

CONTRACTUAL AND COORDINATION CONSIDERATIONS
 IN CONNECTION WITH USE OF POWER LINE CARRIER
 ON RURAL ELECTRIFICATION ADMINISTRATION LINES

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1. GENERAL

1.01 The material contained in this section is identical, with minor revisions, to that formerly contained in Bell System Practices Section AF4.45, Issue 1, AF4.46, Issue 1 and Addendum AF4.46, Issue 1 which are superseded by this section.

1.02 This section covers the contractual arrangements and the coordination required between Rural Electrification Administration borrowers and the Telephone Company in connection with the installation and maintenance of power line carrier systems.

2. POWER LINE CARRIER AGREEMENT FORM

2.01 The attached form of the general agreement for power line carrier facilities was prepared cooperatively by the REA and the Telephone Company. The REA initially designated this form of agreement as REA Form DS-209. The number of this form was subsequently changed to REA Form 262. No change was made in the text or exhibits. For convenience to the Telephone Company, the text and associated exhibits of the REA form have been made available as Form E-3645. Since REA Forms DS-209 and 262 are identical except for designation, Form E-3645 cross referenced to REA Form DS-209 will be

used until the present stock is exhausted. Copies of Form E-3645 can be obtained on requisition from the Western Electric Company.

2.02 Form E-3645A, a copy of which is attached, is the equivalent of REA Form 262a and provides the form of an amendment to the general agreement for power line carrier facilities. The execution and attachment of this amendment is a condition of REA approval of the general agreement except those approved prior to October 28, 1949. This amendment requires the Telephone Company to submit a detailed program for area coverage telephone service during the term of the agreement which will provide for making telephone service available to the widest practicable number of members and consumers of the Cooperative. Copies of Form E-3645A can be obtained on requisition from the Western Electric Company.

2.03 Article 12 of the general agreement specifies that during any period in which the Cooperative is a borrower from the REA, the agreement and any amendments thereof shall have the approval in writing of the Administrator of the REA. The procedure of the REA requires that three copies of each specific agreement signed by authorized officials of the Cooperative and the Telephone Company be sent to the office of the Administrator by the Cooperative. If satisfactory, two of these copies approved by the Administrator are returned, one for the Cooperative and one for the Telephone Company. Where agreements are signed by a person other than a general officer of the Telephone Company, approvals by the Administrator will be expedited if evidence of authority to sign is filed with the office of the Administrator of REA.

2.04 Deviations from the attached forms may be desirable in specific instances. However, in the interest of expediting approval by the Administrator, these deviations should, so far as practicable, be limited to items necessary to adapt the form to special requirements in specific situations. Every effort should be made to employ the standard forms without basic change.

2.05 Article 2 in Form E-3645 provides space to describe the territory covered by the agreement. It is suggested that this be done as follows: After the colon in the last sentence in Article 2 add, "As shown in Appendix 1." Appendix 1 should consist of a map outlining the area served by the power line carrier proposal. REA recommends that the key map of the REA borrower be used for this purpose.

3. COORDINATION BETWEEN REA BORROWERS AND TELEPHONE COMPANIES

3.01 In recognition of the necessity for close cooperation and coordination between REA borrowers and Telephone Companies in connection with the installation, operation and maintenance

of power line carrier systems, representatives of the REA and the Bell Telephone System jointly prepared a report in the early stages of the power line carrier development which provides a general description of the system and details some of the responsibilities of the respective parties in operations where coordination is required. The report entitled "Considerations of Mutual Interest to REA Borrowers and Telephone Companies in Installing and Maintaining Equipment Used for Carrier Telephone Service" dated July 9, 1947 is included as Appendix 1 to this section. The report is presented herein in its original wording, however, Bell System comments in the form of parenthetical notes have been inserted in the text of the report to reflect changes in the art since the original report was prepared.

Attached:

Appendix 1 - Report, "Considerations of Mutual Interest to REA Borrowers and Telephone Companies in Installing and Maintaining Equipment Used for Carrier Telephone Service."

Form E-3645 - General Agreement for Power Line Carrier Facilities.

Form E-3645A - Amendment to Form of General Agreement for Power Line Carrier Facilities.

CONSIDERATIONS OF MUTUAL INTEREST TO REA BORROWERS
AND TELEPHONE COMPANIES IN INSTALLING AND MAINTAINING
EQUIPMENT USED FOR CARRIER TELEPHONE SERVICE

1. GENERAL

1.01 The provision of telephone service in rural areas by means of carrier transmission over power lines involves the utilization of the poles and wires of a power system for both power and telephone services. For satisfactory service to be provided by this method, there should be close cooperation between the REA Borrowers, hereinafter known as Power Systems and the Telephone Company. The purpose of this report is to make available engineering information of mutual interest concerning the installation, operation and maintenance of such carrier systems and to suggest possible procedures for cooperative handling. This report is issued as preliminary information and is subject to revision in the light of experience obtained from field application.

1.02 Joint considerations by both parties will determine the general areas or sections of power line that will be utilized for carrier telephone service, taking into account the present and future plans and requirements of both services.

1.03 The equipment required for application to the power system to permit its use as a medium of carrier transmission is designed so as to have a minimum effect on the operation of the power system. All of this equipment, except minor items which the Power System normally uses, will be supplied by the Telephone Company. The installation and maintenance of this equipment will be handled as outlined in later paragraphs of this report.

1.04 The frequency band which the carrier telephone system utilizes at present, where conditions permit, is from 150 to 455 kc. The use of this entire band provides five carrier telephone channels, each channel normally serving up to 8 subscribers. In many cases arrangements can be made to divide the power system into several carrier sections, each serving up to 40 subscribers. Special consideration will be required in those cases where it is proposed to operate other carrier communication or control systems on or in proximity to a power system to which the rural carrier telephone system is applied.

2. APPLICATION

2.01 In selecting locations where the power line carrier system is to be used, it will be helpful to keep in mind the following general considerations:

(1) At present the application of these systems is generally limited to single phase multigrounded neutral power lines operating at voltages below 8700 volts between phase wire and neutral. Under favorable conditions, it may also be applied to multiphase lines and lines without primary neutral wires, provided the phase-to-ground voltage does not exceed 8700 volts. Special engineering consideration will be required in these cases to select the most satisfactory arrangement.

(2) At present the application of the carrier system is generally restricted to sections of lines having continuous load currents not exceeding about 10 amperes, and maximum short circuit currents of the order of 500 amperes for one second. This restriction is necessary because of the present limitations of the series choke coils. Choke coils capable of carrying larger load and short circuit currents can be made available in the future, if required, or, under special conditions, chokes may be operated in parallel.

(Note: It is now felt that the carrier system may be applied to lines having maximum normal phase wire currents up to 15 amperes.)

(3) Where the frequency band between 150 to 455 kc can be utilized, a maximum of five carrier channels, each serving normally up to eight customers, may be operated over a given section of power line. More than one section of a power system may be used for carrier where desired. If for any reason, the entire frequency band can not be used over a particular section of power line, the number of channels available, and therefore the number of customers that can be served, will be decreased. Where the expected development of telephone service along a route served by a power line is greater than can be provided by the carrier channels available, other methods of extending rural service to all or part of

the prospective customers will probably be required ultimately, and this may affect the plans for initial use of carrier.

(4) In general, power line carrier will be attractive only for power line routes which are not paralleled by existing telephone plant. Some exceptions may occur such as when the prospective telephone growth would involve modification or complete rebuilding of the telephone line to accommodate the extra circuits required.

(5) Power service is at present required in the home of each customer to be served by power line carrier, as no method has yet been worked out for supplying the subscriber carrier terminals with power from batteries or other sources. Development is under way of a means of extending telephone service beyond the subscriber carrier terminal by means of a 2-wire voice-frequency circuit.

(Note: This can now be accomplished with the MLS2 terminal.)

(6) The carrier system has so far been applied only to radial power feeders. Where power may be supplied from either end of a carrier section and an open switch may be in series with the carrier transmission path, a bypass circuit will be necessary to insure continuity of carrier service.

(7) Where divided code ringing is to be provided, the power supply to the common carrier terminal and to all subscriber terminals on the same carrier channel must be from the same phase of the power line.

(Note: Phase shifters are now available for use with subscriber terminals which are not powered from the same phase as the common terminal.)

(8) In selecting locations where service might be given by power line carrier, consideration must be given to the location of the power line relative to the telephone central office and to the boundaries established for the particular exchange.

(9) Operation of the carrier system from magneto, common battery manual or dial offices is feasible. The common carrier terminals may be located at the telephone central office if the power system arrangement permits, or at some distance from the central office, provided voice-frequency pairs can be made available.

3. EQUIPMENT

3.01 Where telephone service is to be provided by means of power line carrier, special equipment will be required as shown in Fig. 1. This equipment can be conveniently grouped into two general classes as follows:

(Note: This figure has been revised to show 99A protectors at the coupling capacitors and a voltage regulator in the subscriber carrier terminal power supply circuit.)

(a) Equipment Installed and Maintained by the Power System: This consists of series chokes, coupling capacitors, fuses, line coupling units (except maintenance of equipment in coupler box) and connections between these units and the power wires, etc, which are necessary to make the power line circuit suitable for carrier current operation and to connect the power line at carrier frequencies to the equipment in (b) below. The dimensions and weights of the power line equipment are shown in the attached Figs. 3 to 8.

(Note: These figures do not show the 99A protector at the coupling capacitor. Fig. 9 has been added to show the details of the installation of the 99A protector on the coupling capacitor mounting bracket.)

(b) Equipment Installed and Maintained by the Telephone Company: This consists of common carrier terminals, subscriber carrier terminals, combined telephone sets, central office equipment, etc, needed to form the communication circuit, exclusive of apparatus connected directly to the power line. The Telephone Company will also maintain certain apparatus installed in line coupling units which will be mounted on the power poles by the Power System.

3.02 The supply of 120-volt power service to the subscribers' telephone set will be arranged for by the Telephone Company from a convenience outlet on the appliance or lighting circuit in the subscriber's premises. The power requirements for the subscribers' set range from 7 watts in the standby condition to 25 watts in the talking condition. In the case of the common carrier terminals not located in telephone central offices, the 120-volt power supply will be installed by the Power System in the same way as a normal service. Power requirements for the common terminal range from approximately 15 watts per carrier channel in the standby condition to approximately 30 watts under talking conditions.

(Note: Further experience indicates that the power requirements for the subscriber set will range from 8 watts in the standby condition to 20 watts in the talking condition when a voltage regulator is not used. When a regulator is used, the requirements will increase to 19 watts in the standby condition and 29 watts in the talking condition.)

4. INSTALLATIONS ON POWER LINE

4.01 A power system is prepared for carrier telephone operation in the following manner (see Fig. 2):

(a) "Isolating" chokes or "tap" chokes are inserted in the phase wire at each location past which the flow of carrier current is not desired. An isolating choke is more effective in limiting the flow of carrier current than is a tap choke. It also can handle larger power load currents than a tap choke and may be required for this reason in some cases where, from the carrier standpoint, a tap choke would be adequate (see Table 1).

