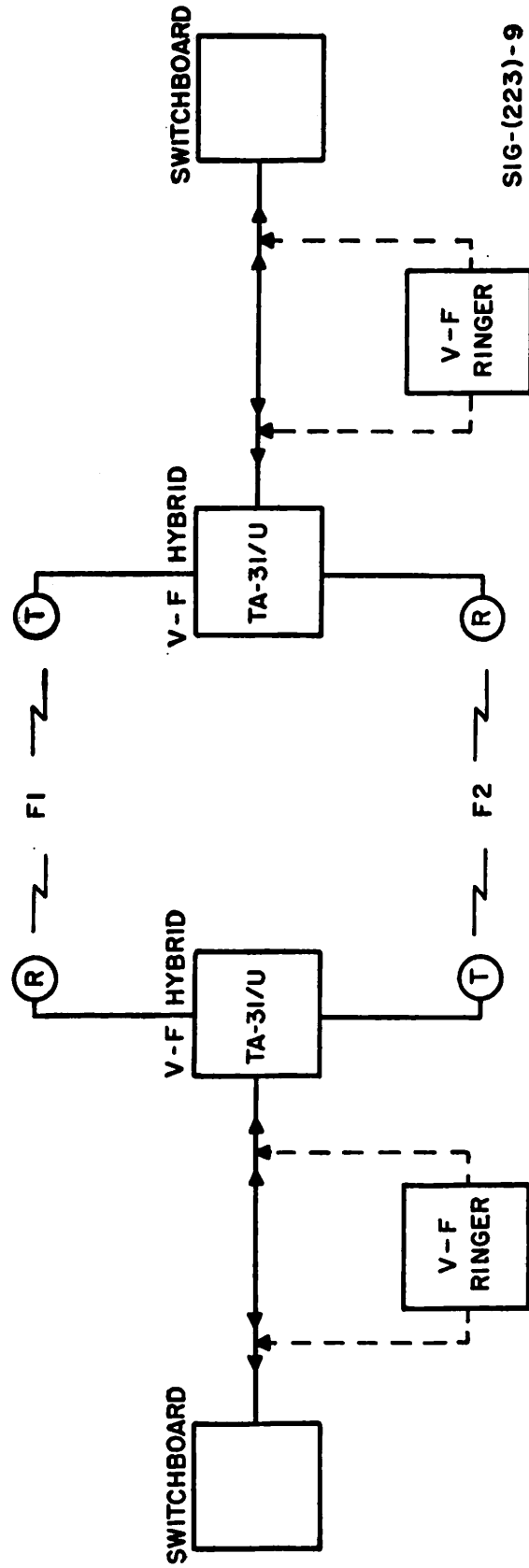


Figure 9. Use of Voice Frequency Hybrid TA-31(XC-3)/U in full-duplex radio circuit without remote control (use of v-f ringer is optional).

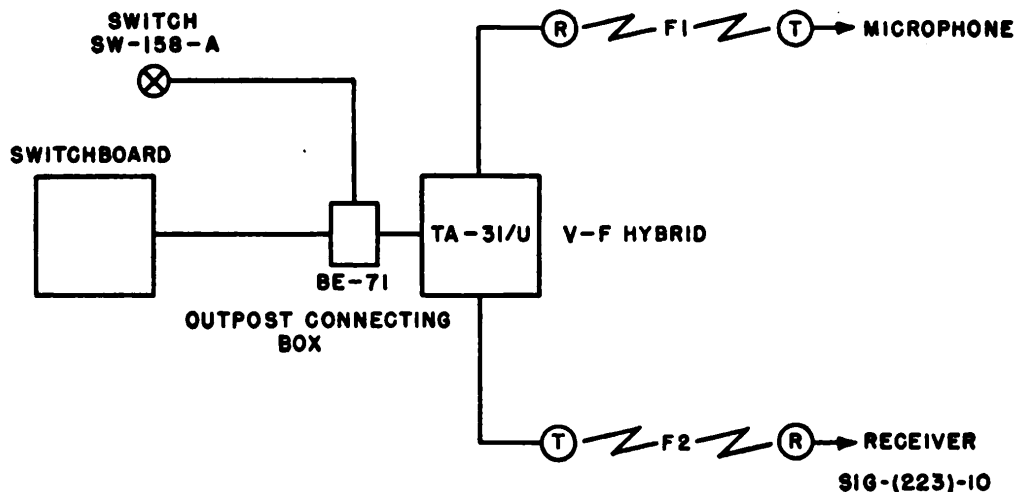


Figure 10. Use of Voice Frequency Hybrid TA-31(XC-3)/U in full-duplex radio circuit with remote control at one end and 4-wire termination at the other end.

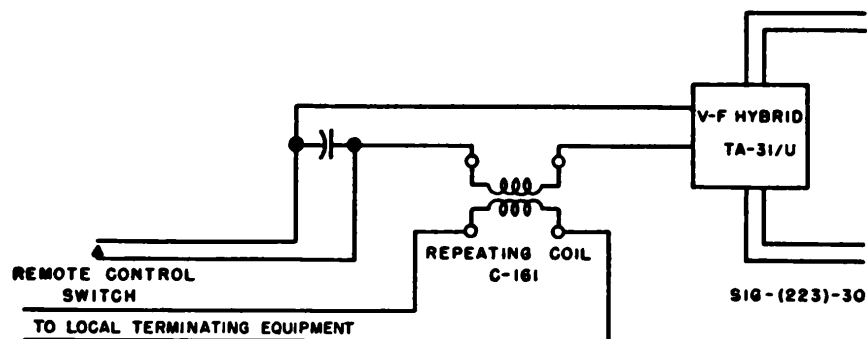


Figure 11. Use of repeating Coil C-161 and a 2-uf low-voltage capacitor for remote control.

### Section III

## RADIO

13. GENERAL PRECAUTIONS. Poor radio communication or lack of communication can be due to any one of a variety of reasons and is not always due to excessive distances or bad terrain. Poorly kept equipment and improper operation can be just as effective in preventing communication as excessive

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is published for the information and guidance of all  
concerned.

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distance or a mountain range. It is essential therefore that the following precautions be observed at all times:

*a.* Read the technical manual for the set. This gives complete operating and maintenance procedures.

*b.* Keep the set clean and dry.

*c.* Handle the set carefully.

*d.* Set up a routine inspection and check procedure covering the following points:

(1) Plugs and jacks should be clean.

(2) Antenna connections should be tight.

(3) Antenna insulators must be dry and clean.

(4) Power connections must be tight.

(5) Motors, fans, etc., should run freely.

(6) Knobs and controls should operate easily.

(7) Dry batteries must be fresh.

*e.* With equipment in good shape, lack of communication can be caused by—

(1) Too great a distance between sets.

