

## ENGINEERING AND OPERATING CONSIDERATIONS INVOLVED IN FURNISHING CIRCUITS TO THE WESTERN UNION TELEGRAPH COMPANY UNDER SPECIAL CONTRACT

### 1. GENERAL

1.01 Attached to this section is a copy of "Engineering Notes" prepared to assist in the administration of the agreements between the Western Union Telegraph Company and the Telephone Companies, known as Contract No. 1 and Contract No. 2. These notes include information regarding the provision and use of intra-exchange and interexchange circuits.

1.02 The attached "Notes" have been revised to bring them up to date and to include additional information required by the adoption of Amendment 3 to Contracts No. 1 and 2 effective January 1, 1962. Due to the extent of the modifications, arrows will not be used to indicate changes.

1.03 Amendment 3 to Contracts 1 and 2 primarily provide for Western Union's use of leased circuits for private line voice and alternate voice purposes including connections to Telephone Company instrumentalities and through such instrumentalities to the Telephone Company exchange and toll network or switched private line facilities. In addition, provision is made for leasing to Western Union 100-speed fully operative telegraph circuits.

1.04 The information covered in these notes has been concurred in by the Western Union Telegraph Company and copies have been furnished to them for their use.

### 2. TELEGRAPH AND DATA FACILITIES

2.01 Circuit sections furnished to the Western Union Company under Contract No. 2, suitable for voice-frequency transmission, also

referred to as type (a) (1) circuits, are used by Western Union for the operation of their voice-frequency carrier telegraph systems. In general, the specific telegraph level on the interexchange portion of such circuit sections should be -21 db, except when operated over N, O, or ON carrier channels.

2.02 When operated over N, O, or ON carrier channels the same levels should be employed as those recommended for the Bell System 43A1 carrier telegraph system. The optimum levels to employ have been covered in Bell System Practices. Reference should therefore be made to this standard information.

2.03 Fig. 5B of the attached "Notes" shows a single half duplex loop extended to battery or ground at the telegraph office over a single conductor. The battery or ground at the Telegraph Company office will be furnished by the Telephone Company. The connections of the 43A1 channel terminal at the Telephone Company Central Office are shown on Drawing SD-70552. If plus battery is furnished at the outlying point, either Fig. 2 or Fig. 7 of Drawing SD-70552 may be employed. If ground is furnished at the outlying point, Fig. 2 of Drawing SD-70552 must be employed.

2.04 Fully operative circuit sections are sometimes terminated at the office of the Telegraph Company, or at premises of its customer, in 130-type subscriber sets. There are three types of 130 sets which may be encountered: the 130 B1, 130 B2, and 130 C1. The following tabulation gives reference information for interconnecting from such sets to the Telegraph Company's plant:

| TYPE OF SUB SET | TYPE OF SERVICE | TYPE OF LOOP | DRAWING REFERENCE    |
|-----------------|-----------------|--------------|----------------------|
| 130 B1          | Half duplex     | 2-wire       | SD-70679-01 Fig. 2   |
|                 | Half duplex     | 1-wire       | SD-70679-01 Fig. 2*  |
|                 | Full duplex     | 2-wire       | SD-70679-01 Fig. 4   |
|                 | Full duplex     | 1-wire       | SD-70679-01 Fig. 4** |
| 130 B2<br>or    | Half duplex     | 2-wire       | SD-70848-01 Fig. 1   |
|                 | Half duplex     | 1-wire       | SD-70848-01 Fig. 1*  |
| 130 C1          | Full duplex     | 2-wire       | SD-70848-01 Fig. 3   |
|                 | Full duplex     | 1-wire       | SD-70848-01 Fig. 3** |

\* Omit SL1 or B lead.

\*\* Omit SL1 or B lead and RL1 or B lead.

With either single conductor or two conductor loops, the resistance external to the 130-type set must be in accordance with the attached "Engineering Notes."

**2.05** The loop potentiometers and loop current adjustments of 43A1 carrier telegraph terminals used in connection with Western Union service including those used with 130 B1 sets at Western Union offices where the loop circuit is connected on a single wire basis to a teletypewriter or to telegraph repeater equipment, should be made in accordance with instructions in the appropriate series of practices. Where TLT or other jacks are not provided in the loop circuits, milliammeters or other equipment used for testing should be connected into the circuit in the same electrical relation to the rest of the equipment as outlined in the appropriate sections of practices.

**2.06** The level of AM data or facsimile signals should be adjusted to -4 dbm at a zero transmission level point. Frequency modulated data or facsimile signals should be adjusted to -8 dbm at a zero level point. These levels apply only to voice-bandwidth channels. Where channels of wider bandwidth are involved, the latest information should be obtained.

### 3. FACILITIES FOR VOICE OPERATION

**3.01** Section 4 of the "Notes" discusses basic engineering ground rules for voice or alternate voice facilities leased under the contracts. It is not intended as a detailed practice on engineering design.

**3.02** The design of circuits used to furnish service to its customers will be the responsibility of the Telegraph Company. However, the Telephone Company should provide the necessary information, such as facility make-up and terminating equipment capabilities, to enable the Telegraph Company to satisfactorily carry out its design procedures. Close cooperation will be required between the designated representatives of the two Companies to implement this exchange of information.

**3.03** When a Western Union private line voice circuit, leased or owned, can be interconnected with other services of the Telephone Company at a Telephone Company instrumentality, the design used by Western Union should agree closely with that used by the Telephone Company.

### 4. INTERFERENCE AND PROTECTION

**4.01** Section 5 of the "Notes" is intended to discuss in a general way the engineering and operation aspects of interference and protection. It is impossible to include in this section all of the details, rules and regulations that must be considered when services of this type are provided. It will be the responsibility of both the Western Union and the Telephone Company to engineer and maintain to the best of their ability a safe and interference-free communication service.

Attached: Engineering Notes

Contract Numbers 1 and 2

Between The Bell System Telephone Companies and The Western Union Telegraph Company

**ENGINEERING NOTES**  
**CONTRACT NUMBERS 1 AND 2**  
**BETWEEN THE BELL SYSTEM TELEPHONE COMPANIES**  
**AND**  
**THE WESTERN UNION TELEGRAPH COMPANY**

**Revised January, 1963**

**ENGINEERING NOTES**  
**CONTRACT NUMBERS 1 AND 2**  
**BETWEEN THE BELL SYSTEM TELEPHONE COMPANIES**  
**AND THE WESTERN UNION TELEGRAPH COMPANY**

**INDEX**

| <b>SECTIONS</b>  | <b>PAGE</b>  |
|--|--------------|
| <b>I    GENERAL . . . . .</b>                            | <b>I-1</b>   |
| <b>II    DISCUSSION OF CONTRACT PROVISIONS . . . . .</b> | <b>II-1</b>  |
| <b>III    TELEGRAPH AND DATA FACILITIES . . . . .</b>    | <b>III-1</b> |
| <b>IV    FACILITIES FOR VOICE OPERATION . . . . .</b>    | <b>IV-1</b>  |
| <b>V    INTERFERENCE AND PROTECTION . . . . .</b>        | <b>V-1</b>   |

**ENGINEERING NOTES**  
**CONTRACT NUMBERS 1 AND 2**  
**BETWEEN THE BELL SYSTEM TELEPHONE COMPANIES**  
**AND THE WESTERN UNION TELEGRAPH COMPANY**

**SECTION I**

**GENERAL**

**1.01** The "Engineering Notes" are intended to provide a general understanding of the provisions of the special contracts between the Western Union Telegraph Company and the Telephone Companies. These contracts are known as Contract No. 1 and Contract No. 2. Contract No. 1 covers the leasing of certain telephone circuits and associated equipment and duct and pole line attachment space within exchange areas. Contract No. 2 covers the leasing of circuits between exchange areas. Both contracts were previously amended and have now been amended for the third time each effective January 1, 1962.



**ENGINEERING NOTES**  
**CONTRACT NUMBERS 1 AND 2**  
**BETWEEN THE BELL SYSTEM TELEPHONE COMPANIES**  
**AND THE WESTERN UNION TELEGRAPH COMPANY**

**SECTION II**  
**DISCUSSION OF CONTRACT PROVISIONS**

**2.01** Contract No. 1 provides for the leasing to Western Union of outside plant facilities to be used in the furnishing of various communication services as covered in Paragraph 2.02. Circuits leased to the Telegraph Company for these purposes under Contract No. 1 ordinarily consists of pairs of wires of the general types normally employed in furnishing exchange telephone service. Such circuits may be used by the Telegraph Company for certain local intra-exchange nonvoice services. They are also required as local terminal circuits to extend circuit sections furnished under Contract No. 2 to the premises of the Telegraph Company and to the premises of a customer of the Telegraph Company. In addition circuits are leased for certain private line purposes and covered in Paragraph 2.10.

**2.02** Circuits leased to the Telegraph Company in accordance with Contract No. 1 may be used for the provision of any of the following services for which such circuits are suitable: (i) message telegraph service, including messenger call service in connection therewith, (ii) facsimile transmission, including voice coordination thereof, of messages, photographs, diagrams, drawings and printed material, (iii) the following exchange-type switched services: teleprinter, facsimile, distant writing, and data transmission, including voice coordination of such services, (iv) the following private line leased services: Morse, teleprinter, ticker, distant writing, facsimile, data transmission, and remote control and operation of sensing devices, alarms, signals, dis-

plays, controls, computers, or business machines such as tabulating, calculating and sorting machines, (v) telemeter service, (vi) ticker service, (vii) the local termination of interexchange circuits for any of the purposes specified in items (i) to (vi) above, of this paragraph, and of interexchange circuits for private line leased voice or alternate voice transmission, (viii) the local termination in a principal office of the Telegraph Company of interexchange circuits for the remote operation and control of clocks, and (ix) forwarding telegrams by telephone.

**2.03** Circuit sections leased to the Telegraph Company under Contract No. 2 include the following:

(a) (1) Circuit sections suitable for voice-frequency transmission and (2) circuit sections of specified wider bandwidth, suitable for facsimile or data transmission in one direction.

(b) Circuit sections suitable for direct current telegraph transmission not requiring the exclusive use of a wire or wires and not precluding normal voice-frequency telephone use.

(c) Fully operative telegraph circuit sections for Morse or teletypewriter transmission.

(1) Circuits suitable for operation at a line signaling frequency not exceeding 28 cycles per second, for 24-hour operation daily.

(2) Circuits suitable for operation at a line signaling frequency exceeding 28 cycles per second, but not exceeding 37 cycles per second, for 24-hour operation daily.

(d) Circuit sections suitable for direct current telegraph transmission using exclusively a pair of wires in cable or an open wire.

**2.04** Circuits leased to the Telegraph Company in accordance with Contract No. 2 may be used only for the provision of any of the following services for which such circuits are suitable: (a) message telegraph service, (b) facsimile transmissions, including voice coordination thereof, of messages, photographs, diagrams, drawings and printed material, (c) the following exchange-type switched services: teleprinter, facsimile, distant writing, and data transmission, including voice coordination of such services, (d) the following private line leased services: Morse, teleprinter, ticker distant writing, facsimile, data transmission, remote control and operation of sensing devices, alarms, signals, displays, controls, computers, or business machines such as tabulating, calculating and sorting machines, and voice transmission, either exclusively or alternately with any such service, (e) telemeter service, (f) ticker service and (g) the remote control and operation of clocks.

**2.05** Contract No. 2 states that the obligation of each party to lease circuits to the other (except under emergency conditions) is limited as outlined in the following paragraphs of Section 6 of that contract as amended:

*Paragraph (a)* "No direct current telegraph circuits of the type specified in item (b) of Schedule A, except those under lease hereunder on June 1, 1958, will be furnished after such date. All circuits of such type under lease hereunder on such date will be furnished, subject to the provisions hereof, for a period of five (5) years thereafter except that if before the end of such five year period the lessee shall terminate the rental of any such circuit upon written notice to the lessor, or the lessor shall give written notice to the lessee that any such circuit is deemed necessary by the lessor for its own public communications business, such circuit will not be furnished after

the date of termination specified in such notice by the lessee or after three (3) months from the date of such notice by the lessor, as the case may be. Any such circuit so terminated upon notification by the lessor will be replaced by a circuit of the type specified in item (c) or item (d) of Schedule A and at the rental provided for therein."

*Paragraph (b)* "With respect to all other types of circuits.

(i) Over routes where the operating needs do not require all the lessor's available circuits of the desired type on the route, circuits will be furnished on demand;

(ii) Over routes where all the lessor's available circuits of the desired type are required by the operating needs, the lessor will undertake as expeditiously as practicable at its own expense to provide additional circuits to meet the combined additional requirements of itself and the lessee, except that where additional construction by the lessor would be required to meet the needs of the lessee, additional circuits need not be provided (otherwise than by special agreement), if in the judgment of the lessor the requirements of the lessee for plant construction are in excess of the probable requirements of the lessor's own business over the route for a reasonable period in the future;

(iii) Where at the request of the lessee, the lessor furnishes circuits with special characteristics, or undertakes other special measures, in order to make the circuits furnished by the lessor suitable for the purpose for which the lessee intends to use them under this agreement, the lessee shall reimburse the lessor as provided in item (f) of Schedule A."

*Paragraph (c)* "The lessor shall not in any case be required to provide a circuit section to any point or into any territory not served by its existing lines, except that the Telephone Company will furnish over lines of itself and other Bell System Companies and the Telegraph Company will furnish over lines of itself, its subsidiary and affiliated companies (subject to the limitations on furnishing circuits herein applying to all companies in-

volved) any circuit section required to reach points on the lines of such other companies, in accordance with arrangements existing among each group of companies from time to time.”

**Paragraph (d)** “Circuits shall be furnished upon written request of the lessee given for such period in advance as shall be reasonable under the particular circumstance. Except as specified in Paragraph (a) of this section, nothing in this section shall require the lessee to relinquish any circuit after it has once been established.”

**Paragraph (e)** “The lessor shall have the right at all times to substitute a circuit section covered by a particular lettered paragraph of Schedule A for another circuit section leased under the same lettered paragraph.” Such substitution, of course, should never be made without reasonable prior notice to the Telegraph Company.

However, as covered in Schedule A, item (a) (1) :

“When the lessor substitutes one circuit section for another, the substitute circuit section shall not, except in times of emergency, be one suitable for a smaller maximum number of channels than the lessor had previously undertaken to provide on the section replaced, without the consent of the lessee.”

**2.06** Contract No. 1 contemplates that the facilities furnished thereunder be “of the general types normally employed in furnishing exchange telephone service, and the lessor shall not be obligated to furnish facilities with special characteristics.” The lessor may, however, when requested by the lessee, furnish facilities with special characteristics, or undertake other special measures, in order to make the facilities suitable for the purpose for which the lessee desires to use them. In such cases charges as provided in Schedule A of Contract No. 1 shall apply. Charges for special construction to make a circuit or circuits available are also covered in Schedule A.

**2.07** Contract No. 1 provides under Section 2(a) that, “the Telephone Company will furnish, install and maintain circuits for the use of the Telegraph Company, in any exchange area served by the Telephone Company, provided that

in the judgment of the Telephone Company such circuits are available over and above the operating needs of the Telephone Company; where circuits are not so available, the Telephone Company will undertake as expeditiously as practicable, subject to construction charges as provided in item 6 of Schedule A, to construct such circuits for the use of the Telegraph Company.”

**2.08** Schedule A of Contract 2 and Paragraph 2.03 of these notes, describe the types of facilities which may be leased under Contract 2. Schedule A also specifies charges applicable when the lessor furnishes a Contract No. 2 circuit section with special characteristics or undertakes other special measures in order to make the circuits suitable for the purpose for which the lessee desires to use them.

**2.09** While Contract No. 2 contains no separate provision for construction charges similar to that found in Contract No. 1, occasions may arise where they should be applied. This may be done under the Contract No. 2 stipulations regarding the obligation to lease circuits. Paragraph 2.05, b(ii) quotes the appropriate contract provision which states that where construction would be required beyond the requirements of the Telephone Company for a reasonable period in the future, it need not be undertaken “otherwise than by special agreement.” As an example — if, in order to meet Telegraph Company requirements for Contract No. 2 facilities, the installation of an additional carrier system or the construction of additional cable facilities is undertaken in advance of planned additions necessary to meet Telephone Company requirements, construction charges will be applied as mutually agreed upon in advance. A separate agreement should be made to cover each case.