(b) "Transmission" chokes are installed in series with the phase wire of certain branches over which carrier is to be transmitted. The impedance of a transmission choke is such that just enough carrier current passes through it to permit carrier operation on the branch, but not enough to reduce unduly the carrier current on the main line.

(c) At each point on the power line where a common carrier terminal or a subscriber carrier terminal is located, a coupling capacitor with fuse and a line coupling unit are installed. In so far as practicable, coupling capacitors should be located on distribution transformer poles in order to secure the maximum benefit from the lightning protective equipment associated with transformers. Where this is not feasible, the capacitor should be located as near as possible to a transformer pole and the special maintenance procedure covered in Paragraph 10.02 should be followed.

(d) The ends of the carrier section on the main power line and each branch over which carrier is transmitted will be terminated in approximately characteristic impedance in order to prevent reflections with resulting high losses at certain frequencies. At the

common terminal end of the carrier section, a series choke is ordinarily required and the proper termination is provided by the common coupler and common terminal. If carrier transmission is desired to the end of the line (or branch) the termination is provided by the coupling capacitor and terminating subscriber coupling unit at the last pole (or a coupling capacitor and terminating coupling unit if there is no carrier subscriber at the end of the line). If the power line is later extended, the termination is moved to the end of the extension, or an isolating or tap choke is installed on the extension side of the existing termination. Where the line already extends beyond the last carrier subscriber (or termination) a choke also is required beyond the terminating point, preferably on the same pole. Where it is impracticable to install the choke at this point because of the presence of a power transformer, the choke may be installed at a convenient pole further out on the tap, but an additional coupling capacitor and terminating coupling unit will then be required at this same pole. Cooperation between the Power System and Telephone Company will be essential in engineering extensions of the power line sections equipped for carrier operation, in order that the proper carrier terminating equipment will be provided.

(e) The details of one method of mounting the series chokes and the coupling capacitors and line coupling units are shown in Figs. 3 to 8 attached. These sketches are to be considered as illustrative only, since the details of individual installations will differ. Wherever practicable, the series chokes should be located on poles on which no other equipment, such as transformers or oil circuit reclosers, is located. The material ordinarily furnished by the Telephone Company and by the Power System respectively, is listed on Figs. 3 to 8.

(Note: The Telephone Company will also furnish the 99A protector and mounting shown in Fig. 9.)

(f) The presence of an oil circuit recloser in series with the section of line over which carrier is transmitted may result in a high loss to carrier transmission, due to the reactance of the trip coil. The effect of the recloser may be minimized by installing a resistor in parallel with the trip coil. Recloser modification kits are available for the types of reclosers most likely to be encountered.

4.02 In cases where the existing power pole, on which a coupling capacitor and coupling units are mounted, is not high enough to permit stringing the carrier drop, so that the necessary clearance above ground is provided, the Telephone Company will ordinarily set another pole to which the drop may be strung from the existing pole with the necessary clearance. Where an existing REA pole is inadequate to accommodate the telephone facilities associated with the carrier system and replacement is required, the Telephone Company will pay to the Cooperative the then value in place of the pole to be retired, plus the cost of removal (including an appropriate amount for transfer charges) less the salvage value and shall, in addition, pay to the Cooperative the difference in the cost in place of the required new pole and the cost in place of a new pole of the same size as the replaced pole. If a general joint use agreement is also in effect between the two parties, the amounts to be billed should be based on the tables in Appendix A of that agreement. Where a general joint use agreement is not in effect between the parties and for items not covered in Appendix A the amount shall be agreed upon.

5. ELECTRICAL REQUIREMENTS

5.01 All equipment provided by the Telephone Company will meet the normal requirements for protection against foreign potentials in the same manner as ordinary telephone station installations. The telephone station protector grounding will in general be arranged in such a way as to provide a ground common with that used for the power secondary ground.

(Note: It is essential that the telephone protector be commonly grounded or bonded to the power system secondary ground at the subscriber's premises.)

5.02 The electrical requirements for equipment connected to the power circuit are as set forth in Table 1 attached. As indicated in this table, certain characteristics are required in order to provide adequate operation of the carrier system, and to minimize effects on the operation of the power system. In addition, the normal requirements for power equipment similarly connected as set forth in the applicable Standards of the ASA or AIEE will be met. For example, the coupling capacitors will be able to withstand an rms 60-cycle voltage of 35 kv for 1 minute when dry and 30 kv for 10 seconds when wet and have an impulse voltage

strength of not less than 95 kv when tested with a 1.5 x 40 microsecond wave. Each capacitor will be protected by a fuse which will reliably open the short circuit current which would flow if the capacitor failed. Such a fuse will be provided by the Telephone Company and installed or replaced by the Power System. Where the capacitor is on a dead end pole (Fig. 6), the transformer fuse will ordinarily be used to protect the capacitor unless a self-protected transformer is used in which case the installation will be as shown in Fig. 4.

6. CONSTRUCTION REQUIREMENTS

6.01 The only specific construction requirements of mutual interest are those applying to those poles on which coupling capacitors, line coupling units and drops are to be installed. Figs. 3 to 6 show the general arrangement of these units on such a pole. In addition, if common carrier terminals are mounted on power poles, mutual consideration of the mounting arrangement is required.

6.02 The line coupling unit will be located at least 40 inches below the lowest wire attachment or equipment used for power service (including transformers but excluding meter loops) and no wires or attachments installed by the Telephone Company will be within 40 inches of power attachments as described above. The metallic enclosure of the coupling unit will be connected to the vertical ground wire. In general, the requirements are the same as for construction on a pole used jointly for power and telephone wire circuits. Employees of the Telephone Company will not work in space above the line coupling unit.

6.03 The wires from the coupling capacitor and neutral to the line coupling unit will be roughly parallel where they are supported vertically on the pole, and the wire from the coupling capacitor to the line coupling unit will be as far as practicable from the vertical ground wires or other grounded equipment on the pole.

(Note: See Fig. 9 for installation details of the 99A protector.)

6.04 Since the coupling capacitors are not equipped with self-contained discharge resistors care will be required on the part of the Power System employees when disconnecting them to ensure that they are discharged before being handled. This will require that the

pigtail below the capacitor fuse be momentarily connected to the bottom terminal of the capacitor or to the capacitor bracket each time the capacitor is disconnected.

(Note: See Paragraph 10.02.)

6.05 When the capacitor and line coupling unit installation is otherwise completed, the Power System employee will make the connection to the phase wire. Protection for the Telephone Company installer is included in the line coupling unit.

7. ESTABLISHING NEW SERVICE

7.01 In order to arrange for the start of carrier telephone service in a given area the Telephone Company and Power System will first decide jointly what power line sections are to be used and where to install the necessary isolating, tap and transmission chokes, coupling capacitors, line coupling units, etc. Since every primary tap, no matter how short, will have an effect on carrier transmission, it will be necessary to work from an up-to-date detailed map of the power system. The maps will need to be in sufficient detail to select particular poles for mounting coupling capacitors and line coupling units; in many cases it will be necessary jointly to make field surveys. Locations and ratings (current and time) of fuses or breakers and the normal load currents of the power line at each location where a series choke is to be used, will also be required. It shall also be jointly determined that the choke coils proposed are adequate for the locations where they are to be installed from the standpoint of short circuit current.

7.02 Having decided where to install each of the various types of equipment, each Company will normally proceed to make its own installations independently. For initial installations, it is recommended that adequate instruction shall be given to the Power System's installation forces by the Telephone Company before any installation work is started. The Power System will install and connect all series chokes. The Power System will also install and connect the coupling capacitors (with their fuses) and coupling units and a grounding assembly of the ground rod type (if not already present) on each pole where the equipment is located. The connections from the coupling unit to the capacitor and ground are made as indicated in Figs. 3 to 6. The Telephone Company will install all other equipment including the telephone drop connections to the coupling units.

8. CHANGES IN LAYOUT OR LOAD OF POWER LINE

8.01 Any changes in the layout or in the normal load or short circuit currents of the power line within the section equipped for carrier transmission may have an effect on the performance of the carrier system, or on the requirements for series chokes. Therefore, it is essential that arrangements be established between the Power System and Telephone Company so that all prospective changes in the power line which may affect the carrier layout are considered in advance, and proper provision made for any necessary additions or changes in chokes or terminations.

8.02 Further field experience will be required before the most practicable means of handling these joint problems can be worked out. Meanwhile, the following procedure with regard to line extensions is suggested:

- (a) Where an extension of a power circuit from the portion already equipped for carrier transmission is contemplated, and where the extension of carrier service over the power line extension is not to be made, an isolating or tap choke will be installed by the Power System at the beginning of the extension at the time the extension is built.
- (b) Where the extension is to be used for service by carrier, the termination at the end of the existing line will be removed at the time the extension is energized, and the necessary line equipment to adapt the line for carrier transmission will be included in the plans for the extension.

9. ADDITIONS TO OR CHANGES OF CARRIER STATIONS

9.01 When a new telephone service is to be added to a line section already equipped for carrier operation, the pole at which the customer is to be connected will be jointly selected. The Power System will then install the coupling capacitor, line coupling unit and grounding assembly (if not already present), and the Telephone Company will connect the drop and install the station.

9.02 When telephone service is to be discontinued at a given point, the drop will be disconnected from the coupling unit by the Telephone Company. The Power System, when requested by the Telephone Company, will remove the coupling capacitor and coupling unit.

10. MAINTENANCE

10.01 Close cooperation between the local maintenance forces of the Power System and Telephone Company will be essential in connection with maintenance of the carrier telephone service. This will include arrangements for clearing of troubles, replacements of capacitors (or fuses) and chokes, advance notification of planned power system interruptions, and correction by the Power System of power line conditions which create interference with carrier transmission (loose hardware, defective insulators, etc). These are the same conditions which interfere with radio reception in the vicinity of the power line. The employees of the Power System and Telephone Company will limit their maintenance activities to the respective fields, as outlined previously. Arrangements will also be set up for prompt notification of the Power System by the Telephone Company whenever failure of the carrier system to operate is traced to an outage on the power system.

10.02 In any case where the fuse protecting the coupling capacitor is found to be operated the capacitor should be replaced before attempting to renew the fuse.

10.03 Until further experience with the behavior of coupling capacitors has been secured, it is suggested that arrangements be made to turn over to the Telephone Company any capacitors replaced in accordance with Paragraph 10.02 above along with the remains of associated fuses. The Telephone Company will arrange to have these capacitors inspected and tested. Any capacitors found suitable for reuse will be returned.

(Note: The present instructions provide that the capacitors replaced in accordance with Paragraph 10.02 shall not be re-used. The capacitors are to be disposed of locally and will not be returned to the Western Electric Company.)

Attached:

Table 1.

Figs. 1 to 8, inclusive.

Fig. 9 added.