(2) Bad terrain—hills and mountains.

(3) Poor choice of location of one or both ends of the circuit.

(4) Not enough transmitter power.

(5) Noise and interference.

14. SITING (fig. 12). The best locations for transmission and reception are hilltops, elevations, or other slight rises of ground. Flat terrain is also good. As a general rule, transmission over water is better than over land. Valleys, depressions, densely wooded areas, and low places are poor sites. When the set is installed in a vehicle, stay away from bridges, large



Figure 12. Siting.

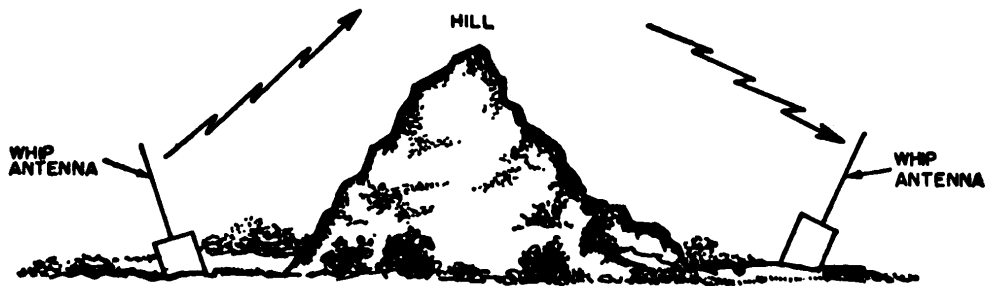


buildings, large trees, and heavily traveled roads. Proper siting and the proper antenna can be more effective in maintaining communication than increasing the power of the equipment 10 or 20 times.

15. ANTENNAS, GENERAL. Practically all of the radio sets used in the combat areas back to division headquarters use a whip or rod type antenna. This is the only type that can be used for vehicles and man-pack sets that must operate in motion. However, it is *not* the best antenna by any means. For example, a 30-foot elevated antenna for Radio Set SCR-300 (stock No. 2S300) (TM 11-242) can increase its range of 2 or 3 miles to 7 or 10 miles in rolling country. Specific recommendations on antenna systems for particular sets are given below. More detailed information is given in the technical manuals of many of the sets and in TM 11-314, Antennas and Antenna Systems.

16. ANTENNAS FOR H-F SETS SCR-694, AN/GRC-9, SCR-177, SCR-188, SCR-193, SCR-506, ETC. The stock numbers for these sets are 2S694/6-12-24, 2S501-9, 2S177, 2S188, 2S193, and 2S506/12 and 2S506/24, respectively. The appropriate technical manuals for the sets are SCR-694 (TM 11-230C), AN/GRC-9 (TM 11-263), SCR-177 (TM 11-232), SCR-188 (TM 11-233), SCR-193 (TM 11-273), and SCR-506 (TM 11-630). With the whip antennas that are provided for these sets, the *maximum* voice range is about 25 miles and the maximum c-w range is about 35 to 50 miles. These ranges are reduced considerably in densely wooded

areas, in mountainous country, or where the locality is very noisy. To overcome this, it is necessary to carefully site the set or change the antenna system. For example, it may be possible to bounce the signal (skywave transmission) over an obstruction by tilting the antenna away from the distant station (fig. 13). The most suitable type of antenna for skywave transmission is the horizontal antenna. When supported above ground between 6 and 30 feet, it will work well for distances of 15 to 200 miles. These antennas can be end-fed or center-fed.

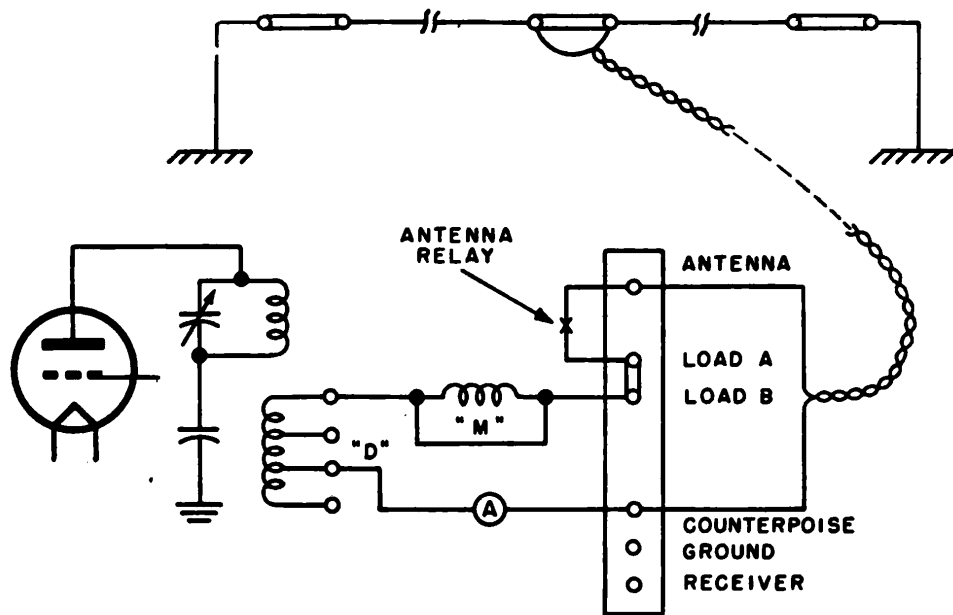


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*Figure 13. Tilting antennas for increasing signal strength over an obstruction.*

17. IMPROVISED CENTER-FED HALF-WAVE ANTENNAS (fig. 14). For Radio Transmitter BC-191 (stock No. 2C6191) (Radio Sets SCR-177 (stock No. 2S177), SCR-188 (stock No. 2S188), SCR-193 (stock No. 2S193)), the arrangement shown in figure 14 can be used. Use available materials such as field wire and insulators.

18. IMPROVISED END-FED ANTENNAS (fig. 15). *a.* Certain radio sets such as the SCR-694 (stock No. 2S694-GP/50), Radio Transmitter BC-



**PROCEDURE :**

- SET "ANTENNA CIRCUIT SWITCH N" ON 3 WHICH GIVES ABOVE CIRCUIT.
- SET "ANTENNA INDICATOR TUNING M" ON 0.
- SET "ANTENNA COUPLING SWITCH D" FOR PROPER LOADING OF AMPLIFIER.
- REMOVE SHORTING BAR BETWEEN COUNTERPOISE AND GROUND TERMINALS.
- CONNECT TRANSMISSION LINE TO TERMINALS MARKED ANTENNA AND COUNTERPOISE AS SHOWN.