**2.10** In those cases where special construction appears necessary, representatives of the Telephone Company and the Telegraph Company should discuss the proposed circuit usage and facility arrangement to the end that any special construction or facility rearrangement is undertaken in the most economical manner which will achieve the desired end result.

**2.11** When assigning leased circuits to Telephone Company facilities, consideration should be given to dispersion of these circuits

among various routes insofar as is practical and among various cable sheaths or channel groups on the same route when entirely different routes are not feasible. The same considerations shall be given to the dispersal of circuits leased to the Telegraph Company as is given to dispersal of Telephone Company circuits.

**2.12** Contract No. 2 circuits requested by Western Union, which are not readily available, should be furnished as expeditiously as practicable. However, a reasonable period will be required to effect connection and, in some cases to provide equipment items required to furnish service.

**2.13** Contract No. 1 provides that circuits furnished for any of the telegraph purposes specified therein (see Paragraph 2.02) shall, by any combination of the Telephone Company's facilities covered by Schedule A (Contract 1) extend only between the following points:

- (1) Two offices of the Telegraph Company.
- (2) An office of the Telephone Company and an office of the Telegraph Company.
- (3) An office of the Telegraph Company and a telegraphically operated agency office of the Telegraph Company, or the premises of one or more of the Telegraph Company's customers.
- (4) Premises of two or more customers of the Telegraph Company, or two or more premises of one customer of the Telegraph Company, or two or more locations on the premises of a customer of the Telegraph Company, provided that in each case the circuit shall be terminated in, or routed through, an office or offices of the Telegraph Company.
- (5) An interexchange circuit of the Telegraph Company from a point of connection on its pole line (or conduit or submarine cable) system or radio beam site and an office of the Telegraph Company or an interexchange circuit of the Telegraph Company at another similar point of connection.
- (6) The terminal of an interexchange circuit of the Telephone Company and the premises of one or more customers of the Telegraph Company in an exchange area where the Tele-

graph Company has no office, provided that the interexchange circuit is connected to an office of the Telegraph Company.

(7) In special cases, by mutual agreement, between an office of the Telegraph Company and an outdoor site, or between two outdoor sites, in the same or nearby exchange, at which terminal equipment of the Telegraph Company is located.

**2.14** Contract 1 circuits leased to the Telegraph Company when used for local termination of interexchange circuits for voice transmission service to one of its customers as provided in item (vii) of Paragraph (a) of this Section 3, or circuits of the Telegraph Company, when used for like purpose, may be terminated in a telephone instrumentality furnished by a telephone company under filed tariffs to the same customer, or in a telephone instrumentality of the United States Military Departments or of the National Aeronautics and Space Administration in cases where interconnection of telephone facilities of such Departments or Administration with facilities of a telephone company is authorized by such telephone company and subject to the conditions of such authorization. Where such telephone instrumentality is suitable therefor, connection of such circuit may be made with telephones and private line voice transmission services connected to such telephone instrumentality, and through such telephone instrumentality with the telephone companies' general exchange and toll networks. Physical connection of local terminal circuits with Telephone Company instrumentalities as authorized by this paragraph shall be made only by the Telephone Company, at charges specified in the Telephone Company's tariffs, and notwithstanding the foregoing provisions of this paragraph, no such connection shall at any time be made or allowed in any jurisdiction except as duly authorized by tariffs in force and effect.

**2.15**

(a) Contract 1 circuits leased to the Telegraph Company for forwarding telegrams by telephone shall connect only:

(1) A telephone order-receiving equipment or telephone set in the Telegraph Company's office and

A PBX or a telephone set in another office of the Telegraph Company, or

A PBX or a telephone set on the premises of a customer of the Telegraph Company, or

A PBX or telephone set on the premises of an authorized agent for the Telegraph Company, or

A coin-box-equipped telephone set in a public location.

(2) A telephone set on the premises of a railroad company which acts as agent for the Telegraph Company and a PBX or a telephone set on the premises of a customer of the Telegraph Company.

(b) Except as otherwise provided in this Paragraph (b), any circuit furnished by the Telephone Company for the purposes specified in Paragraph (a) of this section shall be furnished in its entirety by the Telephone Company and all equipment and equipment wiring connected to such circuit shall be furnished by the Telephone Company. Circuits of the Telegraph Company used for forwarding telegrams by telephone, if not connected at either end to a private branch exchange or other terminal equipment at which circuits may be interconnected, may be connected to telephone order-receiving equipment in which circuits of the Telephone Company terminate. Circuits so provided by the Telegraph Company shall be terminated by the Telegraph Company within buildings at points designated by the Telephone Company, and any additional wiring required between such points of termination and the telephone equipment shall be furnished by the Telephone Company.

(c) The Telegraph Company shall not superimpose any circuit upon, or subdivide, any circuit furnished to it for the purposes specified in Paragraph (a) of this section.

**2.16** Circuits leased to the Telegraph Company under Contract 2 for the purposes specified in Paragraph 2.04 or interexchange circuits of the Telegraph Company when connected to such circuits of the Telephone Company, may be connected for such purposes with circuits owned by:

(1) Other Telephone Companies offering a general telephone service to the public within the continental United States.

(2) The United States Government on military bases, and on reservations of the National Aeronautics and Space Administration.

(3) Electric power, or oil, oil products, or natural gas pipe line companies, or railroad companies where the circuits of such companies are provided primarily to communicate with points along the right-of-way owned or controlled by such company and extending between or beyond exchange areas of the Telephone Company.

(4) Telegraph Companies offering international telegraph service, under filed tariffs, where such circuits are used exclusively in international service and connection is made at terminals within the United States of such circuits.

(5) Telegraph or Telephone Companies, or government-operated telegraph or telephone systems, operating in countries bordering the continental United States, where such circuits are used exclusively in furnishing service between such countries and the continental United States, and connection is made at terminals within the United States of such circuits. But except as otherwise provided in Paragraph 2.17, any other connections of such circuits with circuits owned by any others or of the Telephone Company shall be made only with the written approval of the Telephone Company.

**2.17** Subject to the last sentence of this paragraph, Contract 2 circuits leased to the Telegraph Company hereunder, when used for voice transmission service to one of its customers (2.04), and interexchange circuits of the Telegraph Company when used for like purpose, may be terminated at both ends, via local terminal circuits, in telephone instrumentalities furnished by a telephone company under filed tariffs to the same customer, or in telephone instrumentalities of the United States Military Departments or of the National Aeronautics and Space Administration in cases where interconnection of telephone facilities of such Departments or Administration with facilities of a telephone company is authorized by such telephone company and subject to the conditions of such authorization. Where such telephone instrumentalities at both ends of such circuits are suitable, therefor,

connection of such circuits may be made with telephones and private line voice transmission services connected to such telephone instrumentalities, and through such instrumentalities connection of such circuits may be made with the telephone companies' general exchange and toll networks, it being understood, however, that transmission is not represented as adapted to connection at both ends of such circuits simultaneously. Physical connection of local terminal circuits with Telephone Company instrumentalities as authorized by this paragraph shall be made only by the Telephone Company, at charges specified in the Telephone Company's tariffs. The Telephone Company will file or cause to be filed tariffs authorizing connections with its services as provided by this paragraph, and notwithstanding the foregoing provisions of this paragraph, no such connection shall at any time be made or allowed in any jurisdiction except as duly authorized by tariffs in force and effect.

**2.18** The leasing of duct or pole line attachment space as provided for in Contract No. 1 is subject to the following provisions:

In each lease of duct, separate arrangements shall be made by the parties regarding the period of the lease and the provisions for the relinquishment of the duct.

In the common use of poles by the parties hereto, the lessor shall have the right to specify the locations of wires of the lessee and the spacings of pins and crossarms. Circuits of the lessee occupying space on poles or in ducts of the lessor shall be so operated and maintained by the lessee as not to interfere with or impair the service of the lessor or the service of its associated, affiliated or connecting companies, cause damage of their plant, impair privacy of any communications over circuits of the lessor or such companies or create hazards to the employees of any of them or the public. The lessor shall have the right to terminate the use of any duct or space for pole line attachments provided hereunder in case such circuits shall not be so operated and maintained, and to inspect any such circuits in order to determine compliance herewith.

The expense to be borne by each party shall be agreed upon before either party rearranges or rebuilds its pole lines or ducts to provide space for the other.

The lessee shall bear the cost of transferring its own attachments or other facilities in cases of relocation or replacement of poles or conduits.

Charges for the use of space on poles or in ducts shall date from the first day of the calendar month in which space is occupied or reserved.

The lessee may remove any of its pole line attachments at any time and upon removal shall then advise the lessor. Charges shall be computed to the end of the month in which advice of removal is received by the lessor. The lessor may require the lessee to remove its pole line attachments upon giving six (6) months' written notice to the lessee.

The lessor shall be responsible for compliance with all conditions and obligations relating to compensation for the use of duct or attachment space in favor of any third party and shall protect and save harmless the lessee from such claims in favor of such third party, unless the parties otherwise agree.

Duct and space for pole line attachments furnished pursuant to this Section 8 shall be furnished under the conditions and at the charges specified in Schedule C. Furthermore, the lessee shall pay the charge shown in Schedule C for any duct or attachment space reserved for its future use at its request.

**2.19** The characteristics and methods of operation of any equipment or circuits provided by the lessee and associated with the circuits furnished under Contracts 1 or 2 shall be such as not to interfere with or impair service over any circuits of the lessor or the service of its associated, affiliated or connecting companies, cause damage to their plant, impair privacy of any communications over circuits of the lessor

or such companies or create hazards to the employees of any of them or the public. The lessee shall bear the cost of any additional protective apparatus reasonably required to be installed because of the use of the circuits by the lessee. The lessor shall have the right to terminate the use of any circuits provided hereunder in case the characteristics or methods of operation of such equipment or circuits of the lessee shall not be satisfactory in any of the foregoing respects, and to inspect any such equipment in order to determine compliance herewith.

**2.20** The transmission and signaling design characteristics applied by the Telegraph Company to leased or owned circuits, when connected to Telephone Company circuits or instrumentalities shall be of as high a standard as that established by the Telephone Company for circuits used by it in providing comparable service. The lessee shall provide at its expense, any equipment necessary to render such circuits suitable for operation with lessor's circuits, instrumentalities or services with which they are connected.



## ENGINEERING NOTES

### CONTRACT NUMBERS 1 AND 2 BETWEEN THE BELL SYSTEM TELEPHONE COMPANIES AND THE WESTERN UNION TELEGRAPH COMPANY

## SECTION III

### TELEGRAPH AND DATA FACILITIES

#### Circuits for Data or Facsimile Transmission (Contract No. 1)

**3.01** As mentioned in Paragraph 2.01 of Section II, Contract No. 1 covers the lease of pairs of wires of the general types normally employed in furnishing exchange telephone service. The Telephone Company is not obligated to furnish circuits having special characteristics. However, within this limitation, where there is a choice to be made of the type of facility to be furnished, the selection of the layout should, if practicable, be such that data or facsimile transmission would be satisfactory over the layout.

**3.02** Contract No. 1 provides for furnishing repeaters for facsimile operation or data transmission for frequencies from 100 to 5,000 cycles or from 50 to 15,000 cycles per second if required. These repeaters would be furnished for one-way transmission. Where repeaters are provided, the Telephone Company must also provide equalizers to correct the amplitude response of the circuit over its nominal bandwidth up to the input of the repeater. (Measurements required for adjusting equalizers may be made at the repeater output if this is advantageous.) For example, if a Contract No. 1 circuit is to be used with a Contract No. 2, Class 2 data circuit section, a 50- to 15,000-cycle repeater (line amplifier) might be required. The amplitude-frequency characteristics of the Contract No. 1 circuit must then be equalized up to the input of the repeater. Standard local program channel practices should be followed. The balance of the circuit must be capable of being similarly equalized by the Telegraph Company. Correction of the amplitude-

frequency characteristics of the circuits beyond the repeater would not be provided by the Telephone Company except at the input of a subsequent (Telephone Company) repeater. It is contemplated that such repeaters would be located only in Telephone Company offices. Standard circuit layout and maintenance procedures normally associated with each repeater type would apply. (See Fig. 1C).

**3.03** Where Contract No. 1 circuits are used for facsimile service, the contract permits the Telegraph Company to derive simplex or composite leg from the cable pair. It will, therefore, be necessary to furnish some repeaters under Contract No. 1 to maintain continuity of the circuit simplex or composite legs. Where this is required the Telephone Company will be so notified by the Telegraph Company. Use of the simplex or composite leg is restricted to "synchronization, supervisory signaling and control associated with facsimile operation." Standard simplex or composite bypass arrangements may be used. (See Fig. 1C).

**3.04** In many cases the Telegraph Company will wish to operate its "Desk-Fax" equipment over a Contract No. 1 circuit. This equipment employs two-way transmission and requires that the circuit net loss not exceed 18 db at 1000 cycles and 25 db at 2500 cycles, that the loop resistance not exceed 3000 ohms and the simplex be continuous. If the available facilities do not meet these requirements and unusual equipment or facilities must be used, the Telephone Company will so advise the Telegraph Company.

**3.05** The Telegraph Company should, in general, apply amplitude-modulated facsimile signals to Telephone Company facilities at a maximum level of 1 milliwatt (0 dbm). This level is a general guide, and specific cases should be treated in accordance with the requirements discussed in Part 5 of these Notes. The interference curve in Fig. 3 of Section 5 is the "remote" chance (1 in 1000) curve and assumes that program circuits are included in the noise-exposed group. If there are no program circuits among those exposed, then the level of 1 milliwatt mentioned above is slightly conservative for local facilities at the Telegraph Company's carrier frequencies of 2000 and 2400 cycles per second. On the other hand, if 8 or 15 kilocycle program circuits are subject to the noise influence of a facsimile circuit, then the level of 1 milliwatt (0 dbm) may have to be reduced.

**3.06** If facsimile or data signals are used which employ some kind of phase or frequency modulation, they should be applied to Telephone Company facilities at a maximum total power level of -8 dbm.

**3.07** Where voice or greater bandwidth circuits are involved, the two Companies will interconnect at a nominal impedance of 600 ohms, balanced. The circuit should be isolated from ground at all times except when the circuit simplex or composite leg is being used.

**3.08** Where circuits furnished under Contract No. 1 are intended for connection to facsimile or data circuit sections of Class 1, 2 or 3 (see Paragraph 3.10 for definitions) furnished under Contract No. 2 the Telegraph Company will so specify on the initial order. If the normal exchange facilities are not suitable for extension of the Contract No. 2 section and it appears that special construction or intermediate repeaters will be required, the Telephone Company will so advise the Telegraph Company.

**Circuit Sections Suitable for Data or Facsimile Transmission (In One Direction) (Contract No. 2)**

**3.09** Circuit sections may be provided under Contract No. 2 which are nominally of voice-bandwidth; these may also be referred to as type (a) (1) circuit sections. In some cases these circuits will be suitable for data or facsimile transmission and may be so used.

**3.10** Circuit sections provided under Contract No. 2 may be of wider than voice-bandwidth. These are furnished as type (a) (2), and further identified as follows:

| CLASS                   | APPROXIMATE RANGE OF FREQUENCIES |
|-------------------------|----------------------------------|
| Class 1 circuit section | 100 to 5,000 cycles per second   |
| Class 2 circuit section | 50 to 8,000 cycles per second    |
| Class 3 circuit section | 50 to 15,000 cycles per second   |

**3.11** The 5, 8 or 15 kc circuits will be furnished for transmission in one direction only. These circuits should be furnished in the same way and to the same standards as program circuits of the same nominal bandwidths.

**3.12** Where Contract No. 2 circuits are furnished of type (d), Paragraph 2.03, and are used by the Telegraph Company for facsimile operation, continuity of the simplex or composite leg may be required around repeating coils as discussed in Paragraph 3.03 for Contract No. 1 circuits.