TABLE 1

ELECTRICAL REQUIREMENTS OF CHOKES AND COUPLING CAPACITORS

(A) Chokes

<u>Type</u>	<u>Requirements</u>							
	<u>Nominal 60-Cycle Ohms</u>		<u>60-Cycle Current Ratings</u>		<u>Nominal Inductance</u>		<u>Resonant Freq.*</u>	<u>Special Marking</u>
	<u>Resistance</u>	<u>Reactance</u>	<u>Continuous**</u>	<u>1 Sec.</u>	<u>(MH)</u>			
Isolating	0.9	4.5	10 amp.	500 amp.	10	270 kc	Minimum	None
Tap	0.4	0.95	4 amp.	500 amp.	2.5	270 kc	Minimum	None
Transmission	0.2	0.23	4 amp.	500 amp.	0.6	Note 1		1 Red Band
Transmission	0.1	0.12	4 amp.	500 amp.	0.3	Note 1		2 Red Bands

* Including lightning protective gap and connections.

** These are rated continuous load currents. Tests have indicated that the isolating choke will carry up to 15 amperes without undue heating, while the other three chokes will carry up to 7, 9, and 10 amperes, respectively.

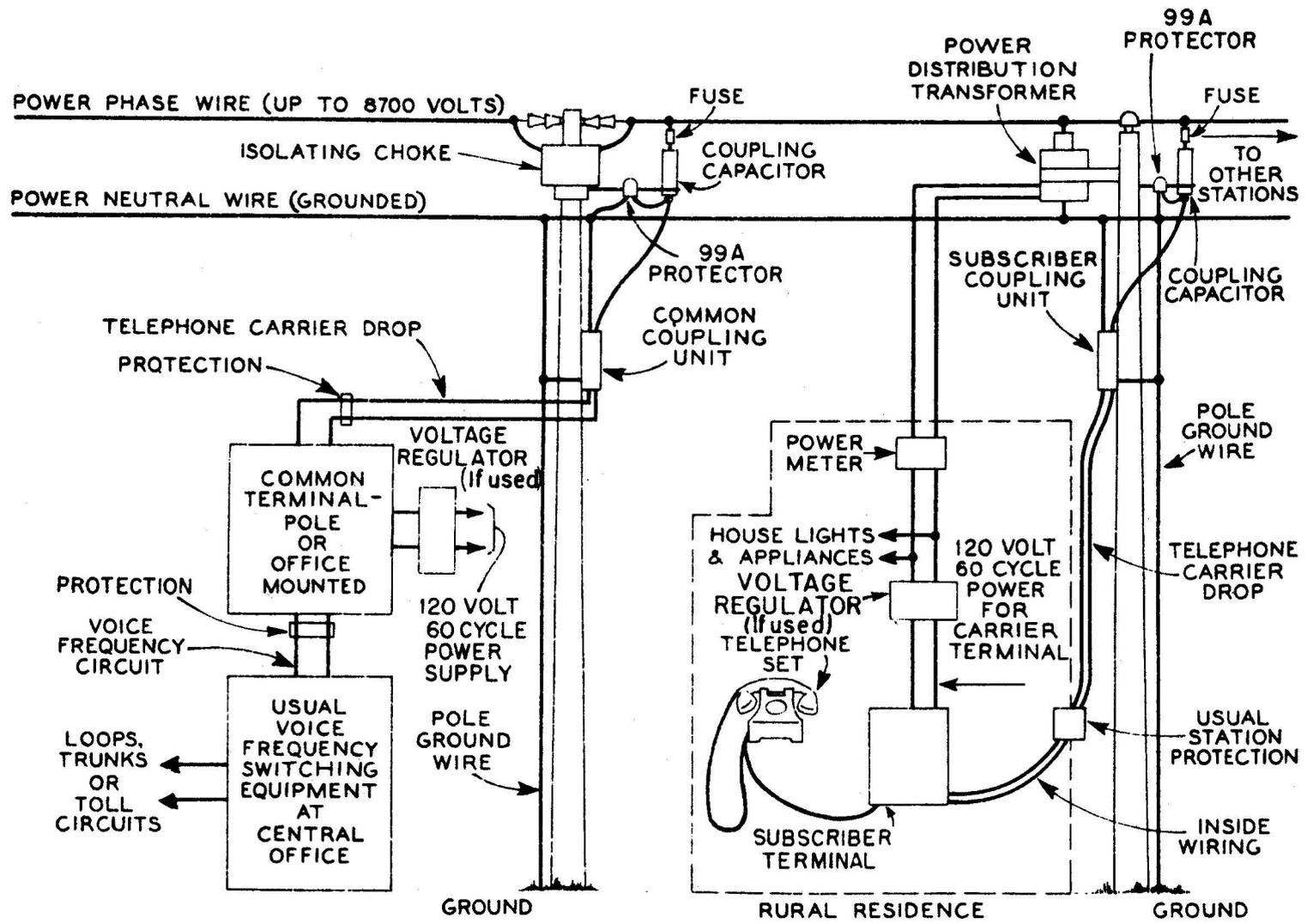
Note 1: Must have inductive reactance at 200 and 500 kc as follows:

<u>0.6 MH</u>		<u>0.3 MH</u>	
200 kc;	680 Min. Ohms	340 Min. Ohms	
500 kc;	2200 Max. Ohms	1100 Max. Ohms	

Chokes shall be so constructed as to meet the standard dielectric tests for transformers of the small apparatus class required by ASA Standard C57.1-1942, Part 3.

(B) Capacitors

Capacitance at all frequencies from 200 to 500 kc is required to be between 0.0019 and 0.00245 mf. Capacitors will meet electrical requirements of AIEE Standard 31 - January, 1944. The capacitors at present available are designed for a rated primary line-to-ground voltage of 8.66 kv.



Revised May, 1954.

Fig. 1

**SCHEMATIC DIAGRAM OF PRIMARY PHASE WIRE OF RURAL POWER LINE
ILLUSTRATING APPLICATION OF M1 CARRIER TELEPHONE SYSTEM**

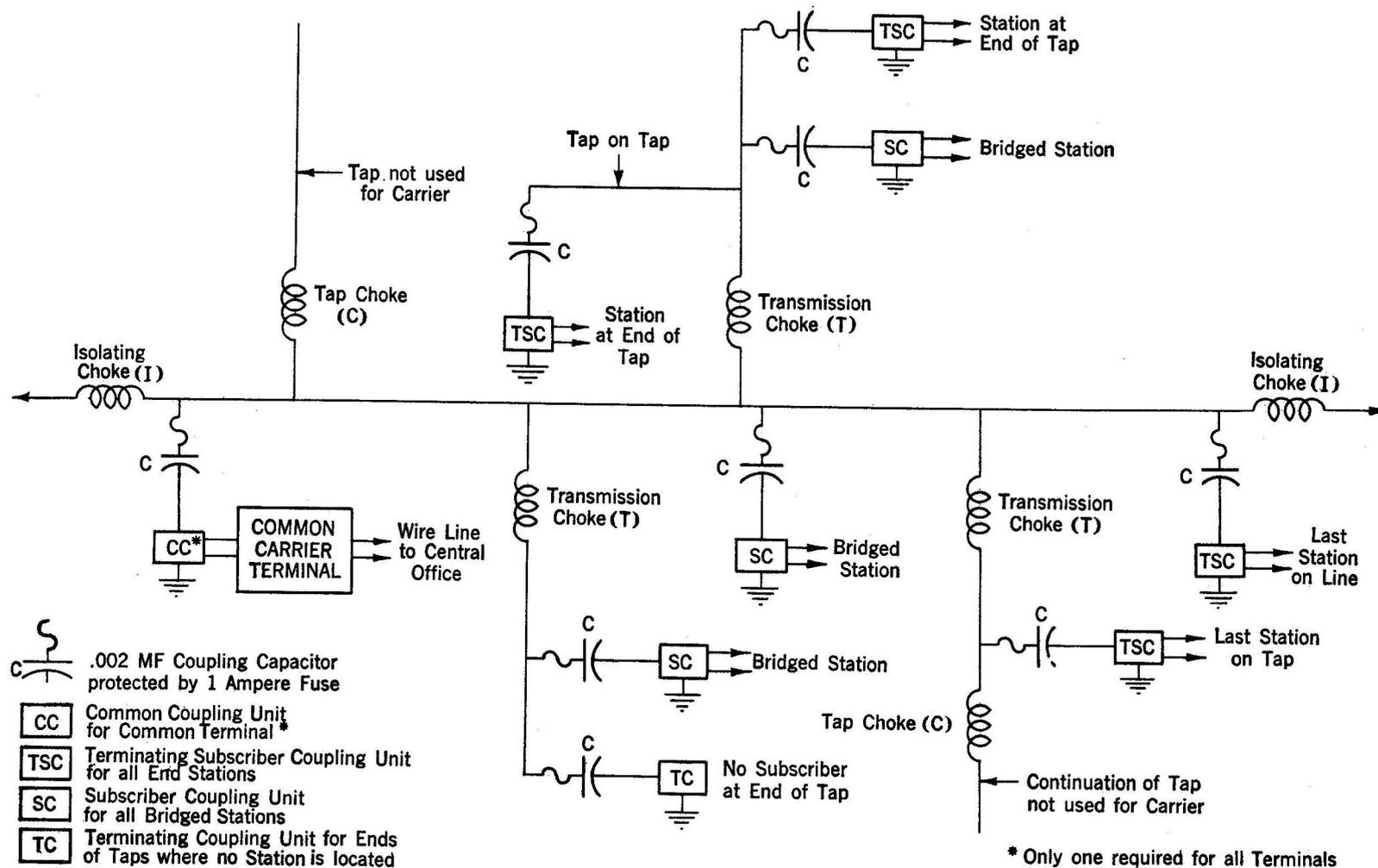
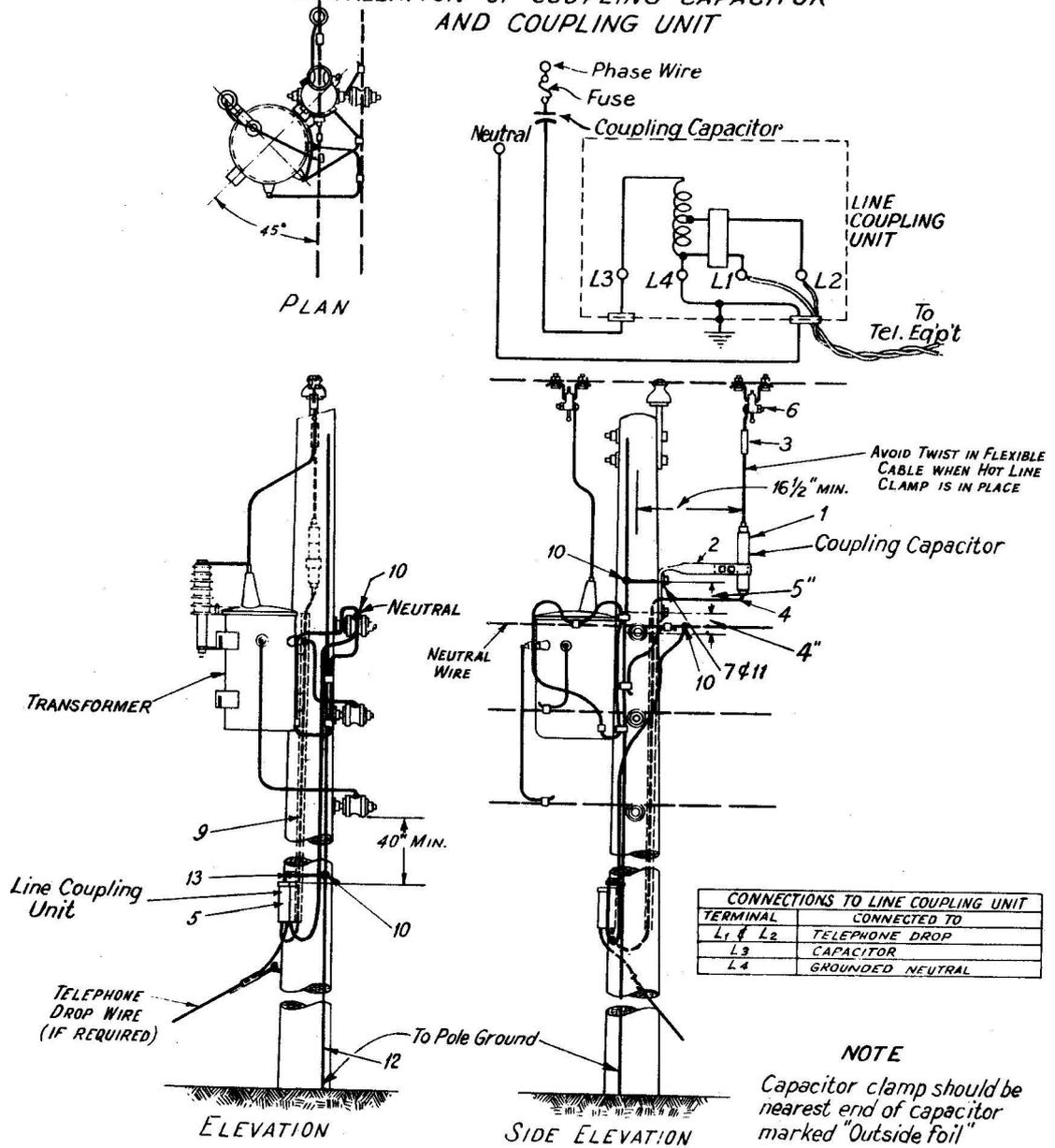