TL 53236-S

*Figure 14. Circuit of Radio Transmitter BC-191-(\*) for use with half-wave doublet antenna.*

191 (stock No. 2C6191), and the AN/GRC-9 (stock No. 2S501-9) are arranged so as to use end-fed half-wave antennas, which are normally supplied with the sets.

b. Improvised antennas can be constructed with available materials as follows: The over-all length should be approximately 234 feet from X to Y. Measuring from X, insulators should be placed at A, B, C, D, and E as shown in table III. By providing shorting jumpers across the insulators (fig. 16), the various required lengths can be set up for the

operating frequency. Additional insulators and jumpers can be added to provide for frequencies above 6 mc.

Table III. Placing insulators.

Frequency (mc)	Length (ft)	Connections
6.0	78	X to A
5.0	94	X to B
4.0	117	X to C
3.0	156	X to D
2.5	187	X to E
2.0	234	X to Y

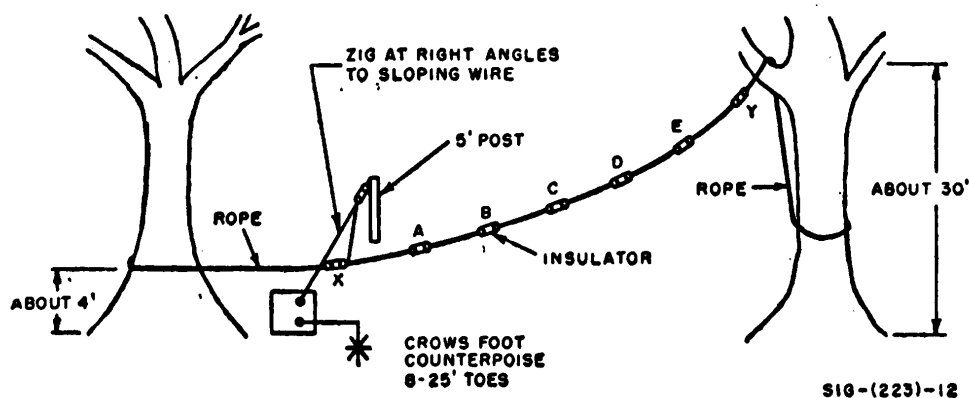


Figure 15. Improvised end-fed antenna.

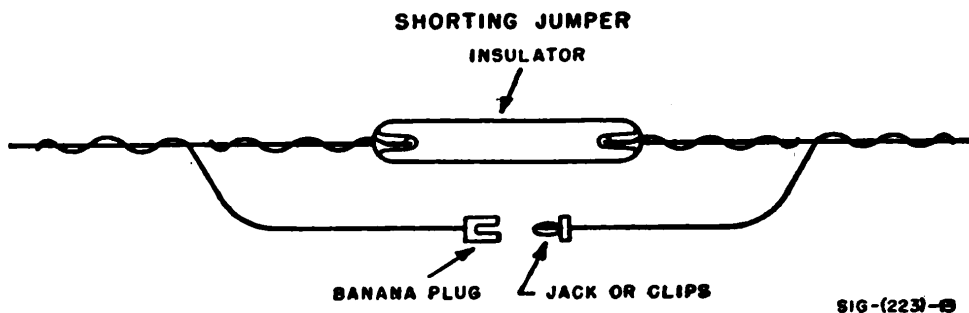


Figure 16. Shorting jumper detail.

c. Antennas AT-101/GRC-9 (stock No. 2A203-101) and AT-102/GRC-9 (stock No. 2A203-102) can be used if available.

d. To determine the proper length in feet of a half-wave antenna for any frequency, divide 468 by the frequency in megacycles. Table IV gives some typical lengths.

Table IV. Typical lengths.

Frequency (mc)	Antenna length (ft)	Frequency (mc)	Antenna length (ft)
2.....	234	8.....	59
3.....	156	9.....	52
4.....	117	10.....	47
5.....	94	11.....	43
6.....	78	12.....	39
7.....	67		

19. ON-GROUND ANTENNAS. Insulated wire if laid on the ground, or preferably, on bushes or poles a few feet off the ground will provide a good antenna in some cases. Lengths should be in accordance with Table IV. A 100-foot on-ground antenna attached to Radio Set SCR-536 (stock No. 2S536) (TM 11-235), handie-talkie, will often increase its range. The direction of transmission is off the end of the wire.

20. LONG-ROD ANTENNAS. Where it is not possible to use a horizontal antenna, the whip or rod antennas can be improved by adding additional sections and guying; that is, using 25 or 35 feet of rod instead of the usual 15 feet of rod. A long vertical

wire can be used in place of the mast sections if the top of the wire can be supported. *This should be done only with high-frequency sets such as the AN/GRC-9 (stock No. 2S501-9) and SCR-193 (stock No. 2S193) and should not be attempted with the SCR-508 (stock Nos. 2S508/12 and 2S508/24) (TM 11-600), SCR-509 (stock No. 2S509) (TM 11-605), SCR-608 (stock No. 2S608) (TM 11-620), SCR-609 (stock No. 2S609) (TM 11-615A), SCR-619 (stock No. 2S619) (TM 11-619), and SCR-300 (stock No. 2S300) (TM 11-242) type sets.*

21. ANTENNAS FOR RADIO SETS SCR-508/528, SCR-509/510, SCR-608/628, SCR-609/610, SCR-619, AND SCR-300. The stock number for SCR-528 is 2S528 (TM 11-600); for SCR-510, 2S510 (TM 11-605); for SCR-628, 2S628/12 (TM 11-620); and for SCR-610, 2S610 (TM 11-615A). The normal antennas for these radio sets are whip or rod types. Increased range can be obtained by getting on high ground or by utilizing elevated antennas of various types.

*a. Antennas for SCR-300 (stock No. 2S300) and AN/VRC-3 (stock No. 2S4502-3) (TM 11-637). Two standard elevated antennas for these sets are available. These are—*

Antenna Equipment RC-291, stock No. 2A289-291.

Antenna Equipment RC-296, stock No. 2A289-296.

An improvised arrangement utilizing field wire is given in figure 17.