**Circuit Sections Suitable for Direct Current Telegraph (Contract No. 2)**

**3.13** As mentioned in Paragraph 2.03 of Section II, Contract No. 2 provides for the furnishing of three different types of circuit sections suitable for direct current telegraph transmission. These are called (1) "inoperative" [type (b)] (2) "fully operative" [type (c)] and (3) those having exclusive use of a pair of wires [type (d)].

**3.14** Inoperative derived circuit sections for direct current telegraph transmission in addition to those under lease at the time of the effective date of Amendment 2 to Contract No. 2, will not be furnished. All such circuits under lease on that date, however, may remain in service under terms set forth in the amendment. Circuits of this class which have been furnished by the Telephone Company are of two general types.

- (a) For grounded operation. Simplexed side or phantom, or one leg of a composited side of phantom, or a combination of these.

*Use.* Such a section may be used for half duplex, full duplex, one way or as a neutralizing wire for a similar parallel section.

(b) For low current metallic operation a section consists of two composited legs of one pair in cable.

*Use.* Such a section may be used for half duplex, full duplex, one way or as one path of a four-wire metallic circuit.

*Note:* Neutralizing wire operation, two path polar or four-wire low current metallic require two paralleling sections.

The successful use of a single path for full duplex operation will depend on the ability of the Telegraph Company to maintain as good a balance as required between the line and artificial line on the section involved. Any telegraph repeater, equalizing, wave shaping, crossfire neutralizing or noise reducing devices required will be provided by the Telegraph Company. Any matters pertaining to coordination of Telephone Company plant with that of power companies will be handled by the Telephone Company. All composite sets and simplex coils will be furnished by the Telephone Company.

**3.15** The Telegraph Company's use of these facilities will be subject to the same broad physical limitations, i.e., length of repeater section, speed of operation and types of repeaters, which govern Bell System use. These types of facilities are normally used for transmission of teletypewriter pulses at line signaling speed of up to 28 cycles per second (sometimes stated as 28.5 dot cycles) and it may be expected that the Telegraph Company will in most cases use comparable speeds.

**3.16** A fully operative circuit section as covered in item (c) of Schedule A of Contract No. 2 may be defined as one which, if a teletypewriter be connected to it at each of its two terminals, either directly or by means of the assigned local channel, will permit the transmission of 7.42 unit teletypewriter code signals at the rate of 75 or 100 words per minute without requiring any other equipment or power supply. The lessor may employ any type of telegraph system, current supply or line facility which it

may elect so long as this over-all result is obtained. However, consideration should be given to provision of an arrangement most compatible with the Telegraph Company's equipment in order to avoid cumbersome and uneconomical interconnection arrangements. In this regard, type 128C subscriber sets are rather inflexible where the circuit is being extended beyond the end of the circuit section. When the use of a 128C set would cause difficulty, alternative mutually agreeable arrangements may be used which do not require additional expense by the Telephone Company. Circuit sections are furnished by the Telephone Company to the Telegraph Company exclusive of teletypewriters or similar transmitting or receiving devices. Individual sections provided shall be suitable for the transmission of teletypewriter signals at a line signaling frequency up to 28 dot cycles per second. Operation may be one way, half duplex, or full duplex as required by the Telegraph Company. At the Telegraph Company's offices these sections may be connected to a teletypewriter, telegraph repeater, other equipment, or another circuit.

**3.17** In general, where fully operative telegraph circuits are provided, the channel terminating equipment (telegraph repeaters, carrier telegraph terminal, etc.) should be located at the principal central office of the Telephone Company. In some special cases, however, where the location of the channel terminating equipment in the Telephone Company's office would result in substantial cost penalties to the Telephone Company or impaired performance, it will be advantageous for such channel terminating equipment as 130B1 sets or 128-type sets to be located at the office of the Telegraph Company or its patron or possibly in some other mutually satisfactory location.

**3.18** Fully operative circuit sections should be assigned to telegraph channels which provide satisfactory teletypewriter service at speeds up to 28 dot cycles per second. These sections may be either direct current or carrier circuits or combinations of both. It is expected that the 43A1 carrier telegraph system will be widely used for furnishing fully operative facilities. It will generally be necessary to interconnect the loop side of the 43A1 terminal or repeater which terminates the fully operative circuit with the equipment in the Telegraph Company's office.

Such interconnection may be on a one-wire or two-wire basis as desired, provided the equipment used and the transmission conditions permit. This interconnection, in cases where the Telegraph Company equipment is not designed to operate on a neutral basis or to supply the required voltage or polarity, will require the use of additional direct current repeaters aside from those required for proper operation of the line facility. Where such repeaters are required they should be furnished by the Telegraph Company. Also where the connection of a fully operative circuit section of the type covered in item (c) of Schedule A of Contract No. 2 to another similar section, or to a circuit provided by the Telegraph Company, requires a regenerative repeater for satisfactory operation, this repeater shall be furnished by the Telegraph Company. If practicable, the Telephone Company's choice of terminating equipment should be compatible with that used by the Telegraph Company.

**3.19** Figs. 2A to 7D, inclusive, indicate typical arrangements to be followed for connection of fully operative sections to, or at, the Telegraph Company's office or patron's office. As indicated on the figures, the normal operating loop current values will be between .060 and .065 amps. The loops may be operated as pairs of wires or as single conductors terminating at one end in the Telephone Company's office and at the other end in the Telegraph Company's or patron's office. The wiring and equipment of the Telephone Company will be separated from that of the Telegraph Company by a terminal strip or block known as a demarcation strip. The figures show such a demarcation strip for those cases where teletypewriter subscriber sets are involved. The cable terminal should not serve as a demarcation strip.

**3.20** All of the arrangements shown on the figures are not always available. The types of loop arrangements available will depend upon the method which the Telephone Company uses to provide the line facility. The most common types of loop circuits in the Telephone Company's plant are the balanced loop shown on Figs. 3A to 4C and the electronic loop shown on Figs. 5A to 5D. Of less frequent occurrence are the open and close type of loop shown on Figs. 2A to 2C. For outlying point operation where the service point is at some distance from a major

toll office, it may be desirable as previously discussed to employ 128B2 or 130B1 subscriber sets and in some cases 128C-type sets as indicated on Figs. 6A to 7B. One type of loop circuit may fit the Telegraph Company's equipment better than another. Since the selection of the type of line facilities, subscriber sets, repeaters, etc., influences the drop or loop side, those to be used should be selected, where practicable, so that the drop or loop will best meet the Telegraph Company's requirements. Discussions of the available options between the representatives of the Telephone Company and the Telegraph Company in the early stages of planning circuit additions and changes should be helpful.

**3.21** Balanced loops (Figs. 3A to 4C) are employed where the Telephone Company's circuit section employs 40-type carrier telegraph, low current metallic telegraph or direct current grounded telegraph where main line-type terminal telegraph repeaters are employed. The balanced loop employs + and - 130-volt potentials, and in general, must terminate in a potential equal to and of the same polarity as the spacing potential sent to the loop by the telegraph terminal. Electronic loops (Figs. 5A to 5D) are employed where 43A1 carrier telegraph sections are used, or where No. 2 or 9B service boards are employed in the Telephone Company's office. With electronic loops the signals are formed at the central office by the action of electronic tubes, and the permissible variation of battery potentials and polarities is limited. In general, balanced and electronic loops are the rule in the larger toll offices. Electronic loops, however, may also be found in the smallest offices. Open and close loops (Figs. 2A to 2C) are rather rare. They may be encountered in small outlying offices, where single line telegraph repeaters are used in connection with extending loops which are too long for operation without some type of repeater.

**3.22** The 128C-type set provides a two-loop half duplex type of termination only. It is intended for connection to a teletypewriter only (or equivalent neutral circuit) and not for connection to the loop circuit of another telegraph repeater or carrier terminal which operates on other than a neutral basis. It must be located within a few hundred feet of the teletypewriter.

**3.23** The 128B2 set provides half duplex transmission only. It has an optional loop connection providing for either single-loop, two-loop neutral receiving or two-loop polar receiving. The single-loop option permits the extension of the loop to a maximum of about 12 miles of 19 gauge cable. The loop of the 128B2 set may be extended to a distant teletypewriter by means of a single conductor, where transmission conditions permit, provided it is terminated at the outlying end in a resistance connected to ground. The resistance should be adjustable to provide .060 to .065 ampere loop current and should be shunted by a 1 mf capacitor. In cases where it is necessary to employ a 128B2 set at one end of a circuit and a 128C-type set at the other, the 128B2 set should be employed at the end which may require that the loop be extended to some distance beyond the subscriber set.

**3.24** The 130-type set may be arranged to extend the loop circuit on either a half duplex or full duplex two-loop basis, to a maximum of 800 ohms, including the teletypewriter, if only one polarity of 130-volt loop battery is employed. Each loop circuit may be a two-wire loop or, where transmission conditions permit, a single conductor. If extended on a single conductor basis, a source of +130 volts should be provided by the Telegraph Company at the distant end of the circuit. The Telegraph Company may supply 110 to 120 volts potential in which case the 800 ohms range will be reduced. An external resistance must also be provided to adjust the total external resistance including the teletypewriter and the conductors to 800 ohms for 130-volt battery or 640 ohms for 120-volt battery at the distant end of the loop.

**3.25** In some cases the provision of full duplex rather than half duplex facilities will require additional expense by the Telephone Company. In such cases, therefore, since both types of operation are furnished for the same charges, it is expected that the Telegraph Company will accept half duplex facilities unless its operation requires full duplex or unless the interconnection of facilities is greatly simplified thereby. In some cases, to simplify interconnection, the Telegraph Company may specify full duplex on one end and half duplex on the other even though operation overall is half duplex.

**3.26** All fully operative circuits must be extended to an office of the Telegraph Company at one or both ends. This is true even though no equipment is required or provided at the Telegraph Company's office. See Paragraphs 2.06 and 2.09 of Section II.

**3.27** Fig. 8 shows the compatibility of various Telegraph Company and Telephone Company dc telegraph arrangements.

**3.28** Circuit sections suitable for direct current telegraph using exclusively a pair of wires in cable or an open wire (a single wire of an open wire line) in general will be used in cases where the section lengths are short. These sections will be connected at the Telegraph Company's office to telegraph repeaters, teletypewriters, Morse sets, other equipment or other circuit facilities. Where transmission conditions permit each conductor of a pair may be used at the option of Telegraph Company as a separate circuit. As described in Paragraph 2.02 of Section II, the Telegraph Company may use any circuit section furnished under Contract No. 2 for purposes other than printing telegraph service. It is possible, therefore, that where the facilities are suitable, the Telegraph Company may use such sections for facsimile, data, etc. However, Contract No. 2 makes no provision for furnishing repeaters to connect to such section; it states that, "A two-point circuit section furnished pursuant to this item (d) shall be furnished on a nonoperative basis, i.e., without repeaters, battery, etc."

#### **Circuit Sections Suitable for Voice-Frequency Transmission (Contract No. 2)**

**3.29** Contract No. 2 specifies that circuit sections suitable for voice-frequency transmission, also referred to as type (a) (1) circuits, "shall be suitable for a minimum of 12 telegraph carrier channels in each direction such as are provided by the Bell System type 40C1 carrier system." The contract further specifies that "no additional charge will be made in cases where the lessor furnishes at its option circuit sections suitable for not more than 18 such type 40C1 carrier telegraph channels." In certain cases, such circuit sections will be suitable for data, facsimile, or some service other than carrier telegraph and may be so used. (See Paragraph 3.09.)

**3.30** The Telegraph Company has the right to create additional communication channels within the voice-frequency range (200-3000 cycles) from circuits it leases from the Telephone Company, by subdivision of the frequency band, time subdivision or in the case of wire pairs by using each wire as a separate circuit. The above statement is not intended to imply that the usable frequency range of voice-frequency circuits leased from the Telephone Company will necessarily have lower and upper limits of 200 and 3000 cycles, respectively.

**3.31** Whenever it becomes necessary to reassign facilities of the type suitable for voice-frequency transmission, the following contract provision is important. "When the lessor (Telephone Company) substitutes one circuit section for another, the substitute circuit section shall not, except in times of emergency, be one suitable for a smaller maximum number of channels than the lessor (Telephone Company) had previously undertaken to provide on the section replaced, without the consent of the lessee (Telegraph Company)." Such substitution, of course, should not be made without reasonable prior notice to the Telegraph Company.

**3.32** Circuit sections intended for the application of voice-frequency carrier telegraph systems by the Telegraph Company should be assigned to circuit facilities of the type normally provided for the operation of the Bell System 40C1 voice-frequency telegraph carrier system. Circuits having the same characteristics are usually provided for the Bell System 43A1 system when used for the office-to-office operation of complete systems. Considerations involved in engineering the circuit layout for voice-frequency carrier telegraph systems are discussed in other literature and should be followed by the Telephone Companies, where applicable. There is a transmission advantage in avoiding the use of compandors. If local practice provides noncompandored channels for Telephone Company VF systems, then the sections furnished for the Telegraph Company should be treated accordingly. When the removal of compandors is requested by the Telegraph Company charges as specified in Schedule A shall apply.

### **3.33**

(a) One system known as the type 70 system provides eight channels spaced 300 cycles apart utilizing a spectrum of 970 to 3,230 cycles.

The loop circuit of the type 70 system is of the electronic type utilizing 12-volt potentials and operating on a polar basis. These channels carry circuits operating up to 180 bauds and cannot be interconnected with Bell System VFCT's or repeaters.

In some cases voice-frequency circuit sections may carry both type 70 channels and the narrow-band types described in (b).

(b) Narrow-band systems having channels spaced 150 cycles apart are known as types 20, 30, 40, and 60. These channels are in widespread use and each provides two groups of eight or ten channels each. The over-all spectrum required for two 10-channel groups is 340 to 3,260 cycles. The chief difference between the type 20 and the 30's, 40's, and 60's is that the latter three employ a relay for the receiving branch which simplifies the requirement for interconnecting repeaters. The loop circuit of the type 20 is of the electronic type similar to that of the 43A1 systems. Where it is desired to interconnect a type 20 channel and a 43A1 channel it is usually necessary to use an interconnecting dc repeater as shown in Fig. 5E.

Other FSK systems used by Telegraph Company for data provide for transmission at 300, 600, 1200 and 2400 bauds.

**3.34** A channel group may consist of one or more channels of the types described in Paragraph 3.33. Various combinations of these channel types may be used in a given group. The output level per channel at the telegraph office into the loop to the telephone office should always be -17 dbm. The level per channel at the Telephone Company secondary testboard into the loop to the telegraph office should always be -17 dbm. Therefore, the level of an individual telegraph channel received at the Telegraph Company office will always be below -17 dbm attenuated by the amount of the loss of the inter-office section. (See Fig. 1.)