Fig. 2

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M1 CARRIER TELEPHONE SYSTEM
INSTALLATION OF COUPLING CAPACITOR
AND COUPLING UNIT



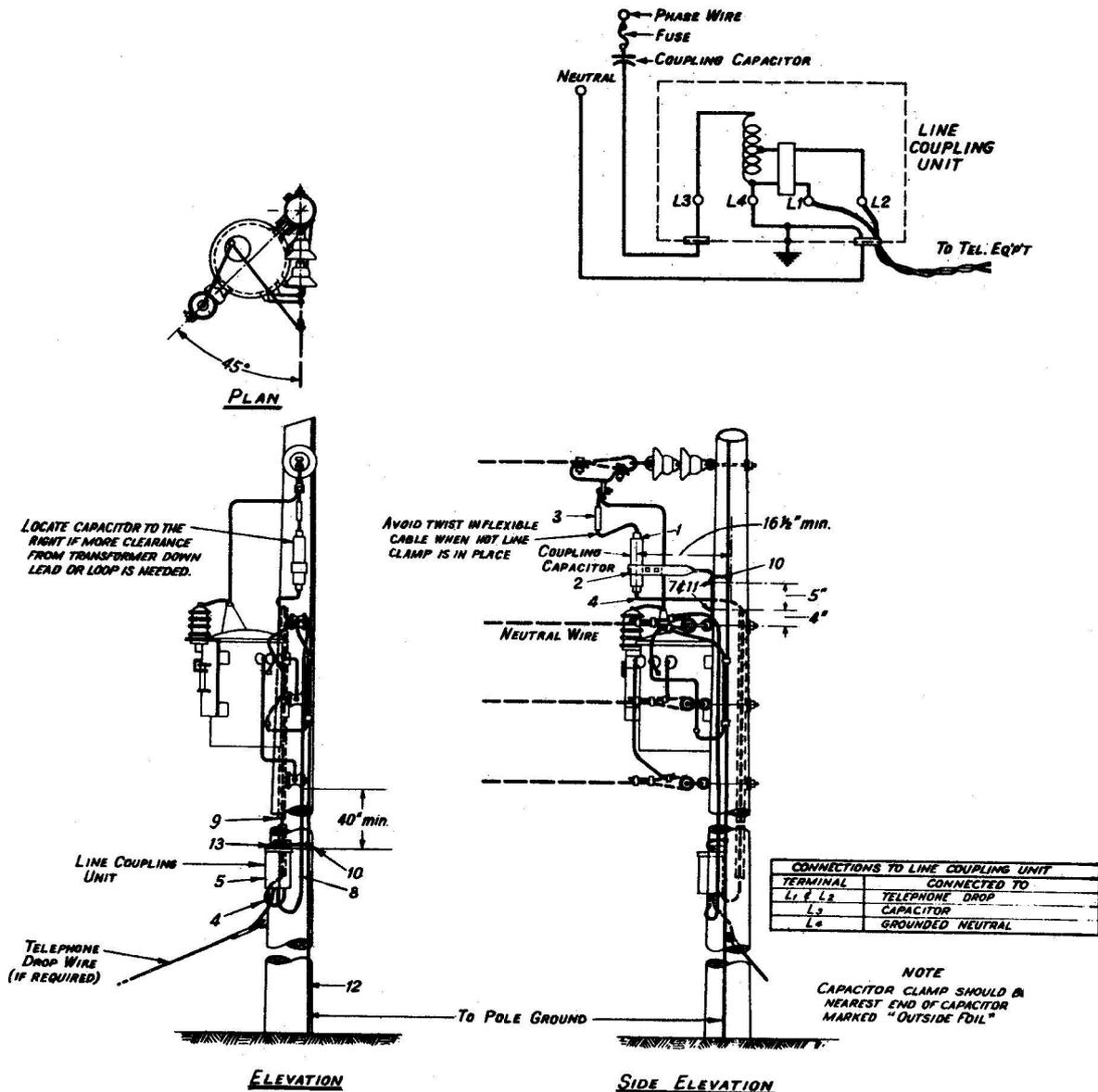
ITEMS TO BE FURNISHED BY TELEPHONE CO.		
ITEM	REQUIRED	
1	1	CAPACITOR KS 13348
2	1	BRACKET BA-444014
3	1	FUSE (J R KERNY CORPN #16074)
4	FEET	10/4N COPPER TREE WIRE PER SPEC. AT-7115
5	1	M1S1 SUB COUPLING UNIT J98701C OR M1S2 TERM. SUB. COUPLING UNIT J98701 F OR M1S1 COMMON COUPLING UNIT J98701D OR M1S2 TERM. COUPLING UNIT J98701E

MATERIAL USED IN INSTALLATION - SUPPLIED BY POWER SYSTEM		
ITEM	REQUIRED	
6	1	HOT LINE CLAMP ASSEMBLY PER POWER SYSTEM PRACT.
7	2	LAG SCREWS 1/2 x 4
8	FEET	#6 SOLID COPPER WIRE - BARE
9	FEET	WOOD MOULDING AND STAPLES
10	3	CONNECTORS - #6 WIRE TO NEUTRAL, POLE, GRD WIRE BRACKET
11	2	WASHERS FOR 1/2 LAG SCREW
12	1	POLE BRD. - IF NONE PRESENT
13	2	LAG SCREWS 3/8 x 2 1/2 FOR LINE COUPLING UNIT

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Fig. 3

M1 CARRIER TELEPHONE SYSTEM
INSTALLATION OF COUPLING CAPACITOR AND COUPLING UNIT ON DEAD END POLE WITH SELF PROTECTED TRANSFORMER



ITEMS TO BE FURNISHED BY TELEPHONE CO.

ITEM	REQUIRED	
1	1	CAPACITOR HS 1394B
2	1	BRACKET BA 4440M
3	1	FUSE (J.B. KEARNEY CORP'N # 18074)
4	FEET	10/8N COPPER TREE WIRE PER SPEC. AT-7115
5	1	MIS1 SUB COUPLING UNIT JS8701C OR
		MIS2 TERM. SUB COUPLING UNIT JS8701F OR
		MIS1 COMMON COUPLING UNIT JS8701D OR
		MIS2 TERM. COUPLING UNIT JS8701E

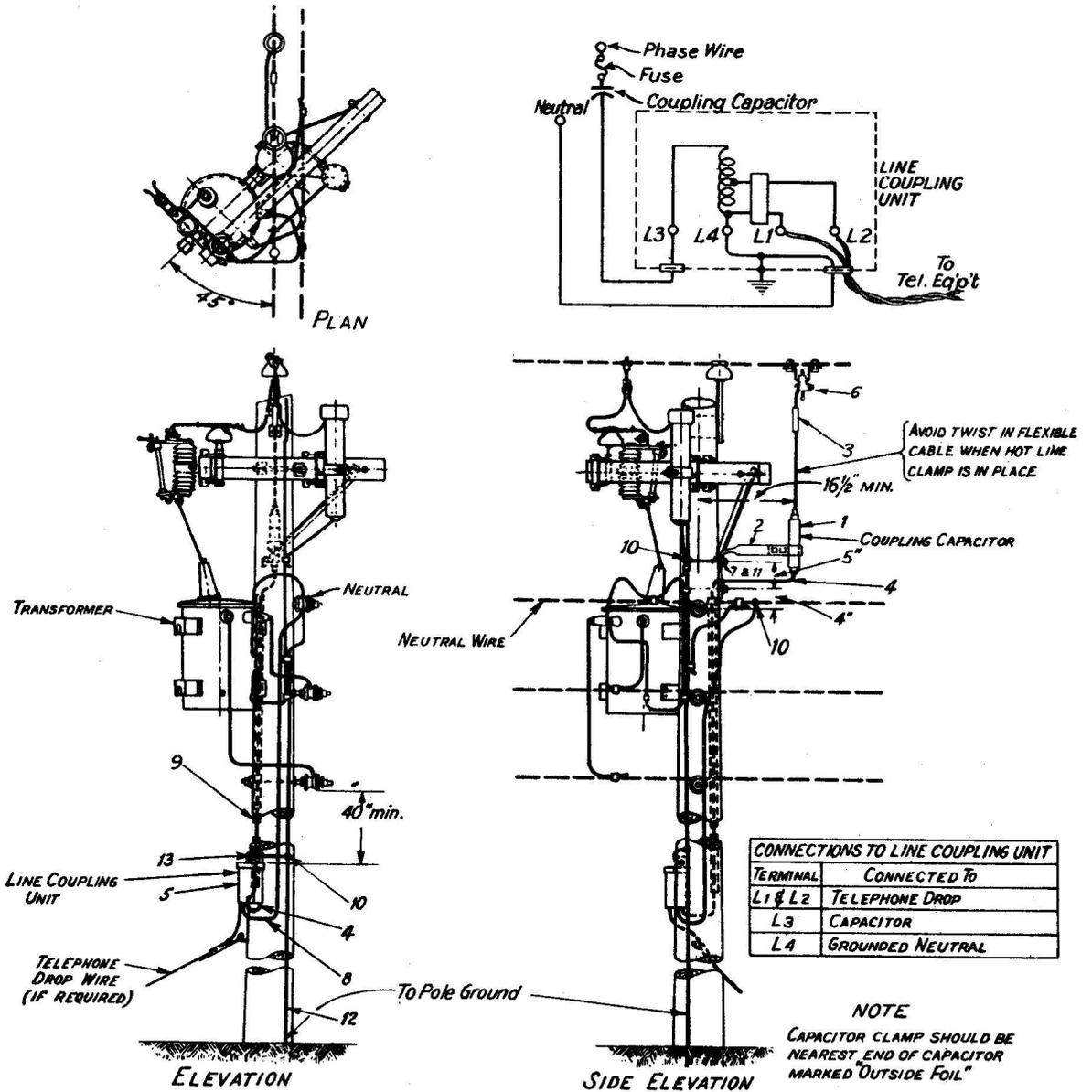
MATERIAL USED IN INSTALLATION - SUPPLIED BY POWER SYSTEM

7	2	LAG SCREWS 1/8" x 4"
8	FEET	#6 SOLID COPPER WIRE - BARE
9	FEET	WOOD MOULDING AND STAPLES
10	4	CONNECTORS - #6 WIRE TO NEUTRAL, POLE, GND WIRE, BRACKET & LINE
11	2	WASHERS FOR 1/8" LAG SCREW
12	1	POLE GND. - IF NONE PRESENT
13	2	LAG SCREWS 3/8" x 5 1/2" FOR LINE COUPLING UNIT