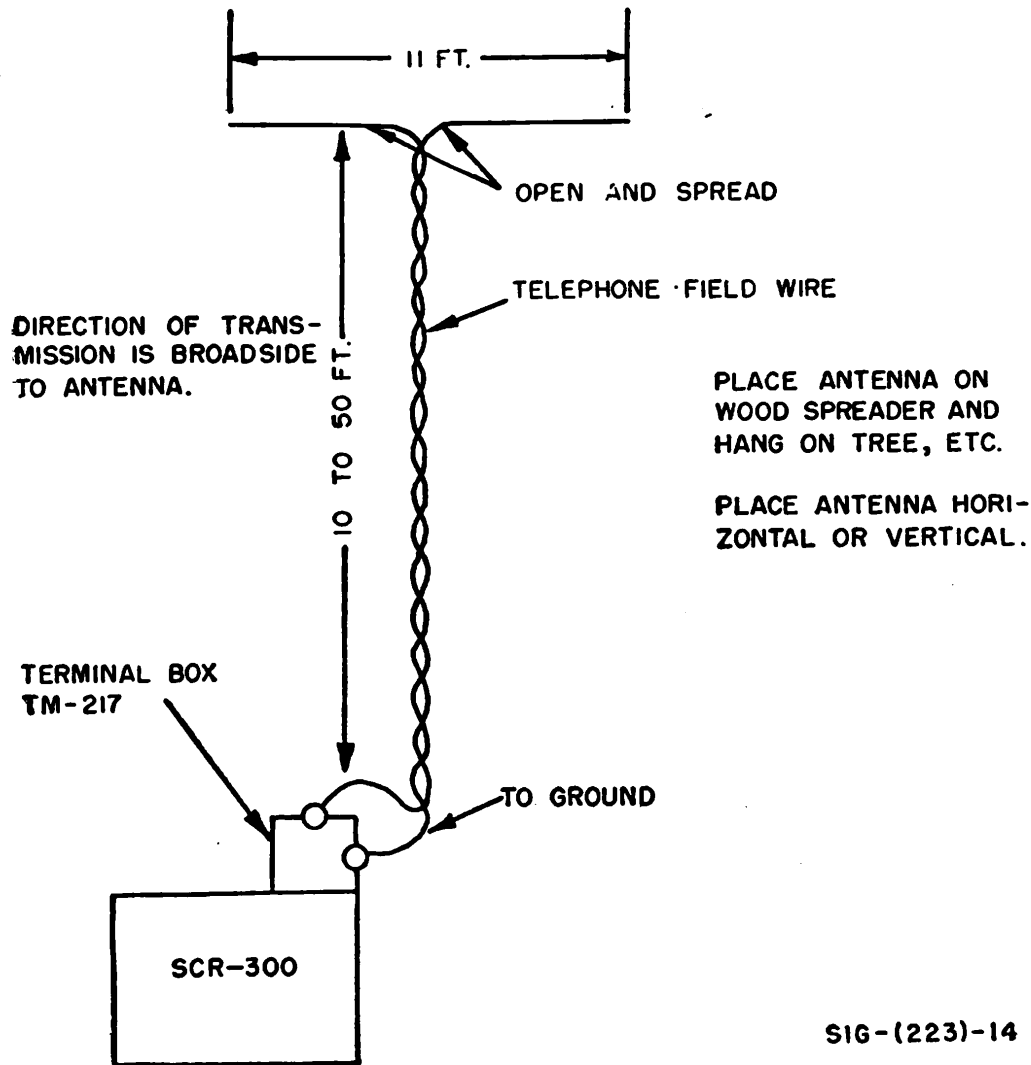


Figure 17. Improvised antenna for sets operating between 40 and 48 mc.

b. *Antennas for SCR-508/528 and SCR-608/628.*  
 A standard elevated antenna is available for fixed-station operation of these sets. This is—

Antenna Equipment RC-292, stock No. 2A289-292.

The above antenna in connection with Terminal Box TM-217 (stock No. 2Z9299-217) can also be used with Radio Sets SCR-300 and AN/VRC-3.

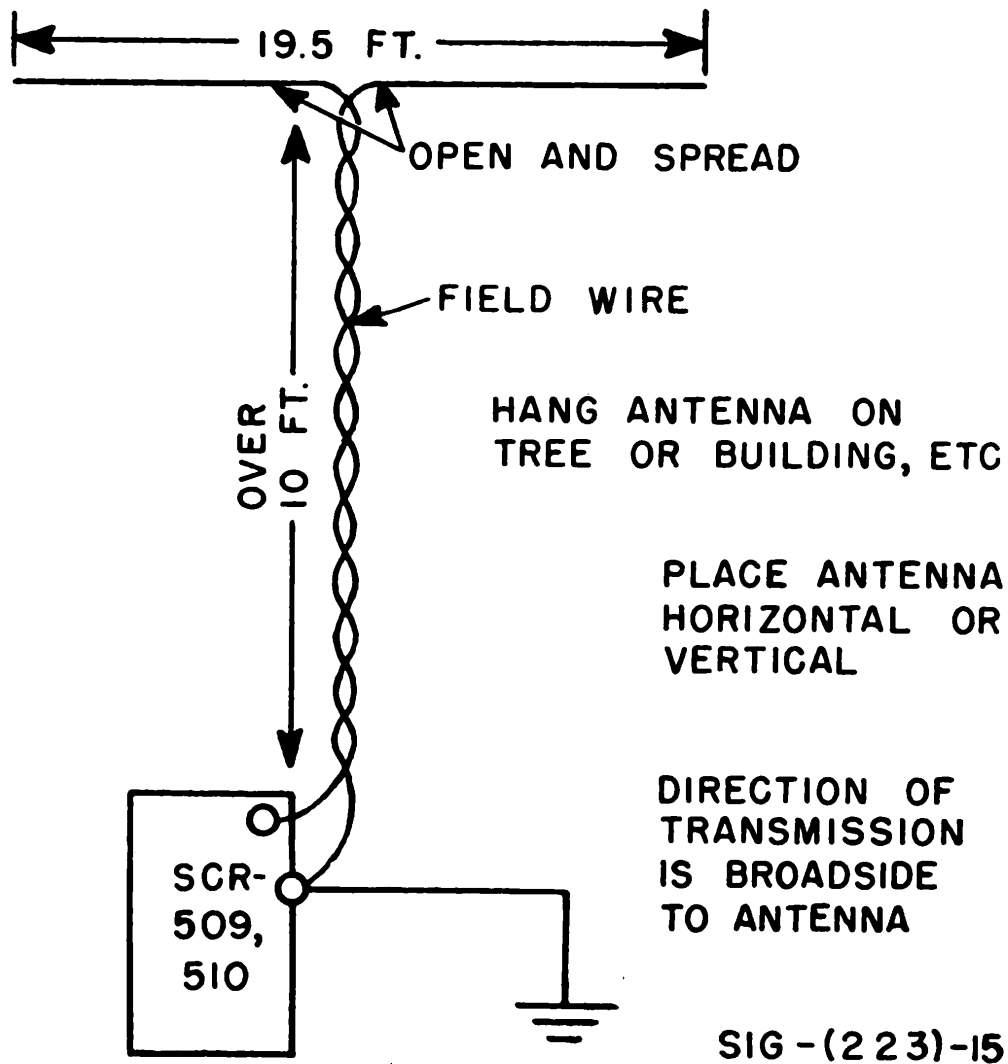


Figure 18. Improvised antenna for sets operating between 20 and 30 mc.

c. *Antenna for SCR-509/510.* An improvised antenna is shown in figure 18. This antenna can also be used with the SCR-508/528 sets.