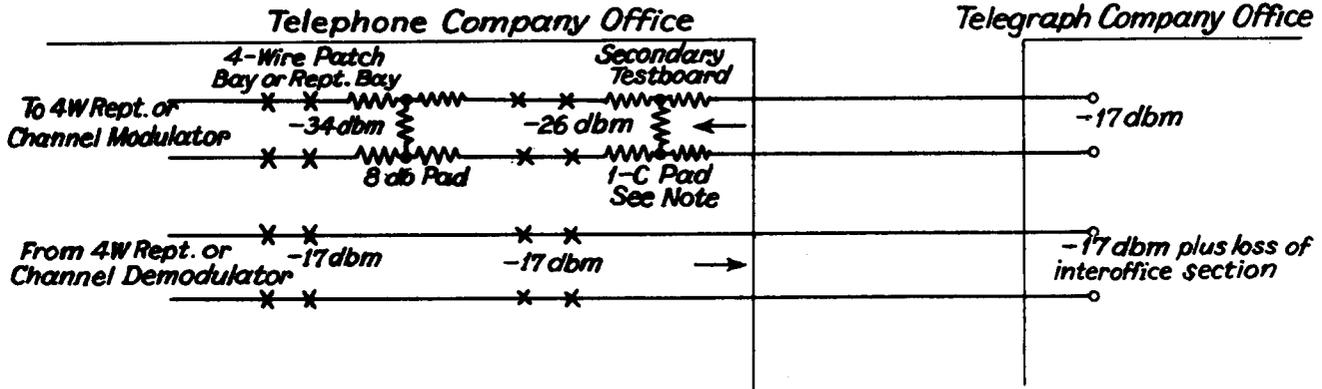
**3.35** The net loss frequency characteristic of the interexchange circuit sections furnished to the Telegraph Company should be comparable to those provided for 40C systems. The net loss frequency requirements are as follows:

| <b>FREQUENCY (cps)</b> | <b>ALLOWABLE DEVIATION<br/>FROM REFERENCE LOSS (db)</b> |
|------------------------|---|
| 1000                   | Ref.  |
| 425                    | -4.5 to +4.5  |
| 500                    | -4.0 to +4.0  |
| 1000                   | -0.5 to +0.5  |
| 1900                   | -3.4 to +3.4  |
| 2500                   | -4.5 to +4.5  |

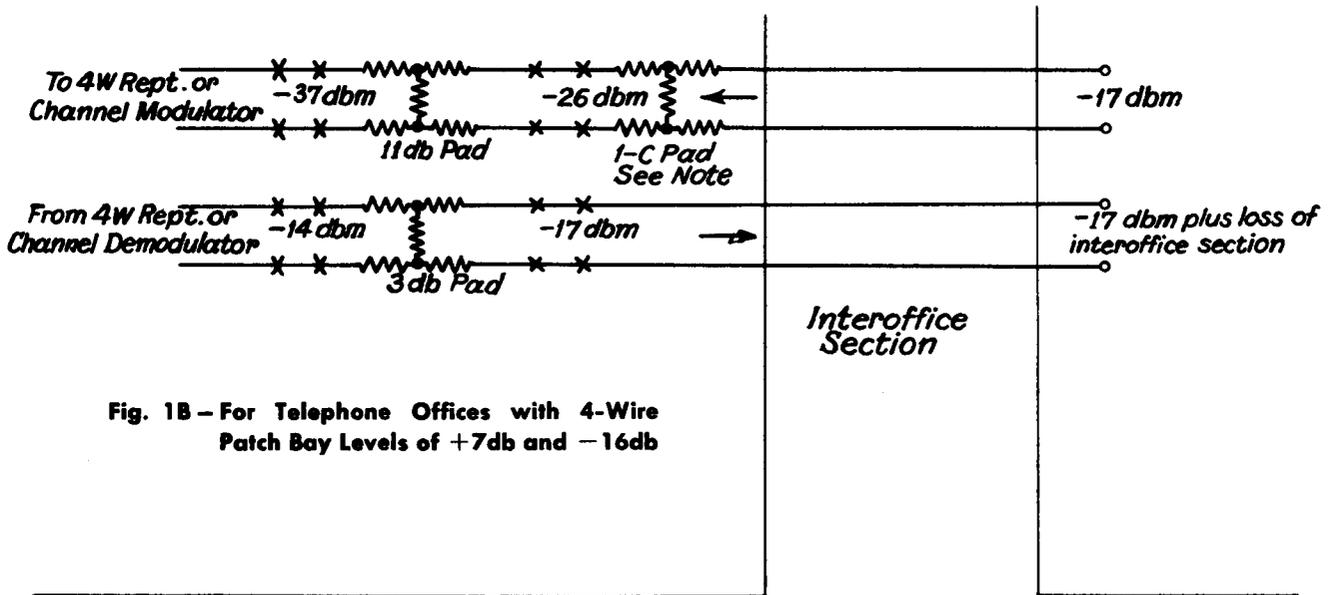
**Attachments:**  
**Figs. 1 through 8**

**3.36** Emergency facilities are sometimes furnished temporarily to the Telegraph Company to replace Telegraph Company plant which is out of service. These emergencies are defined in Contract No. 2 as occasions when regular facilities are not available due to "storm, flood, fire or similar causes." During such times of stress the Telegraph Company will usually order such facilities, when available, at the testroom level. The Telegraph Company will follow normal practices relating to levels, currents and voltages in using such emergency facilities. In order to expedite the restoration of service under such conditions, the Telegraph Company will accept type (a) (1) (voice-frequency grade) circuit sections with level deviation of  $\pm 3$  db from normal.

**TYPICAL INTERCONNECTION ARRANGEMENTS FOR  
CIRCUIT SECTIONS FOR V.F. TELEGRAPH SYSTEM APPLICATION**

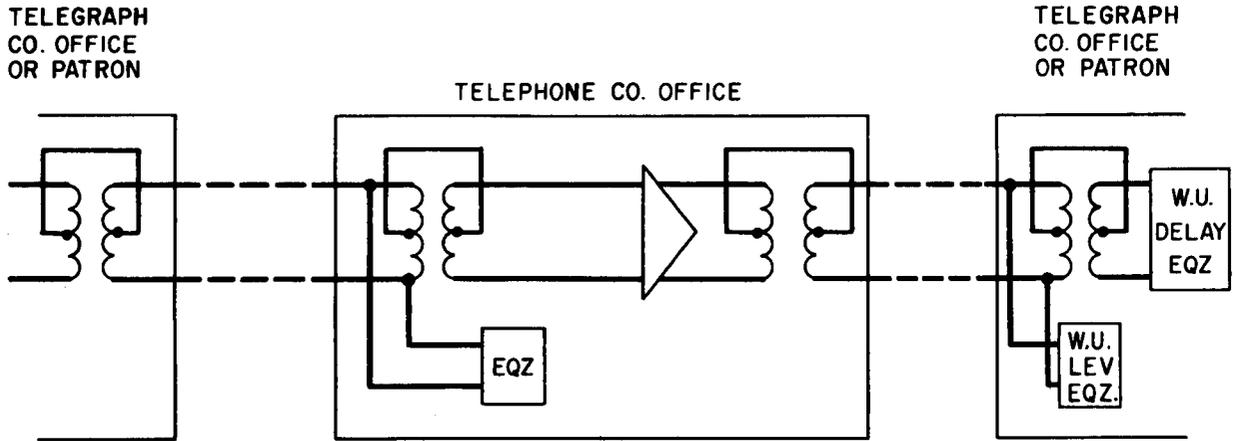


**Fig. 1A – For Telephone Offices with 4-Wire Patch Bay Levels of +4db and -13db**



**Fig. 1B – For Telephone Offices with 4-Wire Patch Bay Levels of +7db and -16db**

**Note:** Loss of cable section plus loss of 89-type resistance should total 9 db.

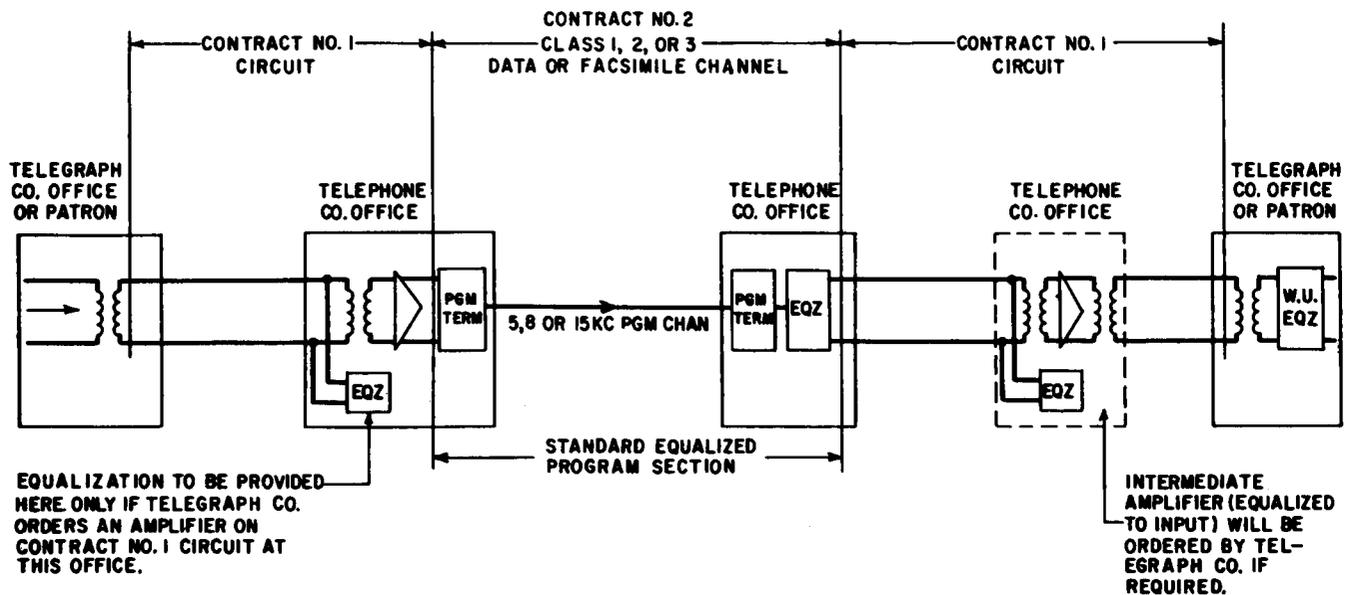


**Notes:**

1. Telephone Company amplitude equalizers and an intermediate repeater are shown in customary locations. The Telegraph Company delay equalizer might be located at either end of the circuit.
2. Continuity of Simplex may or may not be required.

**Fig. 1C – Typical Intraexchange Data or Facsimile Channel with Amplifier and Equalization**

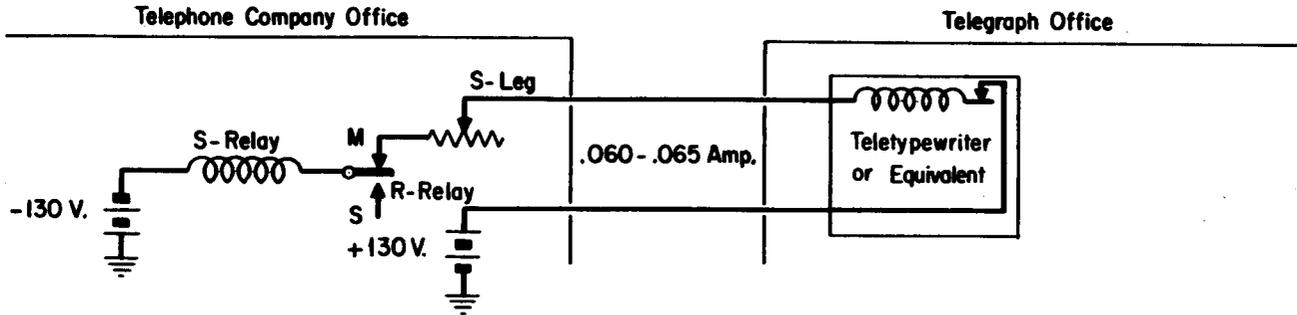
(Furnished under Contract No. 1)



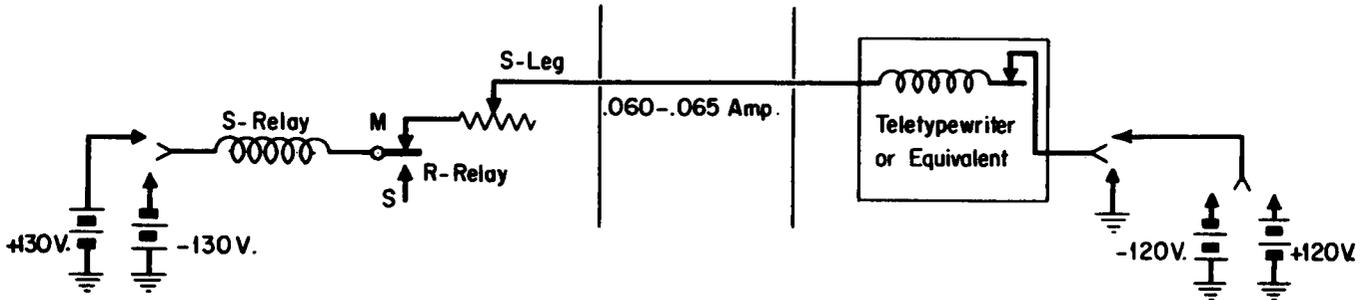
**Fig. 1D – Illustration of Typical Arrangement of 5, 8, or 15kc Data or Facsimile Facilities**

**FULLY OPERATIVE CIRCUIT SECTIONS  
TYPICAL METHODS OF CONNECTING TO TELEPHONE COMPANY OFFICES**

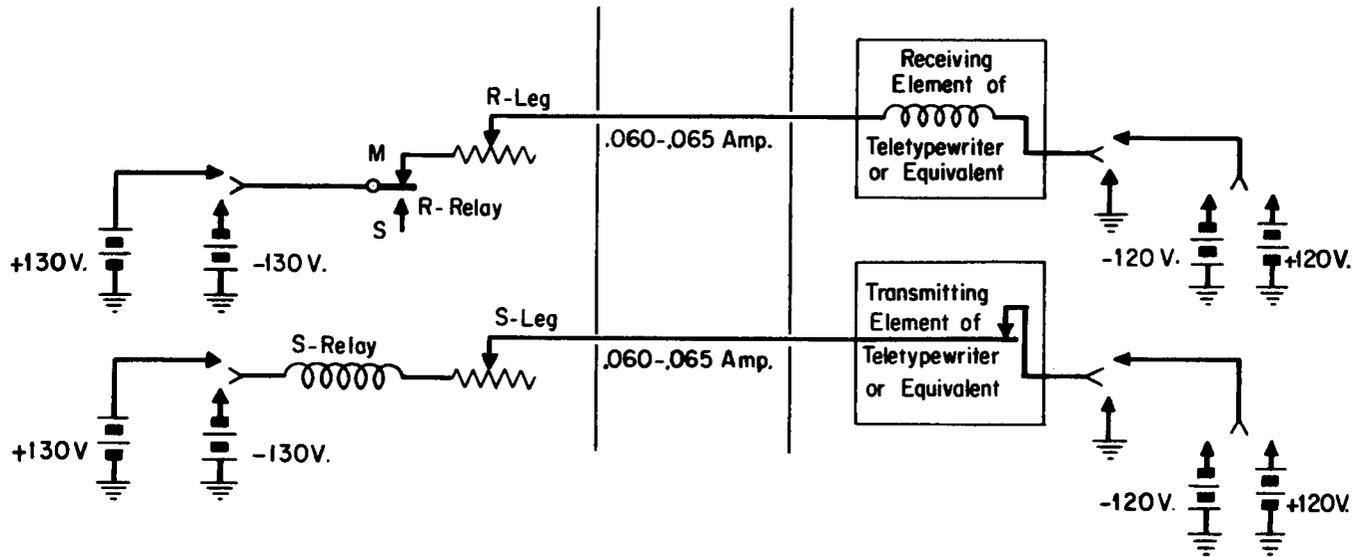
**Applicable Where Telephone Company Line Facility Terminates  
in Single Line or One Way Repeater**



**Fig. 2A - Series Loop Arrangement - Half Duplex Operation  
(2-Conductor Loop)**



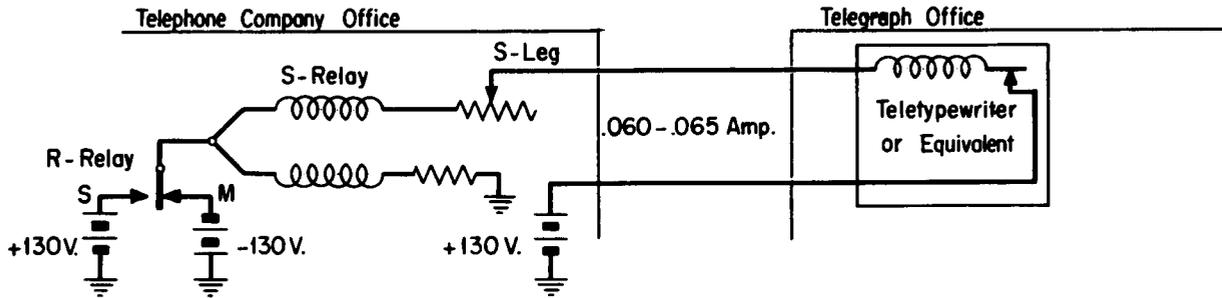
**Fig. 2B - Series Loop Arrangement - Half Duplex Operation  
(1-Conductor Loop)**