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Fig. 4

M1 CARRIER TELEPHONE SYSTEM
 INSTALLATION OF COUPLING CAPACITOR AND COUPLING UNIT
 ON POLE WITH TRANSFORMER EQUIPPED WITH EXTERNAL FUSE AND
 LIGHTNING ARRESTER



ITEMS TO BE FURNISHED BY TELEPHONE CO.

ITEM	REQUIRED	DESCRIPTION
1	1	CAPACITOR RS 13348
2	1	BRACKET BA-444014
3	1	FUSE (J.K. KEARNEY CORPN #16076)
4	FEET	10/8M COPPER TREE WIRE PER SPEC. AT-7116
5	1	MIS1 SUB COUPLING UNIT J98701C OR MIS2 TERM. SUB COUPLING UNIT J98701 F OR MIS1 COMMON COUPLING UNIT J98701D OR MIS2 TERM. COUPLING UNIT J98701E

MATERIAL USED IN INSTALLATION - SUPPLIED BY POWER SYSTEM

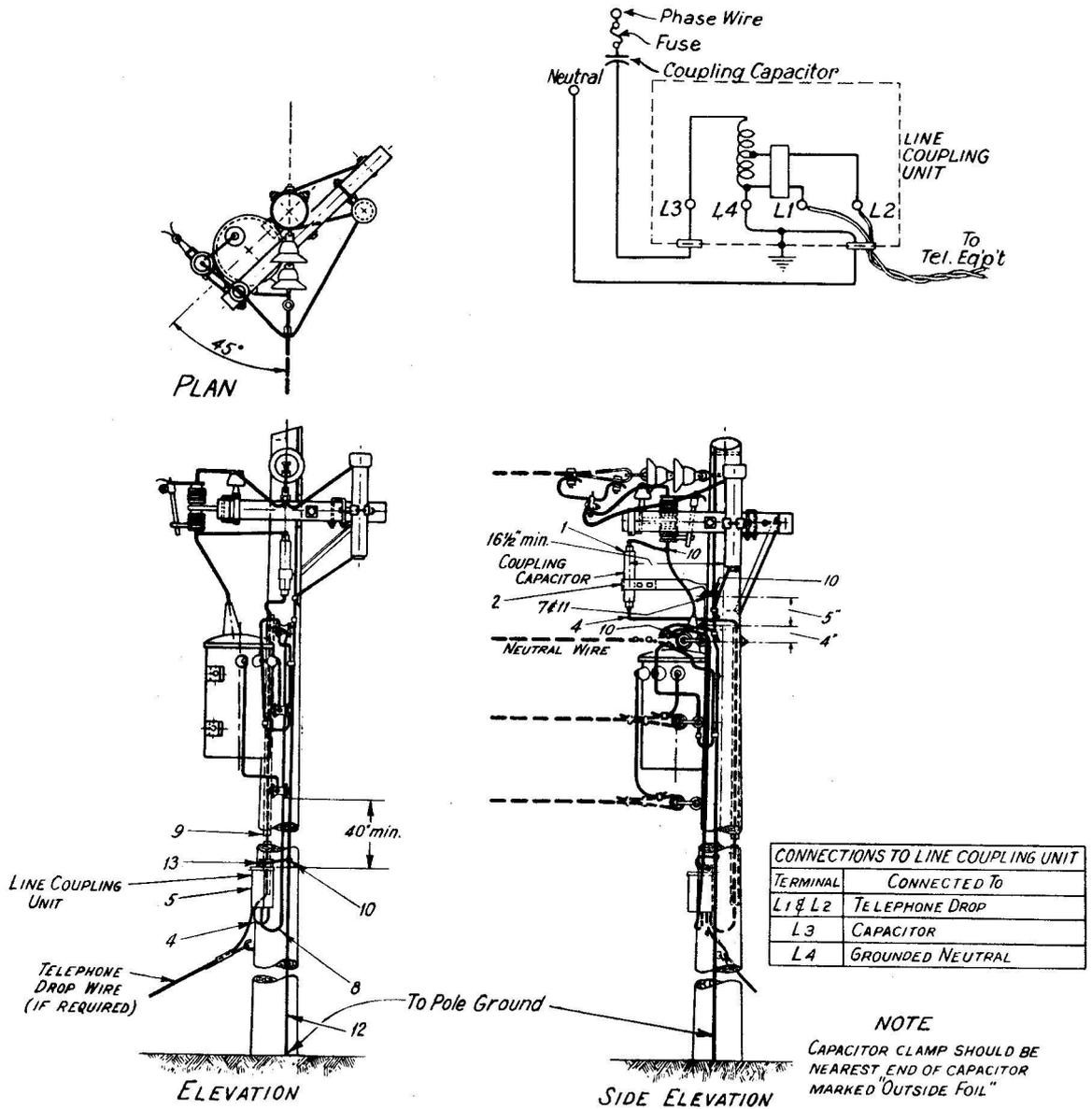
ITEM	REQUIRED	DESCRIPTION
6	1	HOT LINE CLAMP ASSEMBLY PER POWER SYSTEM PRACT.
7	2	LAG SCREWS 1/2" x 4"
8	FEET	#8 SOLID COPPER WIRE - BARE
9	FEET	WOOD MOULDING AND STAPLES
10	2	CONNECTORS - #8 WIRE TO NEUTRAL, POLE, BLD. WIRE, BRACKET.
11	2	WASHERS FOR 1/2" LAG SCREW
12	1	POLE BLD. - IF NONE PRESENT
13	2	LAG SCREWS 3/8" x 3/4" FOR LINE COUPLING UNIT

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Fig. 5

M1 CARRIER TELEPHONE SYSTEM.

INSTALLATION OF COUPLING CAPACITOR AND COUPLING UNIT ON DEAD END POLE WITH TRANSFORMER EQUIPPED WITH EXTERNAL FUSE AND LIGHTNING ARRESTER



ITEMS TO BE FURNISHED BY TELEPHONE CO.

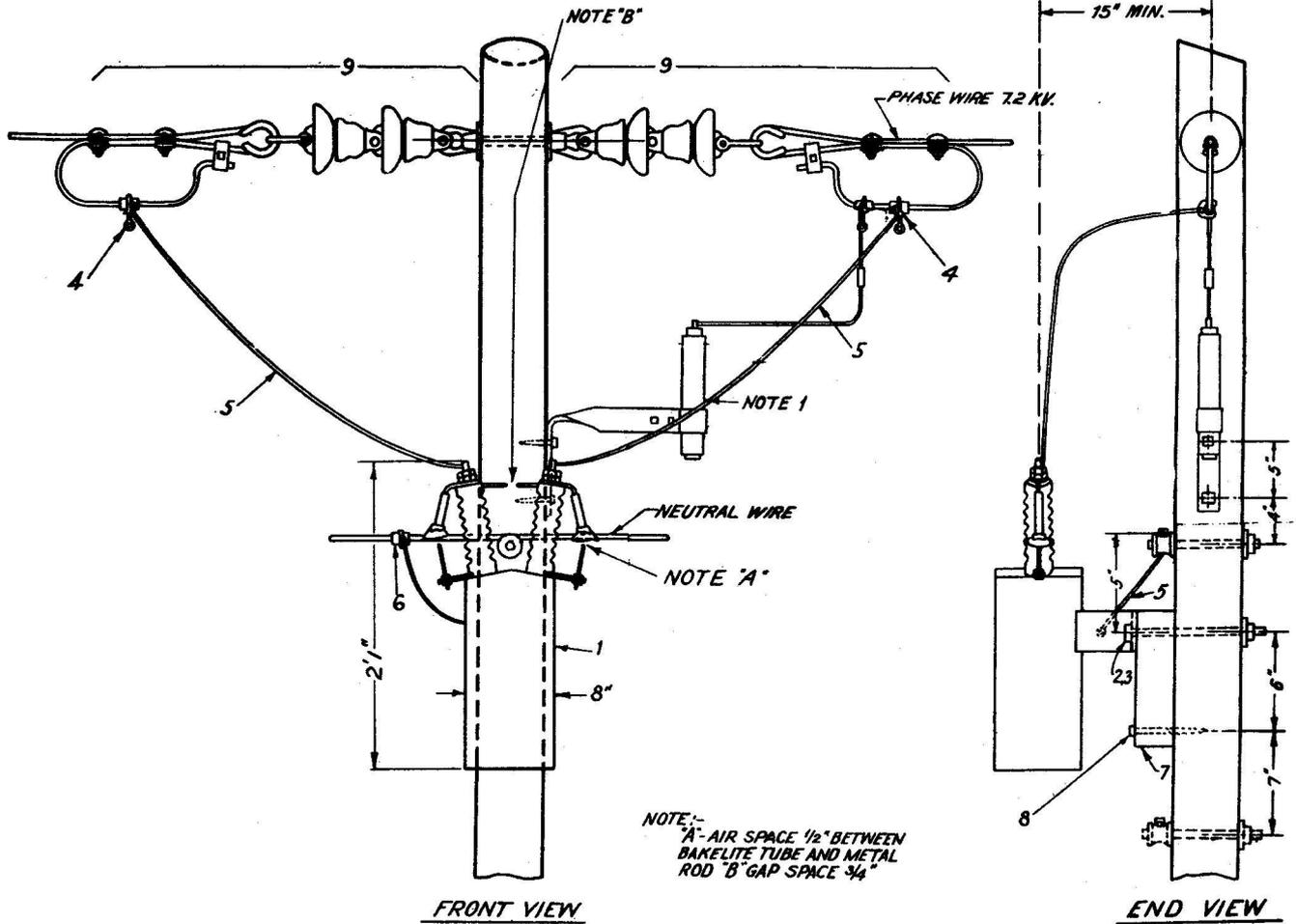
ITEM	REQUIRED		
1	1	CAPACITOR	KS 13348
2	1	BRACKET	DA-44401A
4	FEET	104N	COPPER TREE WIRE PER SPEC. AT-7115
5	1	MIS1	SUB COUPLING UNIT J98701C OR
		MIS2	TERM. SUB. COUPLING UNIT J98701 F OR
		MIS1	COMMON COUPLING UNIT J98701D OR
		MIS2	TERM. COUPLING UNIT J98701E