22. ANTENNAS FOR 20 TO 80 MC. Two field antennas that can be used with the field type h-f or v-h-f sets are the vertical half-rhombic and the wave antenna. These are shown in figures 19 and 20, respectively.



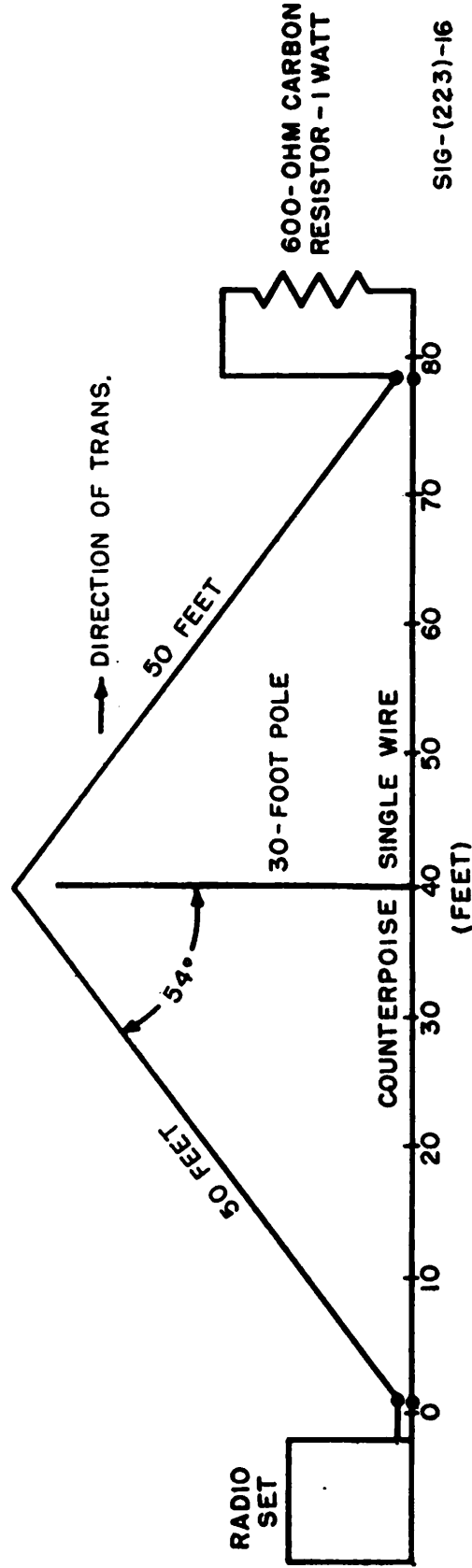
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VERT. HALF RHOMBIC  
20 TO 60 MC/S  
VERTICAL POLARIZATION

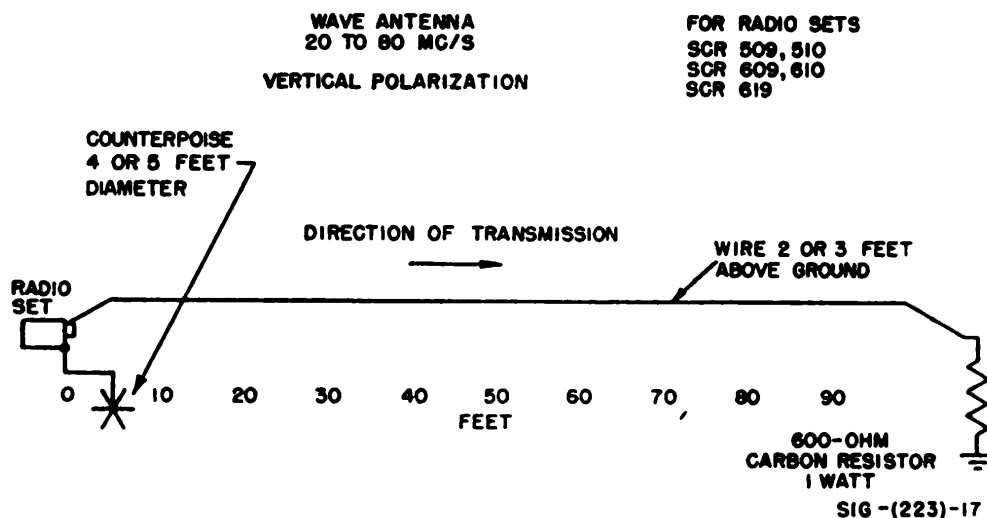
REQUIRED SUPPORT  
2 EA. LANCE POLES PO-2

FOR RADIO SETS  
SCR 509, 510  
SCR 609, 610  
SCR 619



SIG-(223)-16

Figure 19. Vertical half-rhombic for use between 20 and 60 mc.



*Figure 20. Wave antenna for use between 20 and 80 mc.*

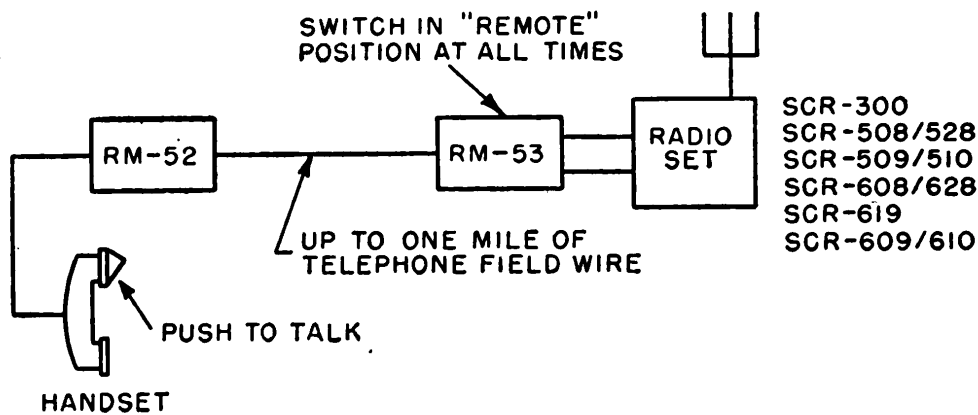
**Warning:** When improvised antennas such as the above are used, the tuning of the antenna circuits and final amplifier circuits should be checked. It is also important that the precautions in regard to proper siting are observed. The higher the ground the better. If the transmitter loads poorly, try adding to or subtracting from the length of the improvised antenna.

**23. REMOTE CONTROL.** The use of remote control equipments is a simple means of attaining the proper siting for the radio set and yet provide for operation from a command post or protected spot for the operator.