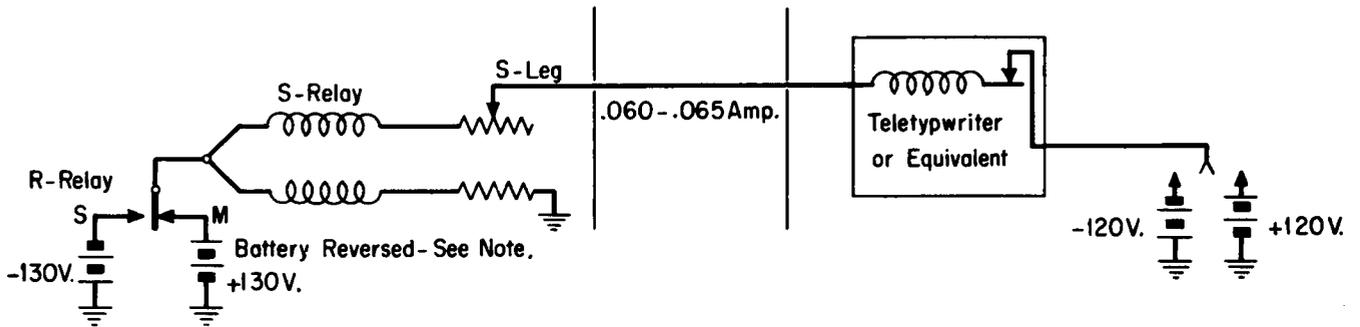
**Fig. 2C - Series Loop Arrangement - Full Duplex Operation  
(Split Loop)**

**FULLY OPERATIVE CIRCUIT SECTIONS  
TYPICAL METHODS OF CONNECTING TO TELEPHONE COMPANY OFFICES**

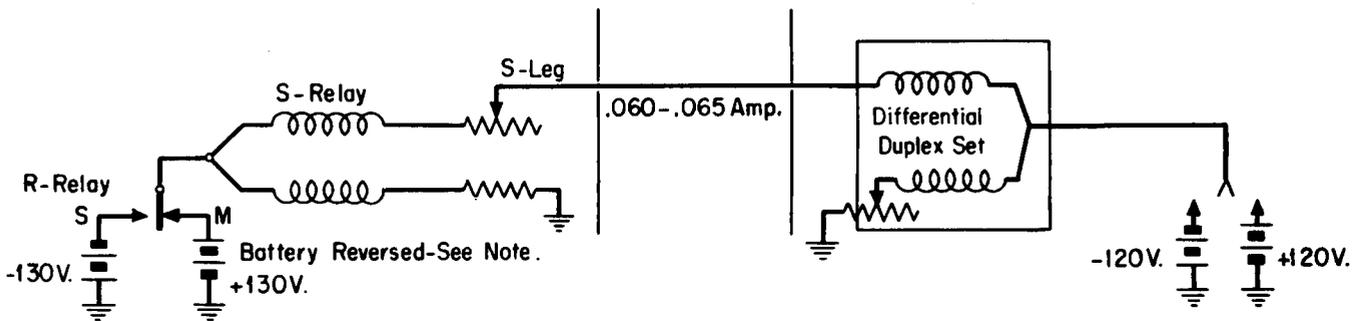
**Applicable Where Telephone Company Line Facility Terminates in 40 Type Carrier, 20 Type Metallic or 16 Type Grounded Repeater Half Duplex**



**Fig. 3A – Balanced Loop Arrangement — Half Duplex Operation  
(2-Conductor Loop)**



**Fig. 3B – Balanced Loop Arrangement — Half Duplex Operation  
(1-Conductor Loop)**

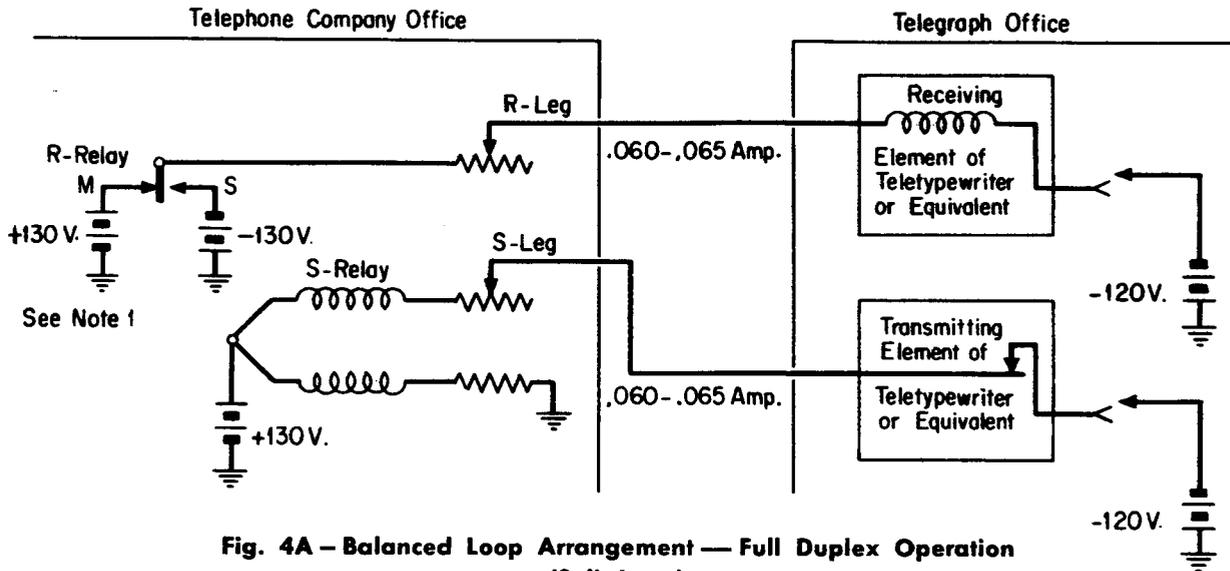


**Fig. 3C – Balanced Loop Arrangement — Half Duplex — Duplex Repeater at  
Telegraph Office  
(1-Conductor Loop)**

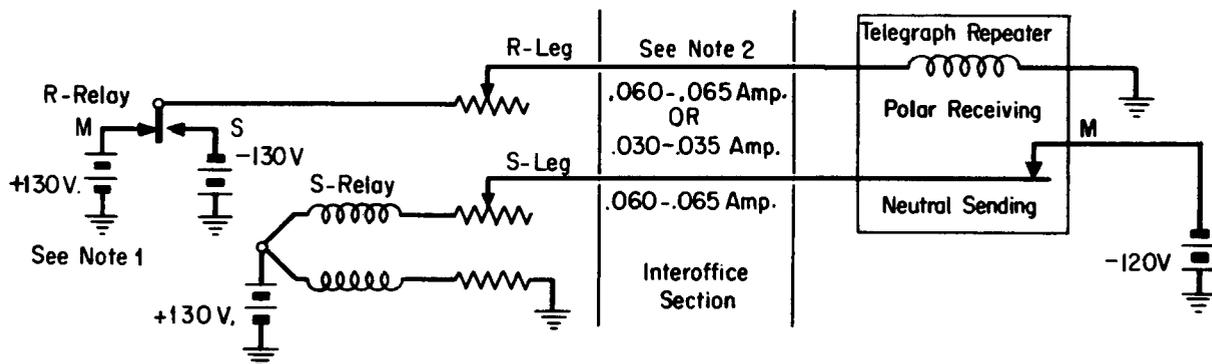
**Note:** M and S Batteries at Telephone Company Office may be interchanged in all cases where Balanced Loops are used.

**FULLY OPERATIVE CIRCUIT SECTIONS  
TYPICAL METHODS OF CONNECTING TO TELEPHONE COMPANY OFFICES**

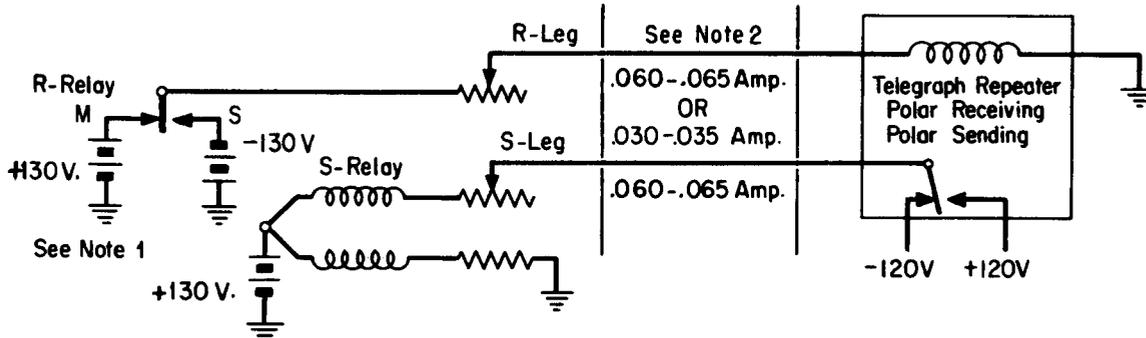
**Applicable Where Telephone Company Line Facility Terminates in 40 Type Carrier, 20 Type Metallic or 16 Type Grounded Repeater Full Duplex**



**Fig. 4A - Balanced Loop Arrangement - Full Duplex Operation  
(Split Loop)**



**Fig. 4B - Balanced Loop Arrangement Full Duplex - Repeater at  
Telegraph Office  
(Split Loop)**

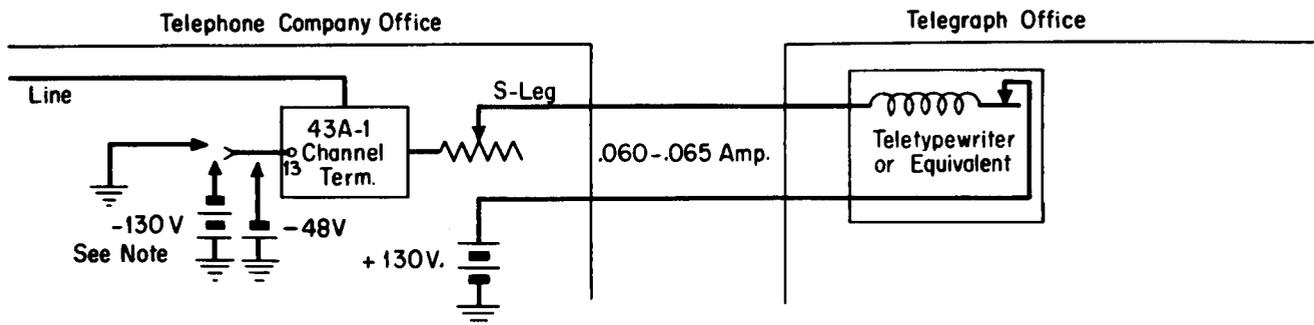


**Fig. 4C - Balanced Loop Arrangement Full Duplex - Repeater at  
Telegraph Office  
(Split Loop)**

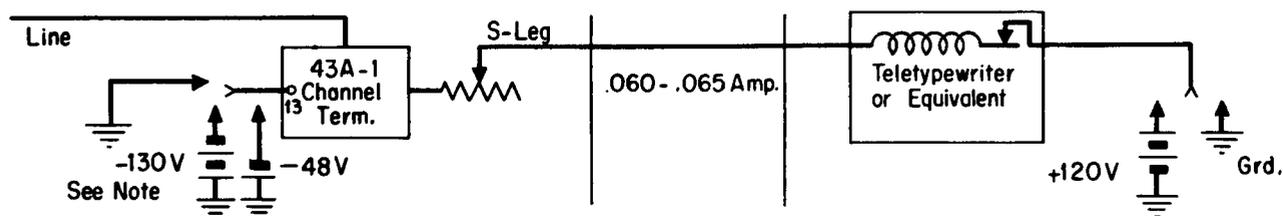
**Note:** M and S Batteries at Telephone Company Office may be interchanged if required.

**FULLY OPERATIVE CIRCUIT SECTIONS  
TYPICAL METHODS OF CONNECTING TO TELEPHONE COMPANY OFFICES**

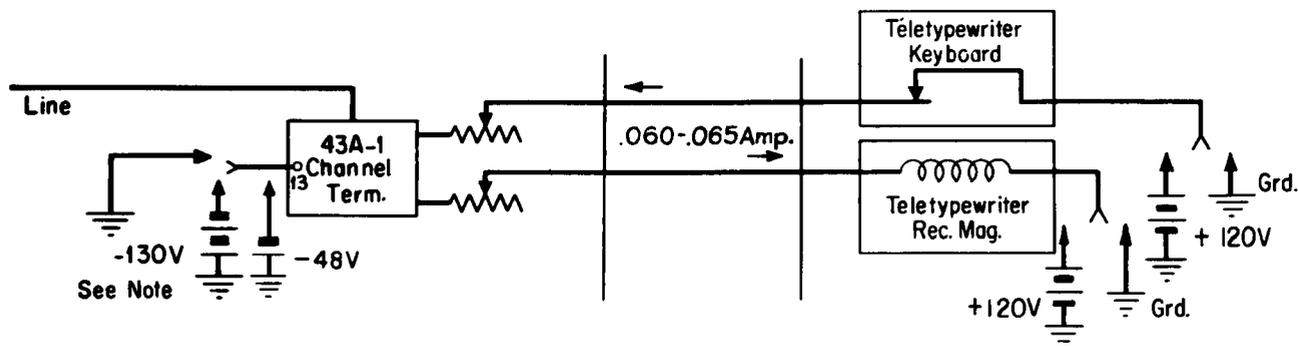
**Applicable Where Telephone Company Line Facility Terminates  
in 43A1 Carrier Terminal**



**Fig. 5A — 43A1 Carrier Telegraph — Half Duplex Operation  
(2-Conductor Loop)**



**Fig. 5B — 43A1 Carrier Telegraph — Half Duplex Operation  
(Single-Conductor Loop)**

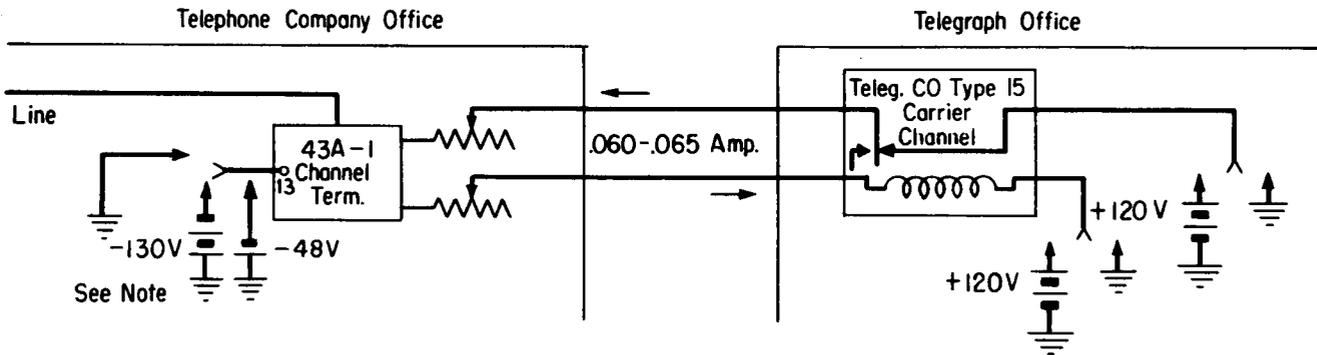


**Fig. 5C — 43A1 Carrier Telegraph — Full Duplex Operation**

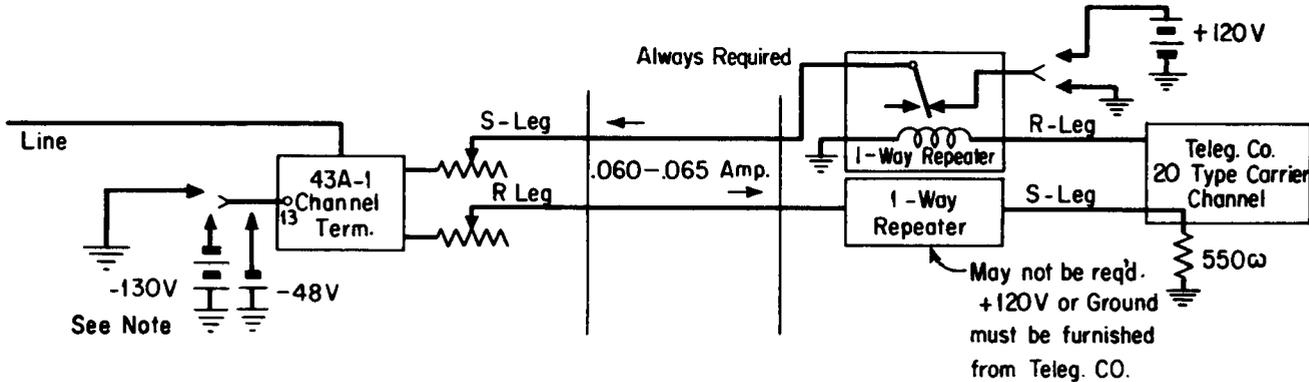
**Note:** Negative 130V. Battery may not always be available at the Telephone Company office. If ground is furnished at either office the loop resistance including terminal equipment is limited to 800 $\omega$  with 130V Battery or less with a lower voltage, (as may be furnished by Telegraph Co.) If both polarities of 130 volt battery are used, the limiting value of loop resistance (including terminal equipment) is 2880 ohms.