MATERIAL USED IN INSTALLATION - SUPPLIED BY POWER SYSTEM

7	2	LAG SCREWS	1/2" x 4"
8	FEET	#6	SOLID COPPER WIRE - BARE
9	FEET	WOOD	MOULDING AND STAPLES
10	4	CONNECTORS	- #6 WIRE TO NEUTRAL, POLE, GRD. WIRE, BRACKET & LINE
11	2	WASHERS	FOR 1/2" LAG SCREW
12	1	POLE	GRD. - IF NONE PRESENT
13	2	LAG SCREWS	3/8" x 2 1/2" FOR LINE COUPLING UNIT

Fig. 6

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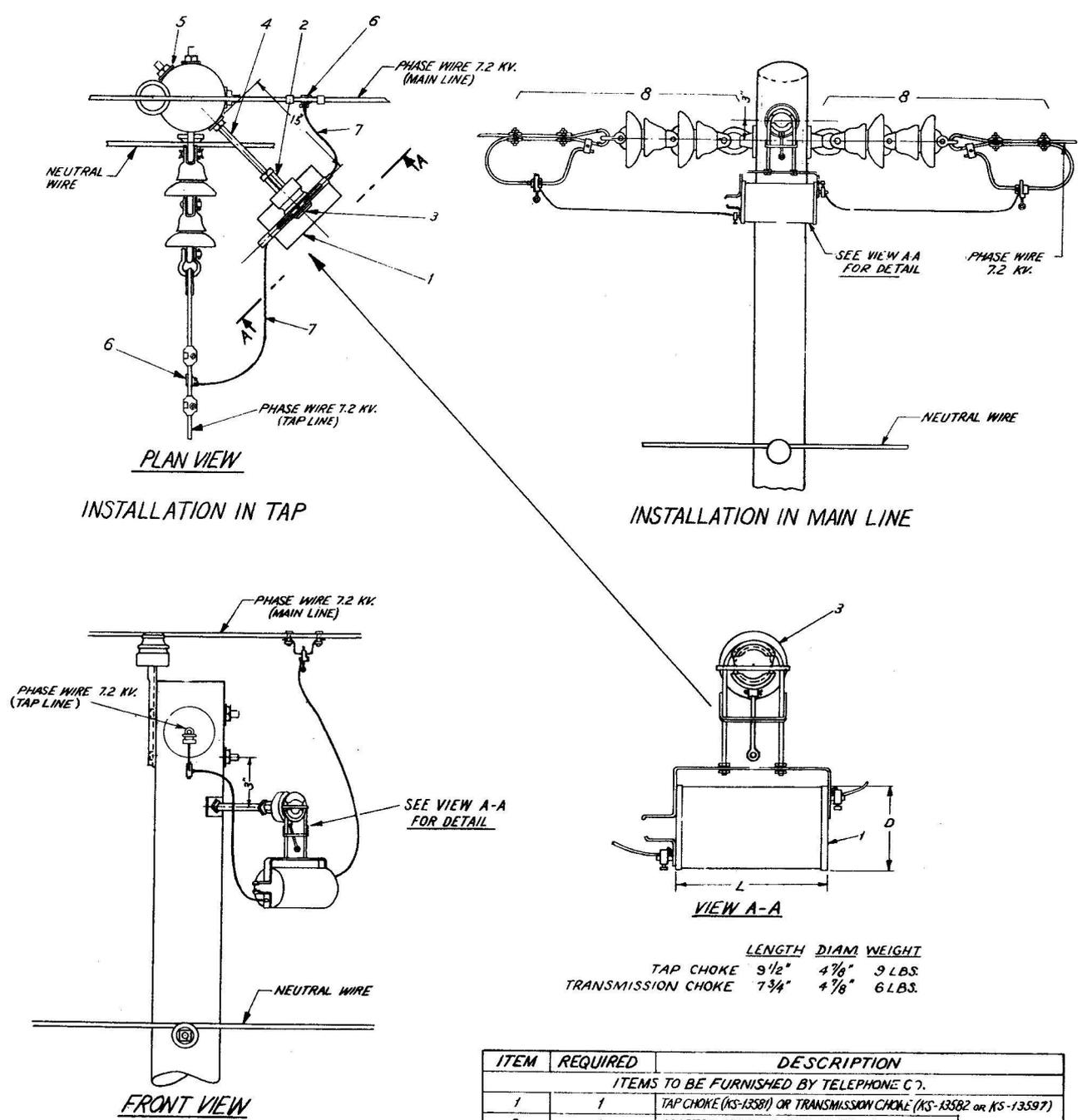
ITEM	REQUIRED	DESCRIPTION
ITEMS TO BE FURNISHED BY TELEPHONE CO.		
1	1	ISOLATING CHOKE, K.S - 13580.
MATERIAL USED IN INSTALLATION-SUPPLIED BY POWER SYSTEM		
2	1	BOLT, MACHINE, 5/8"x12" (WITH NUT)
3	1	WASHER, SQUARE, 2 1/4", 9/16" HOLE.
4	2	HOT LINE CLAMP ASSEMBLY PER POWER SYSTEM PRACTICES
5	3	JUMPERS, BARE COPPER, #6 OR EQUAL.
6	1	CONNECTOR #6 WIRE TO NEUTRAL.
7	1	SPACER BLOCK 3 1/2" x 4 1/2" x 10"
8	1	1/2" x 5" LAG SCREW
(IF PHASE CONDUCTOR IS NOT DEAD ENDED)		
9	2	DEAD END ASSEMBLIES PER POWER SYSTEM PRACTICES

- NOTES:**
1. COUPLING CAPACITOR WILL USUALLY BE REQUIRED ON THIS POLE (SEE FIG. 3 OR 4)
 2. ISOLATING CHOKE MOUNTED IN KYLE OIL CIRCUIT RECLOSER TANK-APPROX. TOTAL WEIGHT 60 LBS.

**M1 CARRIER TELEPHONE SYSTEM-POWER LINE
 CONNECTION DATA-ISOLATING CHOKE**

Fig. 7

M1 CARRIER TELEPHONE SYSTEM-POWER LINE CONNECTION DATA-TAP OR TRANSMISSION CHOKE



	LENGTH	DIAM.	WEIGHT
TAP CHOKE	9 1/2"	4 7/8"	9 LBS.
TRANSMISSION CHOKE	7 3/4"	4 7/8"	6 LBS.

ITEM	REQUIRED	DESCRIPTION
ITEMS TO BE FURNISHED BY TELEPHONE CO.		
1	1	TAP CHOKE (KS-13581) OR TRANSMISSION CHOKE (KS-13582 OR KS-13597)
2	1	ADAPTER, HUBBARD 5058 OR EQUIV. AS REQUIRED
MATERIAL USED IN INSTALLATION - SUPPLIED BY POWER SYSTEM		
3	1	INSULATOR, LOCKE 9995, 88 OR EQUAL
4	1	DOUBLE ARMING BOLT 3/8" LENGTH AS REQUIRED TO GIVE 12" CLEARANCE @ POLE & HANGER OF CHOKE
5	2	SQUARE WASHER 2 1/4", 1 3/16" HOLE
6	2	HOT LINE CLAMPS PER POWER SYSTEM PRACTICES
7	2	#6 SOLID BARE COPPER JUMPERS
(WHERE CHOKE IS TO BE INSTALLED IN MAIN PHASE WIRE NOT ALREADY DEAD ENDED)		
8	2	READ END ASSEMBLIES PER POWER SYSTEM PRACTICES

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Fig. 8

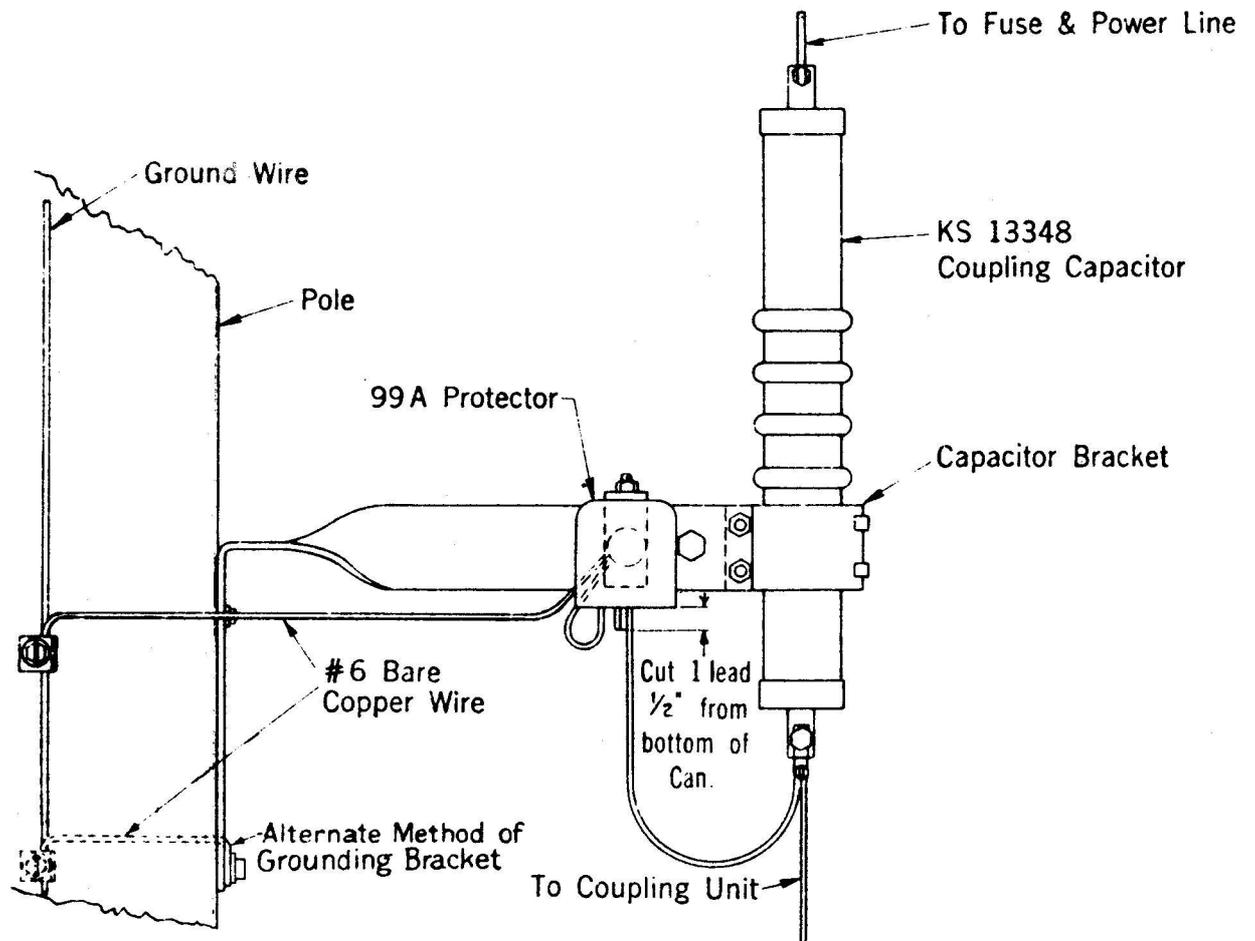


Fig. 9

GENERAL AGREEMENT
FOR
POWER LINE CARRIER FACILITIES

BETWEEN

.....
.....