*a.* Remote Control Equipment RC-261 (stock No. 2C7600-261) (TM 11-2632) can be used with the v-h-f sets such as the SCR-300 (stock No. 2S300), SCR-508 (stock No. 2S508), SCR-609 (stock No. 2S609), and SCR-619 (stock No. 2S619). This can also be used with certain h-f sets for voice transmission only.

b. Remote Control Equipment RC-289 (stock No. 2C7600-289) (TM 11-2667) and Remote Control Equipment RC-290 (stock No. 2C7600-290) can be used with the h-f sets, SCR-694 (stock No. 2S694/6-12-24), AN/GRC-9 (stock No. 2S501-9), etc., as well as with some of the v-h-f sets.

c. A typical set-up using the RC-261 (stock No. 2C7600-261) is given in figure 21.



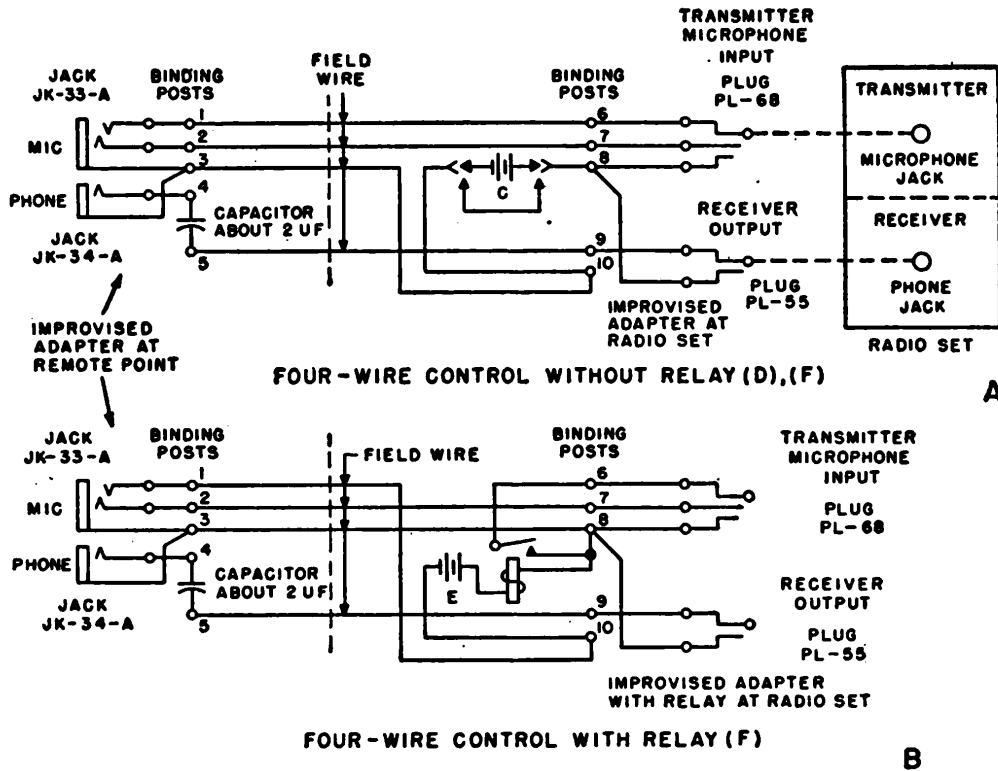
INCREASED RANGE OF REMOTE OPERATION CAN BE OBTAINED BY USING TWO TELEPHONE PAIRS—UP TO APPROXIMATELY TWO MILES.

SIG-(223)-18

Figure 21. Use of remote control units.

d. Improvised remote control arrangements can be made by extending the circuits from the microphone and headset jacks over field wire to the handset.

24. RADIO RELAY OPERATION. a. *General.* In situations where the previous methods of special antennas and siting do not give the required range, there is the possibility of establishing an intermediate station and relaying the message. Normally, this



- NOTES:
- C. PROVIDE BATTERY IF NEEDED TO INCREASE CURRENT TO REMOTE MICROPHONE AND INCREASE OPERATING RANGE OF PUSH-TO-TALK RELAY IN RADIO SET. POLE BATTERY SO THAT IT WILL NOT OPPOSE THE BATTERY IN THE RADIO SET.
  - D. THIS ARRANGEMENT SHOULD NOT BE USED IF THE POWER SUPPLY TO THE CONTROL RELAY IN THE RADIO SET IS NOISY.
  - E. THE VOLTAGE OF THIS BATTERY SHOULD BE ONLY SUFFICIENT TO OPERATE THE RELAY.
  - F. WHERE APPARATUS SHOWN IS NOT AVAILABLE USE EQUIVALENT APPARATUS.

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Figure 22. Improvised arrangements for remote control of radio sets.

requires specially designed sets such as the AN/TRC-3 and -4 (stock Nos. 2S5002-3 and 2S5002-4) (TM 11-2601), AN/TRC-11 and -12 (stock Nos. 2S5002-11.1 and 2S5002-12.1) (TM 11-618), and others. The average type of field set is not designed for this type of operation, but can be adapted for it as a field expedient. The degree of improvement in range is dependent on a number of factors, such as siting, the type of sets used, and in particular, on

the alertness and ability of the operators at the relay point. A system which can be used involving only standard radio sets and remote control equipment is outlined below. It would enable, for example, an SCR-300 (stock No. 2S300) (TM 11-242) to communicate with an SCR-508 (stock No. 2S508) (TM 11-600) through a relay point consisting of both of these sets. For maximum performance, the relay station should be on high ground and should use elevated antennas. The remote control equipments specified are part of Remote Control Equipments RC-261 (stock No. 2C7600-261) and RC-289 (stock No. 2C7600-289).

*b. Remote control radio relay operation (one operator).*

- (1) Read TM 11-2667 and TM 11-2632.
- (2) Install 4½-volt Battery BA-27 (stock No. 3A27) in RM-39 (stock No. 2C629-39), figure 11, TM 11-2667.
- (3) Separate and tape up leads for Batteries BA-34 (stock No. 3A34). DO NOT INSTALL BATTERIES BA-34.
- (4) Install Batteries BA-30 (stock No. 3A30) in RM-52 (stock No. 2C680-52) and RM-53 (stock No. 2C680-53). Refer to TM 11-2632.
- (5) Set up and connect equipment as shown in figure 23.

*Note.* An additional operator is required at Radio Set C during preliminary tests (6 through 11 below) to tune receiver and to set volume control. Radio Sets B and C should be on different frequencies.

- (6) Operator monitor position at RM-52, handset plugged in.