**FULLY OPERATIVE CIRCUIT SECTIONS  
TYPICAL METHODS OF CONNECTING TO TELEPHONE COMPANY OFFICES**

**Applicable Where Telephone Company Line Facility Terminates  
in 43A1 Carrier Terminal**



**Fig. 5D — 43A1 Telephone Carrier — Type 15 Telegraph Carrier —  
Full Duplex Operation**

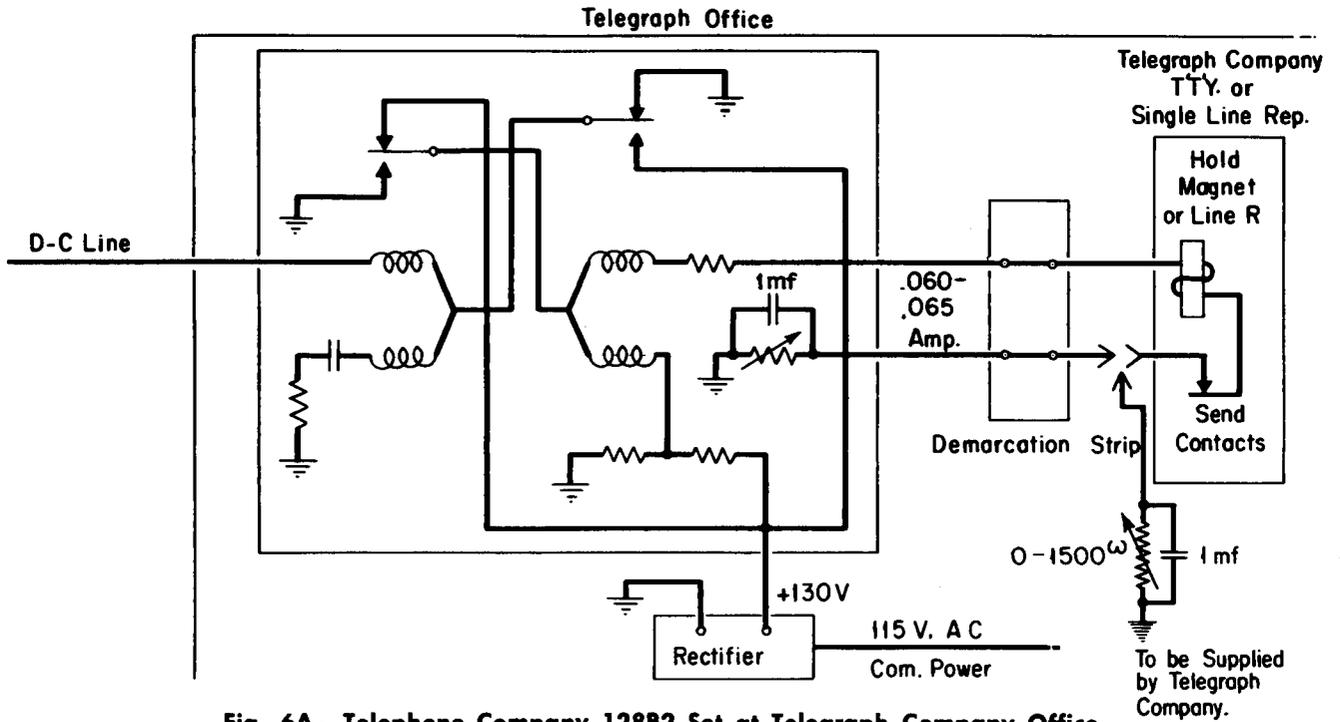


**Fig. 5E — 43A1 Channel Term. at Telephone Office — Teleg. Co. 20 Type Carrier  
Term. at Telegraph Office — Full Duplex**

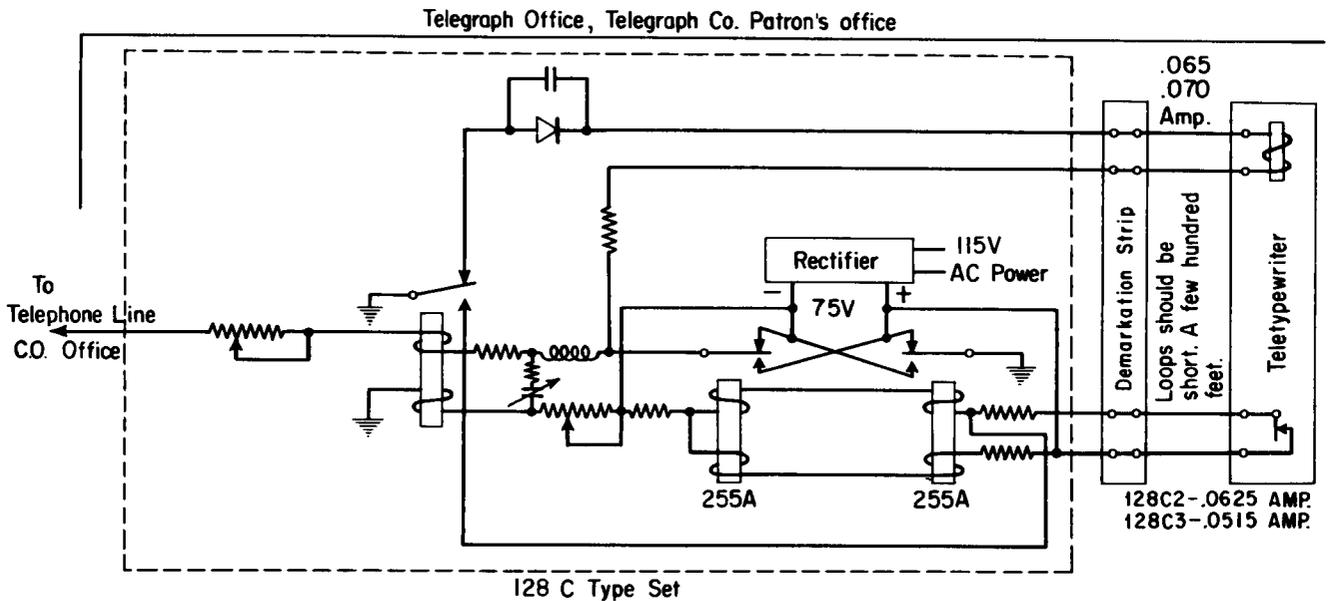
**Note:** Negative 130V battery may not always be available at the Telephone Company office. If ground is furnished at either office the loop resistance including terminal equipment is limited to 800 $\omega$  with 130V battery or less with a lower voltage, (as may be furnished by Telegraph Co.) If both polarities of 130 volt battery are used, the limiting value of loop resistance (including terminal equipment) is 2880 ohms.

**FULLY OPERATIVE CIRCUIT SECTIONS  
TYPICAL METHODS OF CONNECTING TO TELEPHONE COMPANY OFFICES**

**Applicable Where Telephone Company Line Facility Terminates  
in 128-Type TTY Subscriber Sets**



**Fig. 6A – Telephone Company 128B2 Set at Telegraph Company Office  
Half Duplex Only — Single-Loop Operation**

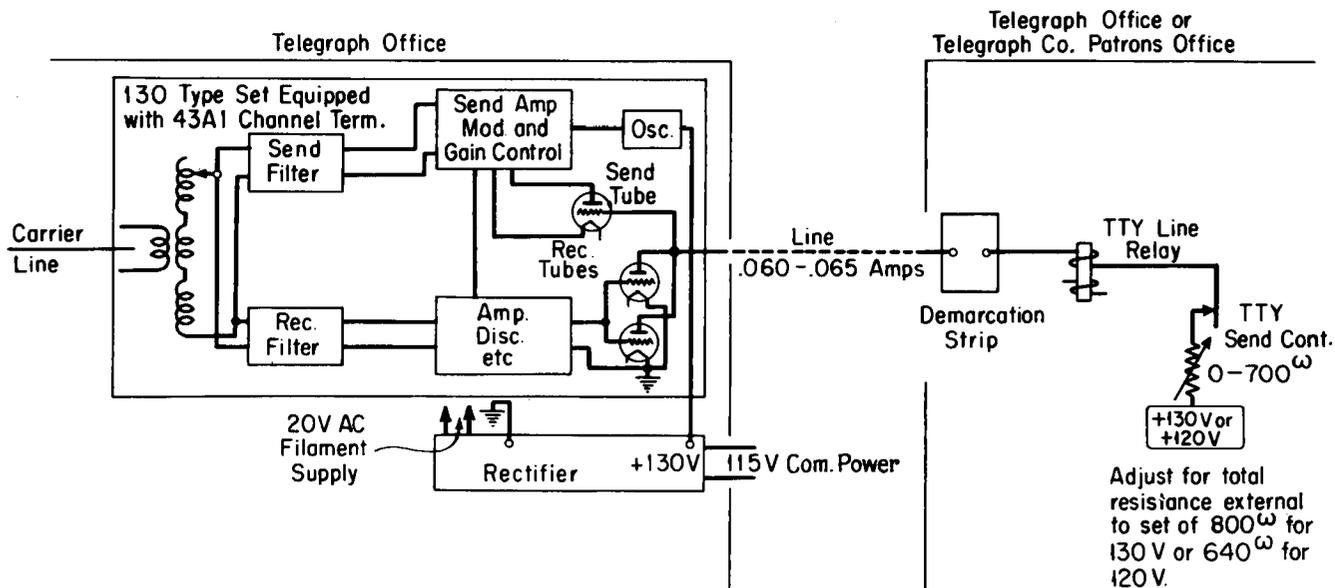


**Fig. 6B – Telephone Company 128C-Type Set in Telegraph Company office,  
or in office of a patron of the Telegraph Company. Half duplex  
service only. The 128C-Type Set must be located in the immediate  
vicinity of the teletypewriter. In cases where it is necessary to employ  
a 128B2 set at one end of a circuit and a 128C set at the other, the  
128C set should not be employed at the end which may require that  
the loop be extended to some distance beyond the subscriber set.**

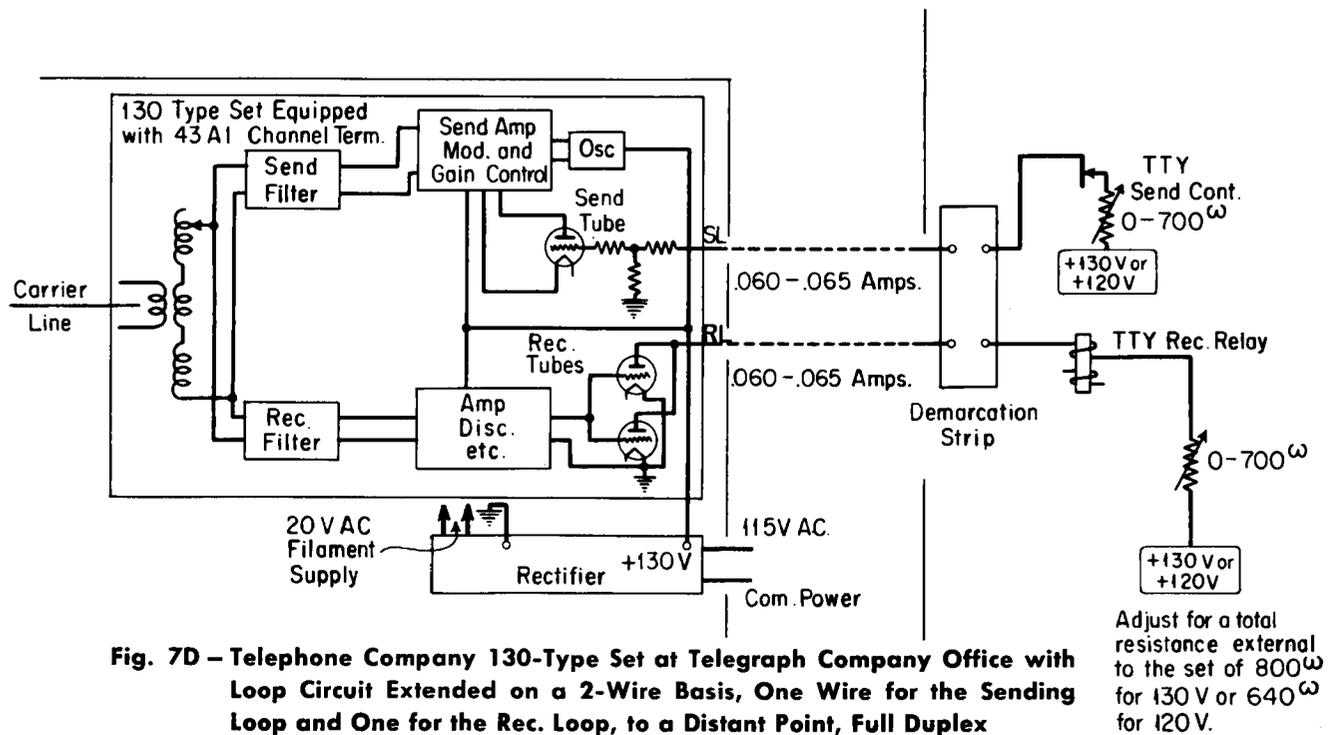


**FULLY OPERATIVE CIRCUIT SECTIONS  
TYPICAL METHODS OF CONNECTING TO TELEPHONE COMPANY OFFICES**

**Applicable Where Telephone Company Line Facility Terminates  
in 130-Type TTY Subscriber Set**



**Fig. 7C – Telephone Company 130 Type Set at Telegraph Company Office with Loop Circuit Extended on a Single Wire Basis to a Distant Point Half Duplex**



**Fig. 7D – Telephone Company 130-Type Set at Telegraph Company Office with Loop Circuit Extended on a 2-Wire Basis, One Wire for the Sending Loop and One for the Rec. Loop, to a Distant Point, Full Duplex**



WESTERN UNION REPEATER SETS

| Single Line Repeater<br>1/2 Dux. | Single Line Repeater<br>Duplex | Type 40 Carrier<br>Type 20 Metallic<br>Type 16 Repeater<br>1/2 Dux | Type 40 Carrier<br>Type 20 Metallic<br>Type 16 Repeater<br>Duplex | Type 43A-1<br>Carrier Terminal<br>1/2 Dux | Type 43A-1<br>Carrier Terminal<br>Duplex                                 | Type 128B-2 Set<br>1/2 DUX. | Type 128C<br>1/2 Dux. 2 Loops | Type 130<br>1/2 Dux.   | Type 130<br>Duplex |   |   |
|----------------------------------|--------------------------------|--|---|---|--|-----------------------------|-------------------------------|--|--------------------|---|---|
|                                  | YES                            | ×  | ×   | ×   | ×  | YES                         | ×                             | YES  | NO                 | NO  | ×   |
|                                  | ×                              | YES<br>Can also meet 8352 Duplex Legs                              | ×   | ×   | YES<br>If Tel. Co. can remove spacing battery.                           | ×                           | YES                           | ×  | ×                  | ×   | NO  |
|                                  | YES                            | ×  | YES   | YES                                       | YES<br>Arrange W.U. Set for 2 path polar and reverse sending polarities. | ×                           | ×                             | NO   | NO                 | YES<br>Use adapter to reverse polarity of Battery | ×   |
|                                  | ×                              | YES  | ×   | ×   | ×  | YES                         | ×                             | NO   | NO                 | NO  | ×   |
|                                  | ×                              | YES  | ×   | ×   | YES  | ×                           | YES                           | ×  | NO                 | ×   | NO  |
|                                  | ×                              | ×  | ×   | ×   | ×  | ×                           | ×                             | YES<br>Special Set For This Service<br>Used Where No Alternative | NO                 | YES with loop from Tel. Co.                       | ×   |
|                                  | YES<br>1 way circuit only      | YES<br>2 PPRs Required   | YES<br>1 way circuit  | YES<br>2 Required                         | YES<br>1 way circuit   | YES<br>2 Required           | YES<br>1 way circuit          | YES<br>1 way circuit   | NO                 | YES<br>1 way circuit                              | YES<br>If two sets are used and if W.U. can supply a battery at the switch board. |
|                                  | YES                            | ×  | NO  | ×   | NO   | ×                           | NO                            | NO   | NO                 | NO  | ×   |
|                                  | ×                              | YES  | ×   | ×   | NO   | ×                           | YES<br>If W.U. inserts 1 PPR  | ×  | ×                  | ×   | NO  |
|                                  | YES                            | ×  | NO  | ×   | NO   | ×                           | NO                            | NO   | NO                 | NO  | ×   |
|                                  | ×                              | YES  | ×   | ×   | YES  | ×                           | YES                           | ×  | ×                  | ×   | NO  |

Fig. 8 - Chart Showing Compatibility of Telegraph Company and Telephone Company dc Telegraph Arrangements



**ENGINEERING NOTES**  
**CONTRACT NUMBERS 1 AND 2**  
**BETWEEN THE BELL SYSTEM TELEPHONE COMPANIES**  
**AND THE WESTERN UNION TELEGRAPH COMPANY**

**SECTION IV**  
**FACILITIES FOR VOICE OPERATION**

**4.01** Amendment No. 3, effective January 1, 1962, to Contract Numbers 1 and 2 provides in part for use of voice grade facilities leased by the Telegraph Company from the Bell System for interexchange voice or alternate voice transmission service.