AND

.....
.....

Date

**GENERAL AGREEMENT FOR
POWER LINE CARRIER FACILITIES**

AGREEMENT made this..... day of, between.....
..... Company, a corporation
of the State of, hereinafter called the Telephone Company and
....., a cor-
poration of the State of, hereinafter called the Cooperative.

WHEREAS, the Telephone Company furnishes telephone service in rural areas of the territory described below and the Cooperative furnishes electric power and light service in the same territory, and

WHEREAS, in parts of said territory the most practicable method of extending telephone service to persons on or near the power lines may be by superimposing carrier frequency currents upon the power lines of the Cooperative, and

WHEREAS, the Cooperative desires that such of its members and consumers as desire telephone service shall have such service made available to them on economical terms and wishes to cooperate to that end by allowing the use of its power lines for telephone transmission, provided its electric power and light service be not interfered with and it be reimbursed for all expenses incurred by it solely by reason of such use,

It is agreed between the parties hereto as follows:

1. The Telephone Company shall have the right, by means of carrier equipment, to the extent hereinafter provided, to utilize the power lines of the Cooperative as a medium of transmission for the furnishing of telephone service. Such transmission shall be confined to frequencies in the 150-500 kc band, and the Telephone Company shall have the right to use all frequencies in that band. However, the Telephone Company's use of such frequencies shall be such as not to interfere with the Cooperative's use of the frequencies outside of the 150-500 kc band.

2. The Telephone Company shall have the right to attach or have attached (as provided in Section 3 hereof) to any poles and wires of the Cooperative within the territory defined below, such equipment as, in the reasonable judgment of the Telephone Company, is required to enable it to use the power lines of the Cooperative in connection with its own lines in rendering telephone service in said territory. This equipment shall include, but shall not be restricted to, line coupling units, drops, common carrier terminals, carrier repeaters, coupling capacitors, fuses and chokes, and shall be of a type which will not adversely affect the electric power and light services of the Cooperative. All of this equipment, including mounting brackets and special mounting parts, shall be furnished by and remain the property of the Telephone Company.

The territory referred to above is as follows:

3. All of the equipment provided for in Section 2 hereof shall be installed and maintained in accordance with the specifications hereto attached, marked Exhibit A and made a part hereof. The Cooperative will install the line coupling units and will install and maintain all other equipment of the Telephone Company which is to be located above them, and will remove, rearrange and perform the work of replacing such equipment (including the line coupling units) upon request by the Telephone Company. The Telephone Company will maintain the equipment in the line coupling units and will install and maintain all of its equipment which is to be located below the line coupling units, and shall have the right to rearrange its equipment and to remove all or any part thereof at any time. The Cooperative will furnish, where required, crossarms, dead ends, special pole grounds, mounting hardware not provided for in Article 2 and the wiring for all equipment which it is required to install or maintain hereunder except as shown on page 2 of Exhibit A and will make all necessary connections between the wires of the Cooperative and the equipment of the Telephone Company. The Cooperative agrees that in the installation and maintenance of equipment as provided for herein it will observe such standards of installation and maintenance as will enable the Telephone Company, in its reasonable judgment, to provide satisfactory telephone service.

4. It is agreed that power for the carrier telephone equipment at the premises of consumers of the Cooperative will be taken from the house service supplied from the lines of the Cooperative.

5. The Cooperative and the Telephone Company will each take all practicable measures to cooperate with the other in connection with the installation, rearrangement, removal and maintenance of the facilities provided for in Section 2, and in connection with any change in plant or equipment of either of the parties which may affect the service of the other, including reasonable advance notification and such testing of the respective facilities as the other party may reasonably request.

6. The Cooperative agrees not to transmit, or to permit others to transmit upon any of its lines within the territory described in Section 2 hereof, electric energy with frequencies which would cause interference with transmission by the Telephone Company over any of such lines of frequencies in the 150-500 kc band.

7. The Telephone Company will pay to the Cooperative, for all rights and privileges granted, wiring furnished and work performed by the Cooperative hereunder, an amount determined as provided in Exhibit B attached hereto and made a part hereof.

8. The failure of either party to insist upon strict compliance with any of the terms or condition of this Agreement in any one or more instances shall not be construed as a waiver or relinquishment for the future of any such term or condition, but the same shall be and remain in full force and effect.

9. The Cooperative does not warrant or assure to the Telephone Company any franchises, right-of-way privileges or easements on, over or across streets, alleys and public thoroughfares, and private or publicly owned property, and if the Telephone Company shall at any time be prevented from placing or maintaining its attachments on the Cooperative's poles or power lines no liability on account thereof shall attach to the Cooperative.

10. This Agreement shall continue for the term of 5 years from the date hereof, and thereafter until terminated by 1 year's notice in writing by either party to the other. The Telephone Company and the Cooperative shall have a reasonable time after termination within which to remove the equipment furnished by the Telephone Company.

11. This Agreement shall apply to and be binding upon the successors and assigns of the respective parties.

12. This Agreement, and any amendment thereof, shall be effective, subject to the condition that during any period in which the Cooperative is a borrower from the Rural Electrification Administration, the Agreement and any amendment thereof shall have the approval in writing of the Administrator of the Rural Electrification Administration.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on the date first above written.

TELEPHONE COMPANY

By.....

Attest:

.....

COOPERATIVE

By.....

Attest:

.....

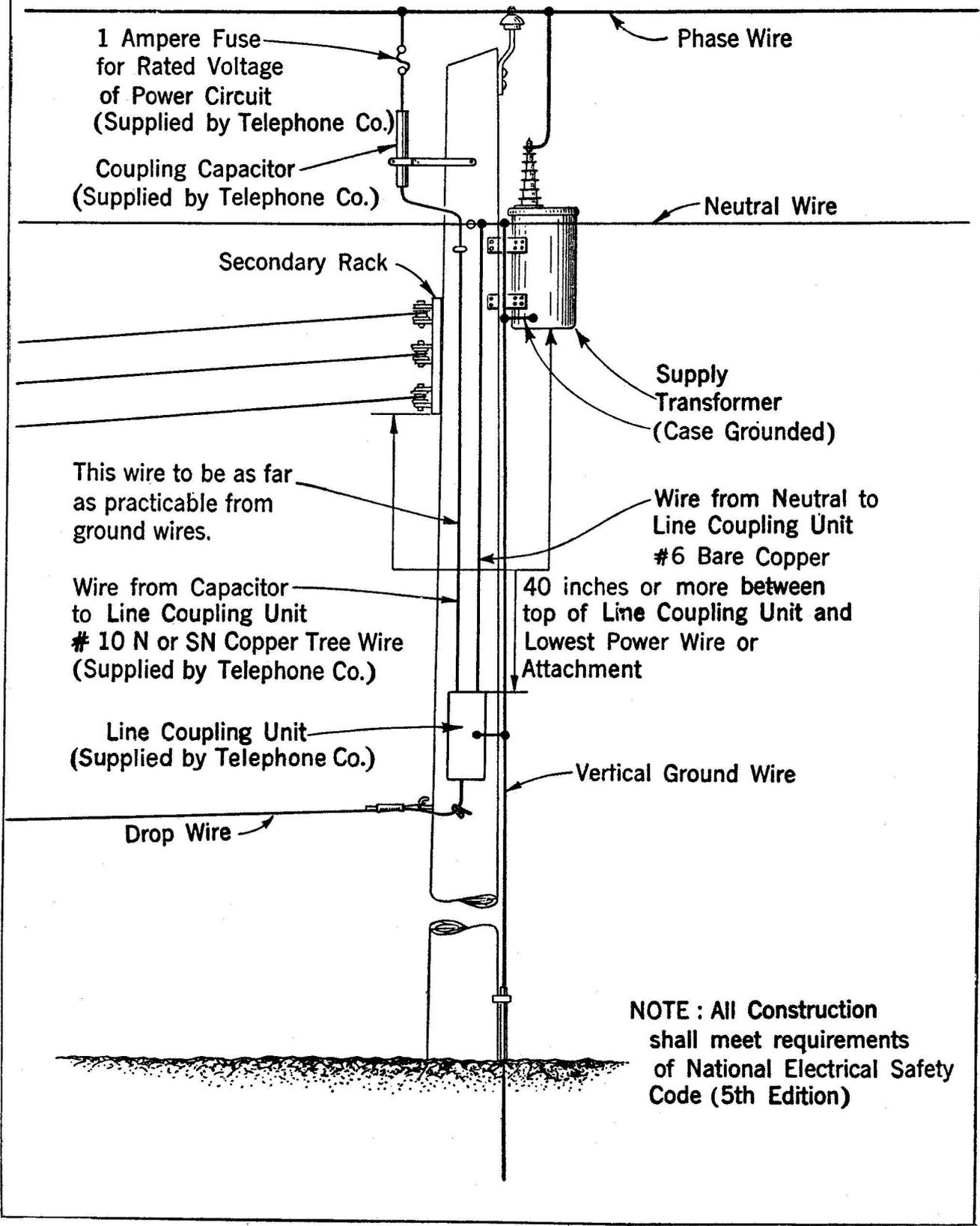
EXHIBIT A

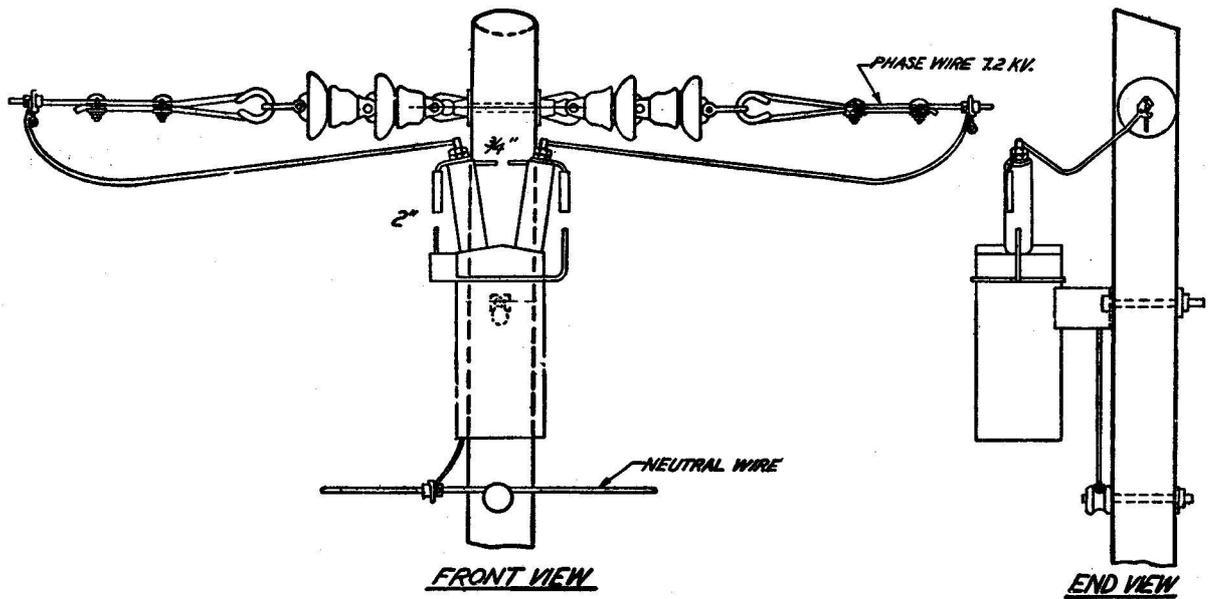
SPECIFICATIONS

The following specifications shall apply, except to the extent that they may conflict with requirements established by lawful authority.