- (a) Radio Set B ON.
- (b) Radio Set C ON.
- (c) RM-39 switch in THROUGH position.
- (d) RM-53 switch in REMOTE position.
- (7) To transmit from Radio Set A to Radio Set D:
  - (a) Radio Set B ON.
  - (b) Radio Set C ON.
  - (c) RM-39 switch in THROUGH position.
  - (d) RM-53 switch in REMOTE position.
  - (e) RM-52 microphone switch on handset pressed.
- (8) To transmit from Radio Set D to Radio Set A.
  - (a) Radio Set B ON.
  - (b) Radio Set C ON.
  - (c) RM-39 switch in THROUGH position.
  - (d) RM-53 switch in REMOTE position.
  - (e) RM-39 antihowl switch pressed.
- (9) Operator monitor to transmit from Radio Set B.
  - (a) Radio Set B ON.
  - (b) RM-39 switch in RADIO position.
  - (c) Handset plugged in RM-39 and microphone button pressed.
- (10) Operator monitor to transmit from Radio Set C.
  - (a) Radio Set C ON.
  - (b) RM-39 switch in TELEPHONE position.
  - (c) RM-53 switch in REMOTE position.
  - (d) Handset plugged in RM-52 and microphone button pressed.

- (11) Operator monitor to communicate with temporary operator at Radio Set C.
- (a) RM-39 switch in TELEPHONE position.
  - (b) RM-53 switch in INTERPHONE position and handset plugged in.
  - (c) RM-52 handset plugged in.

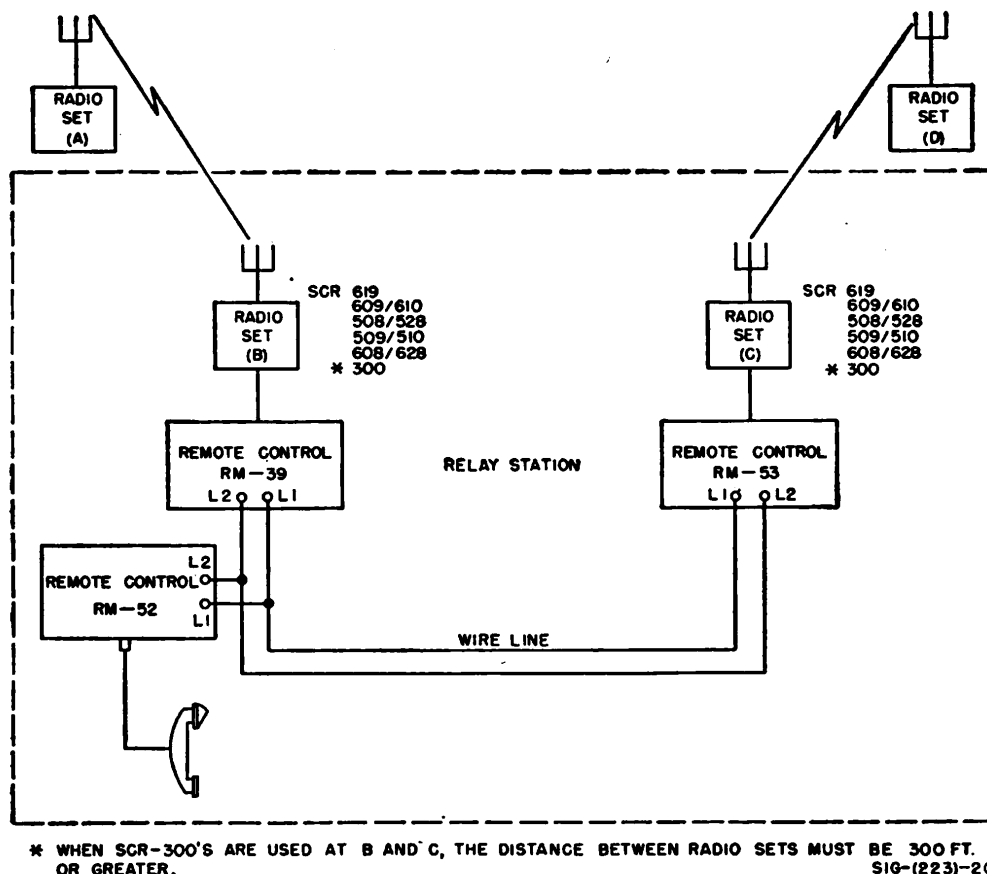


Figure 23. Remote control operation by one operator.

25. SUBSTITUTION OF RADIO SETS. *a.* In a situation where the normal issue equipment does not give the required range and it is not possible to apply any of the foregoing suggestions, the substitution of one type of equipment for another may prove to be an effective solution.



b. For example, substitution of Radio Set SCR-608 (stock No. 2S608) for SCR-619 (stock No. 2S619); SCR-508 (stock No. 2S508) for SCR-509 (stock No. 2S509); and SCR-193 (stock No. 2S193) for SCR-694 (stock No. 2S694/6-12-24) or AN/GRC-9 (stock No. 2S501-9) provides effective power increases of the order of 10 times. The use of h-f sets such as the SCR-193 in place of the v-h-f sets (SCR-300, stock No. 2S300; SCR-619, stock No. 2S619; etc.) may also provide a solution.

c. Additional possibilities of this type involve the use of nontactical equipments such as the f-m sets used by the military police. These sets have the disadvantage, generally, of being only able to operate on a fixed frequency, and frequency changing will be limited to the available supply of crystals. The possible use of captured enemy equipment should also be considered.

d. A list is given below of military and commercial equipments of the police type which may be available.

(1) *25 to 50 watts.*

Radio Set AN/VRC-2 (stock No. 2S4502-2)  
(TM 11-607).

Radio Set AN/FRC-6 (stock No. 2S2002-6)  
(TM 11-5506).

Radio Set AN/TRC-13 (stock No. 2S5002-13) (Galvin FMTR-50BW).

Radio Set AN/TRC-14 (similar to Link 50 UFS).

Link Company Type 25 UFS (stock No. 2C5530).

Link Company Type 50 UFS (stock No. 2C5529).

Galvin (Motorola) Type FMTR-30D (stock No. 2C5530D).

Galvin (Motorola) Type FSTR-50BR (stock No. 2C5103).

Galvin (Motorola) Type FMATR-30D (stock No. 2C5530D-1).

(2) *250 watts.*

Radio Set AN/FRC-9 (stock No. 2C5608).

Galvin (Motorola) Type FSTR-250BR (stock No. 2C5099).

*e.* Note that these equipments can be used as part of the relay system described in paragraph 24. Detailed instructions are not given because of the variety of possible set-ups, but the basic layout is the same as before. Application of standard radio and wire practice and some experimentation will result in a workable system.

**26. GENERAL OPERATING HINTS.** *a.* Use a headset in place of a loudspeaker if the signal is weak. This will cut out local noise.

*b.* Make sure the microphone or handset is in good condition. Speak directly into the microphone; speak slowly and distinctly.

*c.* If the set is in a vehicle, make sure the battery voltage is up. Keep engine running to charge the battery.

*d.* Moving the set and antenna a few feet may improve reception.