**4.02** The Telegraph Company may now use interexchange circuits leased from the Telephone Company under Contracts 1 or 2 to provide interexchange private line voice and alternate voice, data, telemeter, and facsimile channels and services in addition to those uses specified prior to amendment No. 3. Such leased circuits as well as the Telegraph Companies' own facilities can be arranged to:

(a) Provide exchange-type switched voice-coordinated data type transmission services, not connected to Telephone Company instrumentalities or services.

(b) Connect to Telephone Company instrumentalities, e.g., key and station equipment, PBXs, tie line terminals, etc., and through these instrumentalities, connect to the Telephone Company exchange and toll network and Telephone Company furnished private lines. However, connections to Telephone Company instrumentalities and facilities will be made only under the following conditions:

(1) The Telegraph Companies facilities or leased circuits are used only for voice when switched to other services of the Telephone Company.

(2) The Telephone Company instrumentalities are furnished as part of a service furnished by the Telephone Company (i.e.,

instrumentalities are not furnished solely to terminate Telegraph Company channels) to the same customer.

(3) The Telegraph Company facilities or leased channels are connected to Telephone Company instrumentalities at *both* ends except that, in lieu of this, they may be terminated in instrumentalities of the U. S. Military Departments or NASA, where such connections of telephone facilities are authorized by the Telephone Company.

(c) Telephone facilities cannot be leased, under these contracts, to provide voice circuits between instrumentalities within the same exchange area of the Telephone Company.

**4.03** Following is a list of definitions which will be used:

(a) **Circuit** — A communications channel between the two instrumentalities such as PBXs, key and station equipment, etc.

(b) **Facility** — A means of providing a communications channel. A facility may be derived by means of a carrier channel, or a voice-frequency channel, on cable or open wire or radio beam. Several different facilities may be interconnected to provide a circuit.

(c) **Switched Private Line Circuits** — Private Line circuits which may be interconnected with the exchange and toll message network or with other private line services.

(d) **PBX Tie Line or Tie Trunk** — A circuit between two PBXs.

(e) **Conductor Loop Resistance** — An expression used to define the supervision limit of a piece of equipment in terms of the resistance of the cable or open wire of the outside plant facility. This resistance is composed of twice the single wire resistance of the length of cable or open wire involved.

(f) **Maximum External Circuit Loop Resistance** — A supervision limit which includes the resistance within the terminal equipment at the station end of the loop in addition to the conductor loop resistance.

(g) **Loop** — Normally used to define a circuit between a switching equipment and a telephone station.

(h) **Trunk** — Normally used to define a circuit between two switching equipments.

(i) **Transmission Level (TL)** — A means of comparing the relative power levels of transmission signals at different points in a circuit or switching network to a specified reference level (zero transmission level point). In the Bell System the transmission level at any point in a circuit is usually equal to the absolute level of the test tone (db referred to 1 milliwatt — dbm) used in lining up or maintaining a circuit. Normally a 0 dbm (1 milliwatt) is applied at the zero transmission level point (0 TLP). In actual use, the power in voice, data or other signals transmitted over a circuit is normally less than the level of the test tone at any transmission level point. For example, it might be specified that a particular signal might be applied at -11 dbm at the 0 TLP. At the +7 db point, this signal would be -4 dbm. Many transmission requirements are stated in terms of a particular level (dbm) at the 0 TLP.

(j) **“Notes on Distance Dialing”** — A general discussion of the Engineering considerations involved in the design and maintenance of the Telephone Company distance dialing network. These “Notes” are available from Graybar Electric Company.

(k) **Via Net Loss (VNL)** — VNL is the lowest loss in db at which it is desirable to operate a circuit considering limitations of echo, crosstalk, noise and singing. A general

discussion of VNL, echo, crosstalk, noise and singing is included in Chapter 6 of the “Notes on Distance Dialing.”

(l) **Centrex Service** — A Bell System service offering designed to provide improved service features for PBX customers.

Centrex C.O. and Centrex CU are terms used to define the two basic equipment arrangements for providing Centrex service.

**Centrex C.O.** — locates the dial switching equipment on Telephone Company premises. Each Centrex station will be served by a direct line from the switching machine in a manner similar to that used for customers served from a local Telephone Company central office. Attendant facilities and normal station equipment will be provided on the customer’s premises.

**Centrex CU** — locates both the dial switching and the attendant facilities on the customer’s premises in a manner similar to regular PBX arrangements.

**4.04** The design of circuits used to furnish a service to its customer will be the responsibility of the lessee. The lessor will furnish to the lessee the necessary information such as facility makeup and the type and capabilities of terminating equipment for use in design or maintenance.

**4.05** Whenever a customer’s switched private line network is composed of Telephone Company PBXs interconnected by a combination of Telephone Company provided tie line circuits in tandem with Telegraph Company provided tie line circuits, the over-all system design criteria will be those of the Telephone Company. Close coordination between Companies will be required if a satisfactory system design is to be obtained.

**4.06** When a Western Union voice facility is to be interconnected with a Telephone Company facility, it is essential that the facility utilized by the Telegraph Company, whether leased or owned, be entirely compatible with that of the Telephone Company.

**4.07** When Western Union leased or owned private line voice circuits are to be terminated on Telephone Company instrumentalities,

the transmission and signaling capabilities of the circuits should be comparable in quality to those normally provided by the Telephone Company for a corresponding type of circuit under normal private line tariffs. The lessee shall provide, at his expense, equipment necessary to render such circuits suitable for operation with lessor's circuits, instrumentalities or services with which they are connected. The design procedures and standards used by Western Union for these switched private line circuits will need to be closely coordinated with those of the Bell System Company from which facilities are leased.

**4.08** It should not be construed that the transmission and signaling capabilities provided on facilities leased under Contracts No. 1 and 2 are the same as for voice circuits provided under the normal private line tariffs. It will be the responsibility of the lessee to make the facilities suitable for the particular service that is to be provided.

**4.09** Facilities normally provided to the lessee under Contract No. 1, which may be used for voice operation, will consist of the type of cable pair, open wire pair or carrier channel normally employed in furnishing exchange telephone service in the particular area involved.

**4.10** Gain devices, signaling units or other special equipment needed to make the facilities discussed in 4.09 suitable for the purpose for which the lessee desires to use them, will be provided by the lessee and located on either the lessee's premises or on the lessee's patrons premises, or in some cases may be obtained at additional cost from the lessor and located on lessor's premises. Conditioning of outside plant facilities, such as special loading, will be done only by the lessor. Charges for special equipment or conditioning are covered in Schedule A of the Contract No. 1. Application of these charges is discussed in the "Administrative Notes."

**4.11** Interexchange circuit sections for voice operation are leased under the provisions of Schedule A, item (a) (1) of Contract No. 2. These circuit sections have been defined as having transmission characteristics suitable for a minimum of 12 telegraph carrier channels in each direction. These circuit sections shall be

provided by means of carrier or four-wire voice facilities. Unless otherwise agreed upon, standard levels will be provided at the terminal offices as shown in Figs. 1 thru 3 and discussed in Paragraph 4.20.

**4.12** Contract No. 2 circuit sections are not represented as being suitable for voice transmission beyond the terminal central offices of the section nor are signaling arrangements provided.

**4.13** Signaling units or other special equipment needed to make the Contract No. 2 circuit sections suitable for the purpose for which the lessee desires to use them would be provided as discussed in Paragraph 4.10. Charges for special equipment or conditioning provided by the lessor are covered in Schedule A of Contract No. 2.

**4.14** Engineering costs incurred by the lessor in connection with providing circuits or circuit sections with special characteristics over and above those given in Paragraphs 4.09 and 4.12 would be charged to the lessee under the provisions of Schedule A in Contracts Nos. 1 and 2.

**4.15** All equipment located at a Telephone Company central office for use on leased facilities will be owned and maintained by the Telephone Company. This will include Centrex C.O. locations.

**4.16** At a Telephone Company PBX, or other switching instrumentality located on the customer's premises, all equipment normally used in the operation of the instrumentality will be owned and maintained by the Telephone Company. This will include the trunk relay equipment shown in Figs. 2 and 3. It is also preferable that terminating sets, amplifiers and other terminal line equipment required at the switching location for the leased circuit be provided by the Telephone Company.

**4.17** Interconnection of Western Union facilities and/or equipment with those of the Telephone Company will be done at a designated demarcation strip. This demarcation strip should include the necessary protection features as discussed in Section 5 of these Notes. All equipment on the Telephone Company side of the demarcation strip will be owned and maintained by the Telephone Company.

**4.18** At a PBX or other instrumentality which is not owned or maintained by the Telephone Company, all equipment will be provided by Western Union or by its customer.

**4.19** Many types of PBXs and associated equipment are used by the Telephone Company. The type, operating characteristics and availability of the PBX equipment must be determined prior to the design of the line facilities in order to arrange for the proper compatibility in the line facility. This information may be obtained from the appropriate Telephone Company.

**4.20** When Contract Numbers 1 or 2 facilities are provided by means of a carrier channel, the following transmission levels will generally be provided at the carrier terminals (see Figs. 1 thru 3):

- +7 db out of the carrier system and
- 16 db into the carrier system at 1000 cycles.

Both of these levels are with respect to the 0 TLP.

In some cases carrier levels of +4 db and -13 db will be encountered. These exceptions will be handled on an individual basis and should be thoroughly discussed with the lessee to avoid incorrect circuit design.

**4.21** When Contract No. 2 facilities are provided by means of four-wire cable facilities, standard levels similar to those specified in Paragraph 4.20 will be provided unless otherwise agreed upon. Since the levels provided on voice circuits depend to a certain extent upon the type and location of voice amplifiers, it may be necessary to deviate from the standard levels in some cases.

**4.22** The transmission level at the input to exchange cable facilities should not exceed +3 db referred to the 0 TLP (see Figs. 1 thru 3). Where single frequency or composite tone signals are to be transmitted, the actual allowable power at this point may be considerably lower than +3 dbm. Allowable transmission levels for single and composite tones and speech volume levels, are given in Section 5 of these Notes.

**4.23** Fig. 3 shows an example of a typical arrangement for extending a Contract 2 facility from the telephone office to the Western Union office by means of four-wire cable facilities. All levels shown are with respect to the 0 TLP which, in the case of a tie line, is normally at the PBX.

**4.24** Where circuits are to be used for alternate voice and data, teletype, or facsimile use, the transmission levels of the various services must be closely coordinated. In general, the desired loss will vary depending upon the particular type of service. Therefore, suitable means must be provided to independently adjust transmission levels for the alternate services. Specific levels for services other than voice are covered elsewhere in these Notes.

**4.25** The design loss which can be obtained on a switched private line voice circuit will depend upon the circuit arrangement: for example, carrier or voice, two-wire or four-wire, return loss and singing margins at four-wire to two-wire junctions, impedance irregularities in the facilities, and transmission balance at the switching points. In addition to net loss requirements, frequency response becomes quite important particularly when private line circuits are to be operated in tandem or interconnected with the Bell System message network.

**4.26** For satisfactory voice operation, the impedances of connecting facilities must be closely matched. In general, carrier systems will present a nominal impedance of 600 ohms while voice-frequency facilities may have a nominal impedance of either 600 ohms or 900 ohms, depending upon the type of facility. Suitable impedance matching arrangements should be provided by the lessee except at the junction of Contract 1 and Contract 2 facilities in which case they will be provided by the lessor.

**4.27** In order to prevent noise in voice telephone circuits and connecting instrumentalities, a high degree of balance to ground must be maintained both in the equipment and the outside plant facilities. Noise and longitudinal balance requirements are discussed in Section 5 of these Notes.

**4.28** Western Union owned or leased private line circuits terminating at Telephone Company instrumentalities may be connected to the Bell System toll and exchange message network in the same manner as Telephone Company circuits. Two typical arrangements for serving PBX customers are shown in Figs. 4 and 5. Fig. 4 is the conventional arrangement with a PBX on the customer's premises. This includes Centrex CU. Fig. 5 covers the Centrex C.O. arrangement.

**4.29** Voice circuits which terminate in Telephone Company instrumentalities, such as PBXs and are to have the capability of switching to the Telephone Company toll or exchange network or other switched private line circuits, must be designed for less transmission loss than would be allowable if the circuits were to be used only for communication between the two terminal PBXs. For example, with the arrangement of Fig. 4, the over-all transmission quality of a call placed over a tie line which is switched to the toll or exchange message network will be a function of the loss of the tie line, the PBX central office trunk, and the portion of the regular Bell System message network used to reach the called party. For transmission reasons, a switched private line circuit should not be interconnected with the Bell System message network at more than one point on any given call.

**4.30** Simplified schematics of typical facility arrangements which might be used to extend a Contract 2 facility to a PBX are shown in Figs. 2 and 3. There are, of course, many other arrangements which might be used. In many cases four-wire facilities are required from

PBX to PBX in order to meet transmission objectives.