1. The Telephone Company shall place its attachments on the poles of the Cooperative in accordance with the requirements of the National Electrical Safety Code (5th Edition).
2. The coupling capacitors and chokes provided by the Telephone Company shall meet the following requirements:
 - Capacitors shall meet electric requirements of A.I.E.E. Standard No. 31—January 1944.
 - Chokes shall be so constructed as to meet the standard dielectric tests for transformers of the small apparatus class required by A.S.A. Standard C57.1—1942.
3. Installation of coupling capacitors, line coupling units and isolating, tap and transmission chokes by the Cooperative shall meet the requirements of the National Electrical Safety Code (5th Edition). The figures on pages 2, 3 and 4 of this Exhibit A are intended only as pictorial representations and not as specifications.

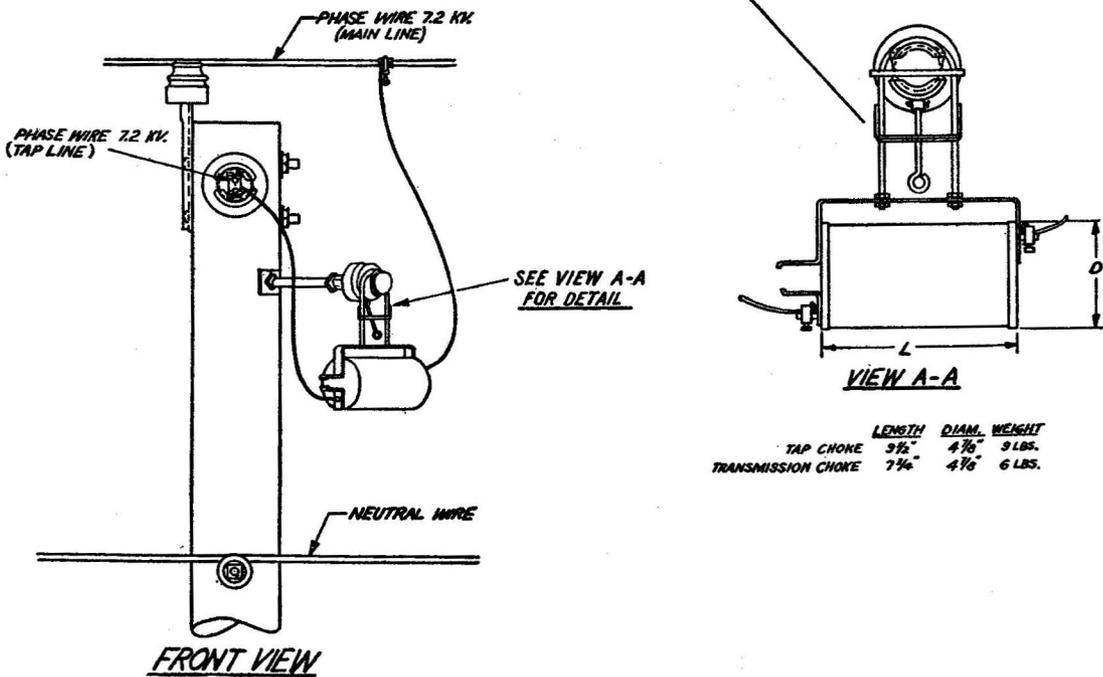
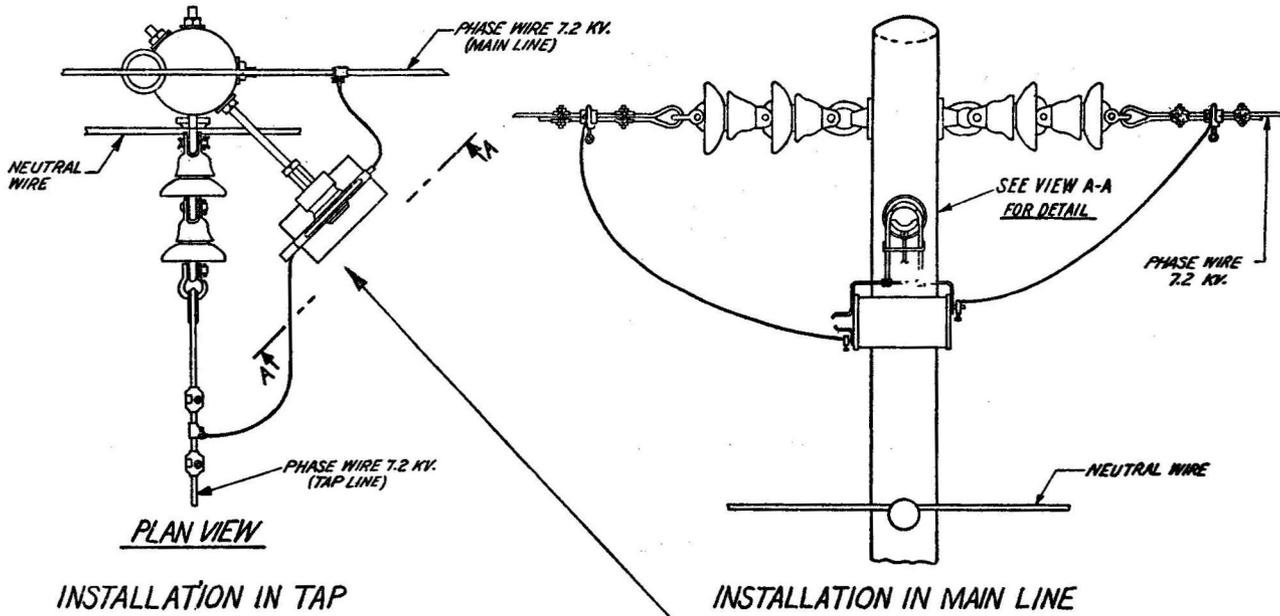
ILLUSTRATIVE SCHEMATIC ARRANGEMENT OF TELEPHONE EQUIPMENT ON POLE CARRYING COUPLING CAPACITOR





*ILLUSTRATIVE SCHEMATIC ARRANGEMENT
OF ISOLATING CHOKE INSTALLATION*

ILLUSTRATIVE SCHEMATIC ARRANGEMENT OF TAP OR TRANSMISSION CHOKE INSTALLATION



	LENGTH	DIAM.	WEIGHT
TAP CHOKE	3 1/2"	4 1/8"	3 LBS.
TRANSMISSION CHOKE	7 1/4"	4 1/8"	6 LBS.

EXHIBIT B

The amount to be paid by the Telephone Company to the Cooperative shall be computed by (a) applying an annual rate of \$1.00 to each pole of the Cooperative upon which the Telephone Company has attachments at any time during the calendar year (except that where the parties have entered into a joint use contract for communication wire telephone service which provides that the contract shall take precedence over this contract as to rental charges for poles, no rental charge shall be made under this Agreement for poles on which rental charge is made under such joint use contract) and (b) adding thereto the amounts determined from the following table:

<u>Per Complete Unit of Equipment Furnished by the Telephone Company</u>	<u>Instal- lation Payment</u>	<u>Removal Payment</u>	<u>Annual Payment for Power Consumption</u>
Coupling assembly	\$25.00	\$15.00	—
Isolating Choke	\$25.00	\$15.00	\$2.00
Tap or transmission choke	\$16.00	\$15.00	\$.10

For each maintenance visit, including visits to replace equipment, requested by the Telephone Company, a payment of \$13.00 shall be made to the Cooperative.

The above specified payments for installation, removal and maintenance are intended to cover the total expense of the Cooperative in installing, removing and maintaining equipment furnished by the Telephone Company, including a proper allocation of supervisory and general expenses.

Either party to this Agreement may, during the month of January in each year, request in writing a joint review of the rates of payment specified above provided, however, that during any period in which the Cooperative is a borrower from the REA no such request by the Cooperative shall be effective without the written approval of the Administrator of the REA. Such a joint review shall then be made and said rates of payment for installation, removal and maintenance shall be so revised as to result in rates which, if effective during the preceding year, would have resulted in payments equal to the actual expense incurred by the Cooperative for the above named purposes during the preceding year. Such revised rates shall apply for the entire year in which the review is made and thereafter until again revised in the manner hereinabove provided.

The Cooperative shall render monthly bills to the Telephone Company for installation, removal and maintenance work and annual bills for pole attachments and power consumption of chokes. Payments shall be made by the Telephone Company to the Cooperative within 30 days following receipt of bills.

Joint Use of Facilities
Rural Electric Power Systems
Telephone Systems

AMENDMENT TO FORM OF GENERAL AGREEMENT FOR POWER LINE CARRIER
FACILITIES

The Cooperative and the Telephone Company agree that the following amendments shall be a part of the Agreement between the parties dated _____, 19____:

1. On page 1, insert the word "and" after the word "use" at the end of the third recital, and add the following recital which will appear just preceding the body of the agreement:

"WHEREAS, the Telephone Company has submitted to the Cooperative its detailed program, marked Appendix I and made a part hereof, for furnishing such telephone service to the widest practicable number of members and consumers of the Cooperative during the term of this Agreement, and has shown in said Appendix I the general location and number of persons to be served and the estimated dates when they will receive telephone service pursuant to the Telephone Company's area coverage program."

2. On page 2, revise Section 10 to read as follows:

"10. This Agreement shall continue for the term of 5 years from the date hereof, and thereafter until terminated by 1 year's notice in writing by either party to the other. The Telephone Company and the Cooperative shall have a reasonable time after termination within which to remove the equipment furnished by the Telephone Company. If, prior to the expiration of such 5-year term, the Telephone Company fails to carry out substantially its program for extending telephone service to the widest practicable number of members and consumers of the Cooperative, as set forth in Appendix I, the Cooperative may, if such failure continues 60 days after due notice thereof in writing is given by the Cooperative, prohibit the Telephone Company from installing on the poles and wires of the Cooperative any additional equipment necessary for the further extension of power line carrier telephone service."

Executed on the _____ day of _____, 19_____.

Attest:

By _____

Attest:

By _____