*e.* Use cw in place of voice.





## Section I

### INTRODUCTION

1. **PURPOSE.** This technical bulletin is intended to acquaint personnel using Signal Corps equipment with field expedients that may be used to increase the operating range (in miles) of wire and radio equipment.

2. **SCOPE.** Section II of this technical bulletin describes general and specific methods of increasing the range of wire equipment; section III describes methods of increasing the range of radio equipment. All personnel are requested to transmit recommended changes in this bulletin, with reasons therefor, and other pertinent material to the Chief Signal Officer. The information contained in this bulletin will be included in the revision of appropriate technical manuals.

## Section II

### WIRE

3. **GENERAL.** *a.* Field wires provide reliable service only when properly installed and maintained.

*b.* Tape splices carefully, both to prevent noise and to prevent the reduced talking range caused by water or electrical leakage.

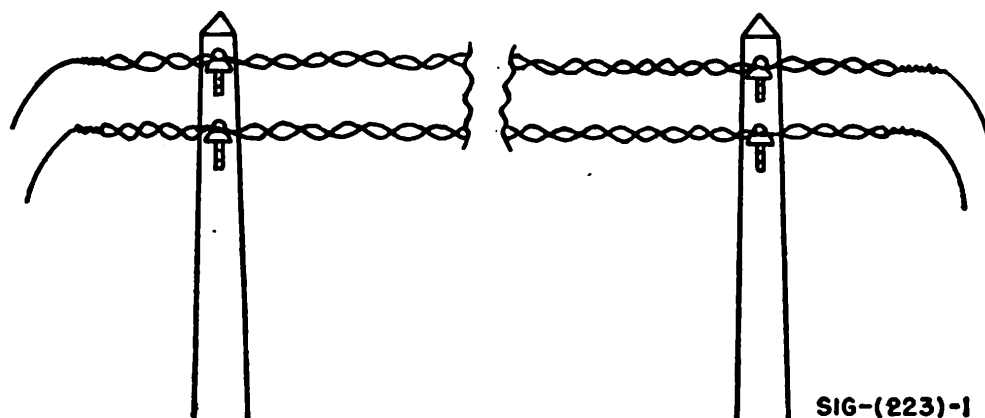
*c.* Lay wires as far off the road or trail as possible, to reduce the possibility of damage by vehicles. Do not make field wire tie loops if the insulation is old or

worn; use small lengths of wire to tie around the supports, and then hang the field wire in the loop. Under unusually wet conditions it will be found that better performance will be obtained if the wire is raised off the ground by tying it to trees, posts, houses, and so forth. Whenever rubber-covered cable is strung, use a messenger—if necessary. Use field wire as the messenger. Methods and equipments for obtaining greater talking range over field wires are briefly discussed in succeeding paragraphs. Remember, however, that field wires were designed for relatively short circuits, to be used for a limited time only. Open-wire lines and carrier telephone systems should be pushed forward as quickly as possible, in order to provide more dependable long-range communication. Make maximum use of enemy and civilian circuits, even if they have been partially damaged or destroyed. It is frequently quicker and easier to repair sections of existing lines than it is to install new ones.

*d.* The full talking range of telephone wire may be used when two telephones are directly connected by the wire. If the two telephones, however, are connected through one or more switchboards, the range is reduced somewhat by each switchboard and the talking range applies to the over-all circuit, and NOT to the individual sections that are connected by the switchboard or switchboards. Whenever circuits are to be connected to other circuits through switchboards, no one circuit should approach maximum length—in other words, **REMEMBER** that the total combined length of the circuits must not ex-

ceed the talking range of the wire if satisfactory communication is to result.

4. USE OF A TWIN PAIR TO OBTAIN EXTENDED TALKING RANGE ON FIELD WIRES. *a.* Wires W-110-B (stock No. 1B110B), WD-1/TT (stock No. 1B190-1), and W-143 (stock No. 1B143) are limited in talking range by the combined effect of the resistance and capacitance of the pair. This effect may be reduced, and the talking range extended, by the use of a twin pair—that is, by using two pairs spaced some distance apart, with the two wires of one pair connected together to form one side of the circuit and the two wires of the other pair connected to form the other side. Such an arrangement is illustrated in figure 1. The talking ranges of a single pair and of a twin pair of wires, under wet and dry conditions, using various construction methods, are shown in table I.



*Figure 1. Arrangement of a twin pair.*

*b.* Extended talking ranges may be obtained also by using loading Coil C-114-A (stock No. 3C114A), Telephone Repeater EE-89-A (stock No. 4B3289A), Telephone Repeater TP-14 (stock No. 4B3250-14),

Table I. Talking range in miles (30-db circuit)

Wire	Single pair		Twin pair					
	Wet <sup>a</sup>	Dry	On poles with insulators (8" spacing)		Strung on trees without insulators (8" to 24" spacing)		On the ground (8" to 24" spacing)	
			Wet	Dry	Wet	Dry	Wet <sup>a</sup>	Dry <sup>b</sup>
W-110-B-----	11	18	65	65	25	65	15	65
WD-1/TT-----	12	20	70	70	27	70	17	70
W-143-----	25	25	215	215	70	215	35	200

<sup>a</sup> The gain in reliable all-weather performance of a twin pair laid on the ground over a single pair is so small that its use should be limited to emergencies only.

<sup>b</sup> The dry talking ranges indicated for pairs laid on the ground should be considered as the theoretical maximums, with actual performance depending on the condition of the ground.



and Telephone TP-9 (stock No. 4B5500-9). Use of this equipment to extend talking ranges is described in later paragraphs.

5. WIRE W-143. Wire W-143 (stock No. 1B143) is an all-weather, stabilized, long-range, parallel pair. It has a talking range of approximately 25 miles. It is somewhat less flexible, harder to handle, and will stand less abuse than Wire W-110-B (stock No. 1B110B) or Wire WD-1/TT (stock No. 1B190-1). It does, however, have the advantage of being stable under all weather conditions, provided the wire and splices are in good condition. Full information regarding handling and splicing Wire W-143 is contained in TB SIG 101.

6. SPIRAL-4 CABLE. Spiral-4 cable, Cable Assembly CC-358 (stock No. 3E358), although designed primarily for use in carrier telephone systems, may be used to provide two high-quality voice circuits. Terminal connections may be made by means of Cable Stub CC-356 (stock No. 1B1456). The two white leads should be used as one pair and the two black (or red) leads as a second pair. The normal talking range over each circuit is approximately 40 miles, under all weather conditions. A third, or phantom circuit, may be obtained by the use of repeating Coil C-161 (stock No. 3C161). This phantom circuit is more noisy than the two metallic circuits and has a talking range of about 20 miles. One method of using repeating Coil C-161 is illustrated in figure 2.