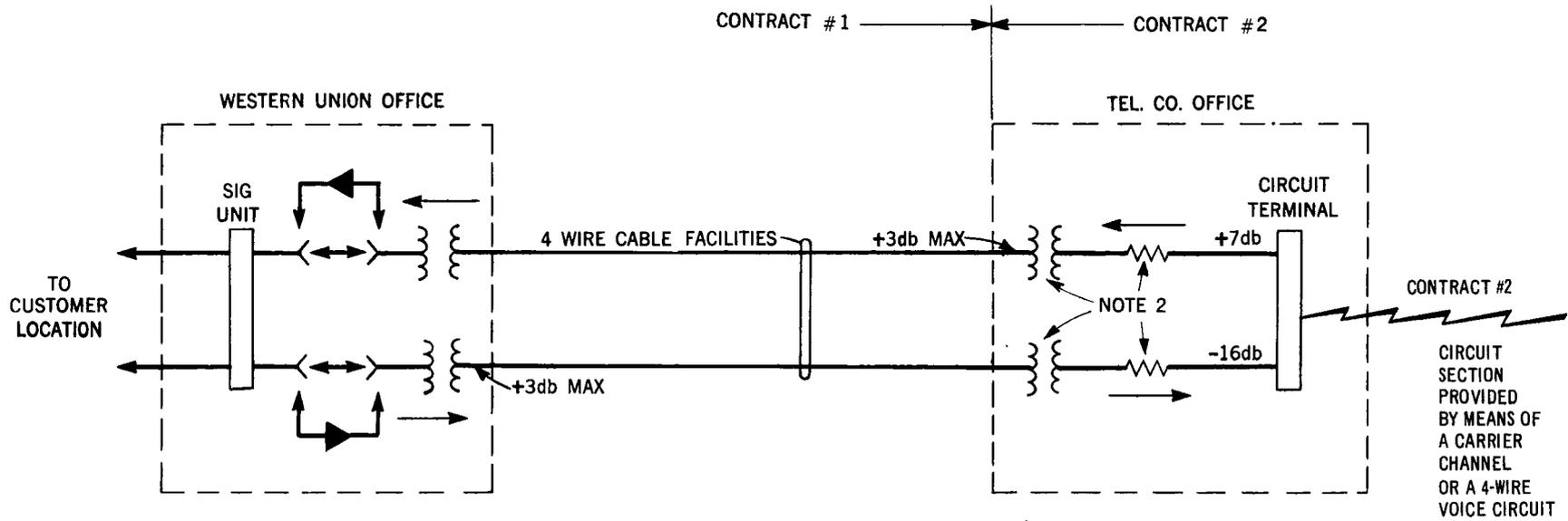
**4.31** Contract 1 facilities, used to extend inter-exchange facilities to a Western Union customer via a Western Union office may involve several trunks and loops composed of loaded and/or nonloaded cable. Figs. 6 and 7 show typical cable arrangements which might be encountered in single and multioffice Telephone Company exchanges.

**4.32** Arrangements for transmitting ringing signals, supervisory signals, or dial pulses are not included as part of the basic facility leased under Contracts 1 and 2. Where signaling capabilities are required, the necessary equipment must be provided by the lessee or obtained from the lessor under the provisions of Schedule A in the Contracts.

**4.33** Many different types of signaling arrangements are available for use on private line circuits. In general "E and M" signaling is preferred where interexchange facilities are involved. Close coordination will be required to assure compatibility between Bell System and Western Union signaling systems. A general description of Bell System signaling systems can be found in Section 4 of the Notes on Distance Dialing.

**4.34** A certain amount of flexibility is available in choosing the type of signaling on line facilities comprising a circuit. This flexibility is not always present in the trunk relay equipment at switching locations. Therefore, it is essential that the type of signaling required by the trunk relay equipment be determined first, so that the type of signaling system provided between terminating points can be made compatible.

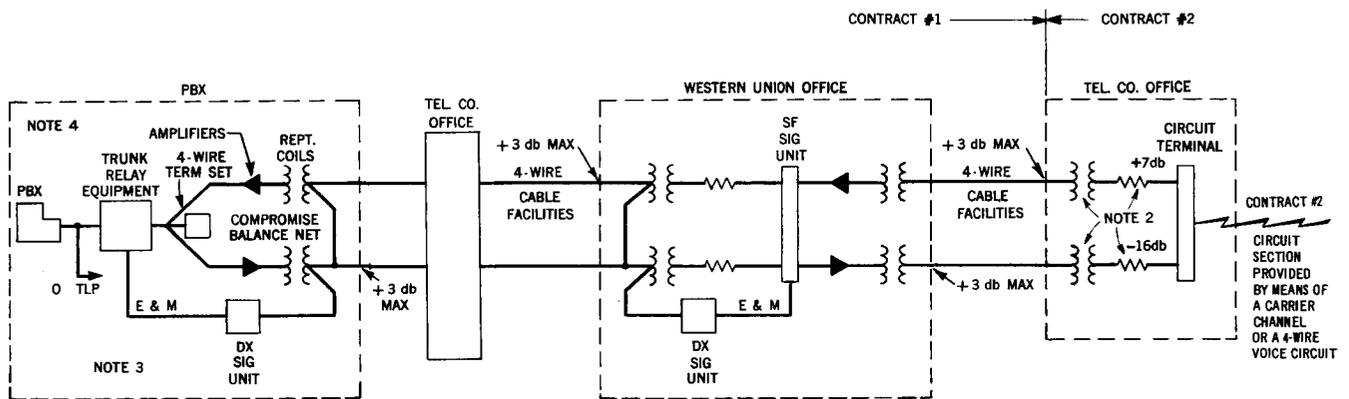
**Attachments:**  
**Figs. 1 through 7**



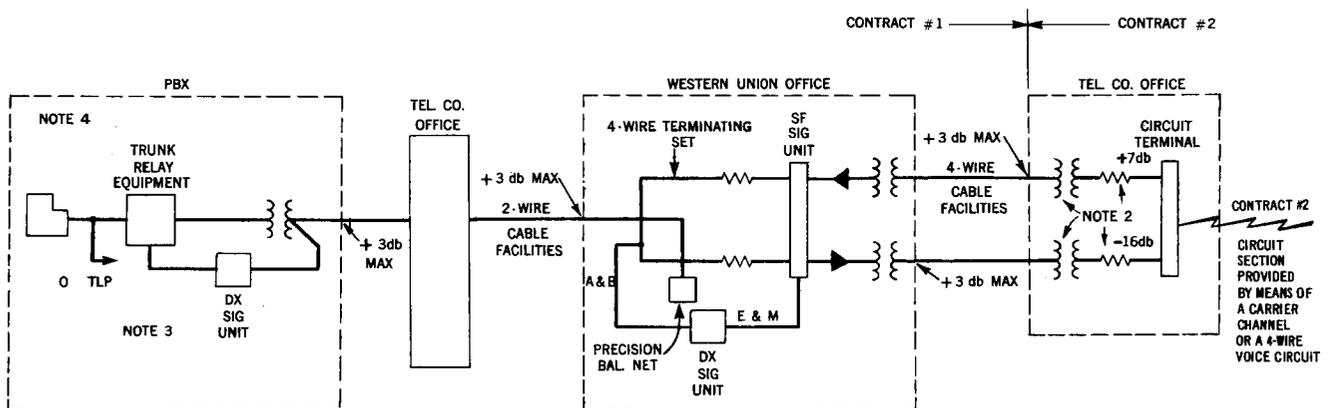
NOTES:

1. ALL TRANSMISSION LEVELS SHOWN ARE WITH RESPECT TO THE 0 TLP AS DEFINED IN PARAGRAPH 4.03 (i).
2. PADS AND REPEAT COILS, WHERE REQUIRED, WILL BE PROVIDED BY LESSOR AS PART OF CONTRACT #2 FACILITY.

**Fig. 1 – Extension of a Carrier Channel on Four-wire Cable Facilities to a Western Union Office**



**Fig. 2 - Typical Arrangement for Extending a Circuit from a Carrier Terminal to the Customer's Premises on Four-wire Voice-Frequency Facilities**



**Fig. 3 - Typical Circuit Extension with the Four-wire Terminating Set in the Western Union Office**

**Notes:**

1. All transmission levels shown are with respect to the 0 TLP as defined in Paragraph 4.03 (i).
2. Pads and repeat coils, where required, will be provided by lessor as part of Contract #2 facility.
3. In some cases the function of the DX signaling unit may be included in the trunk relay equipment.
4. Both of these arrangements assume dial repeating tie lines equipped with trunk relay equipment equipped for E & M.

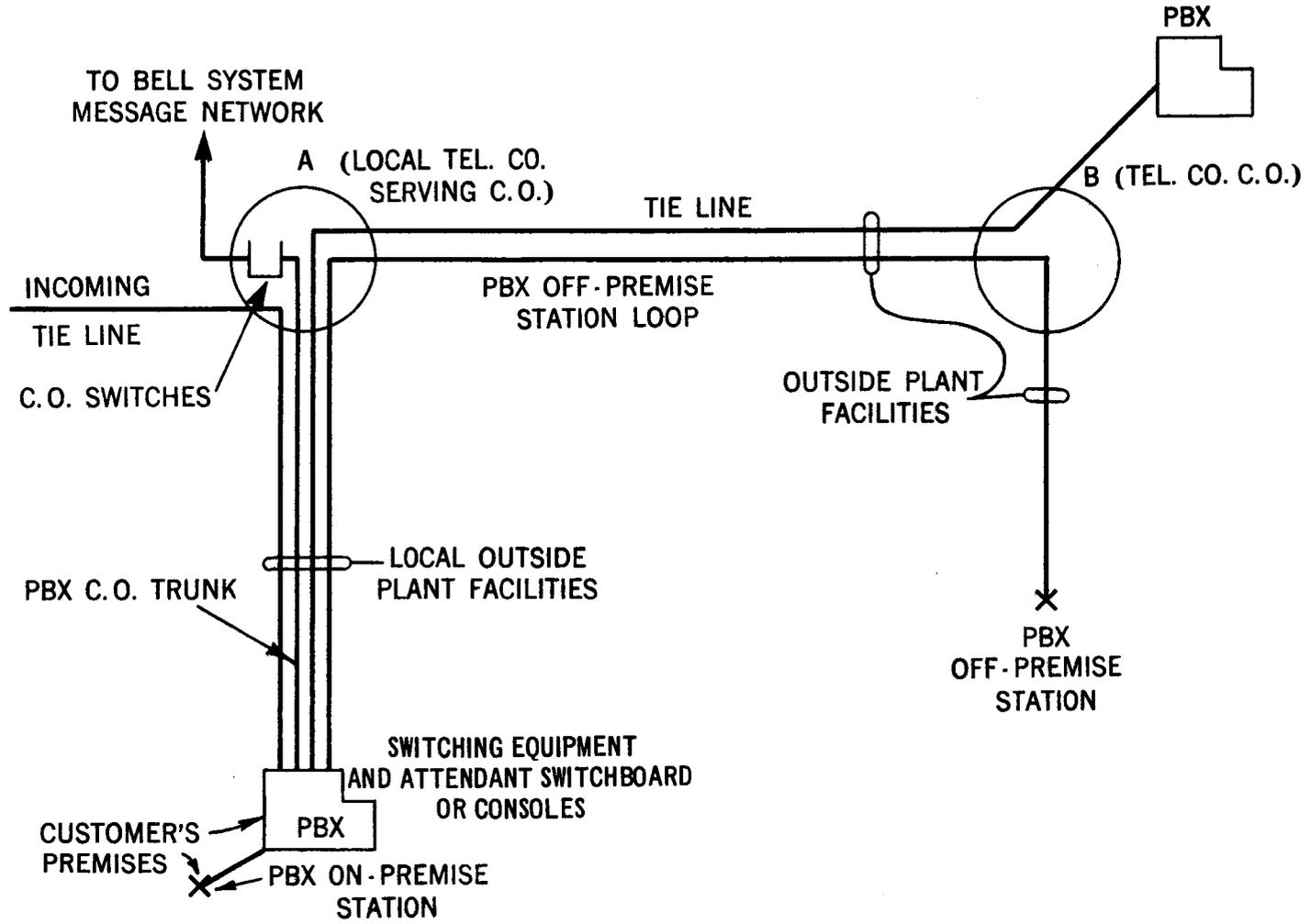
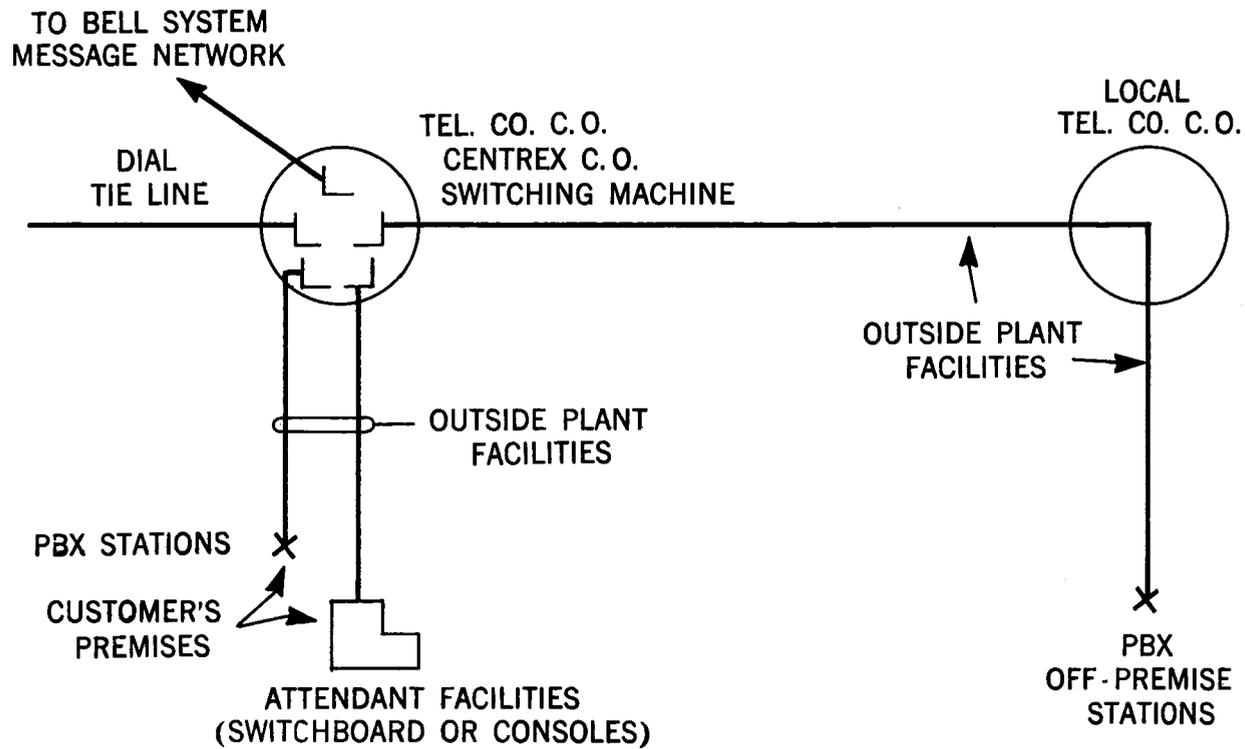


Fig. 4 - Typical PBX Arrangement (PBX on Customer's Premises)

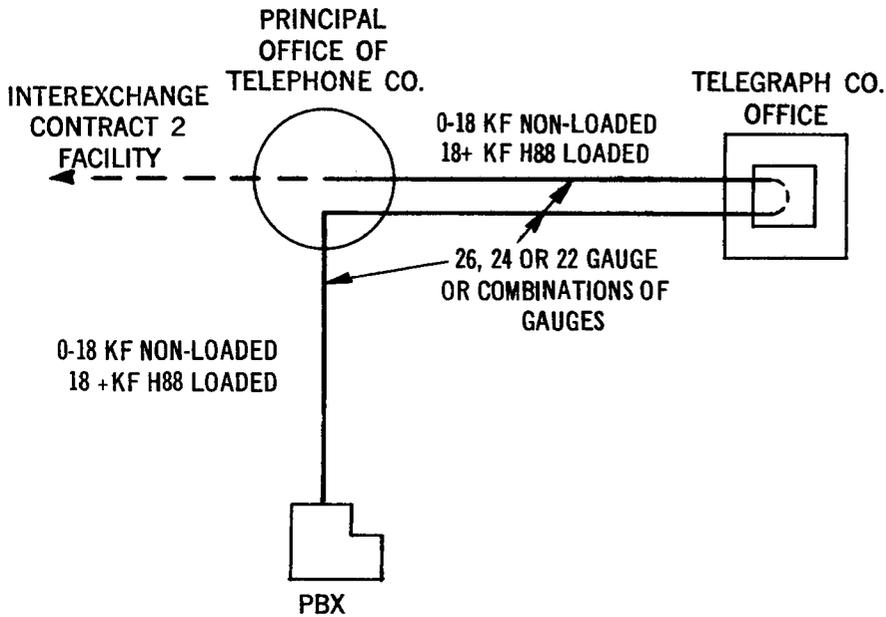


NOTE: MANUAL CIRCUITS SUCH AS RINGDOWN TIE LINES MUST TERMINATE DIRECTLY ON A SWITCHBOARD AT THE CUSTOMER'S PREMISES.

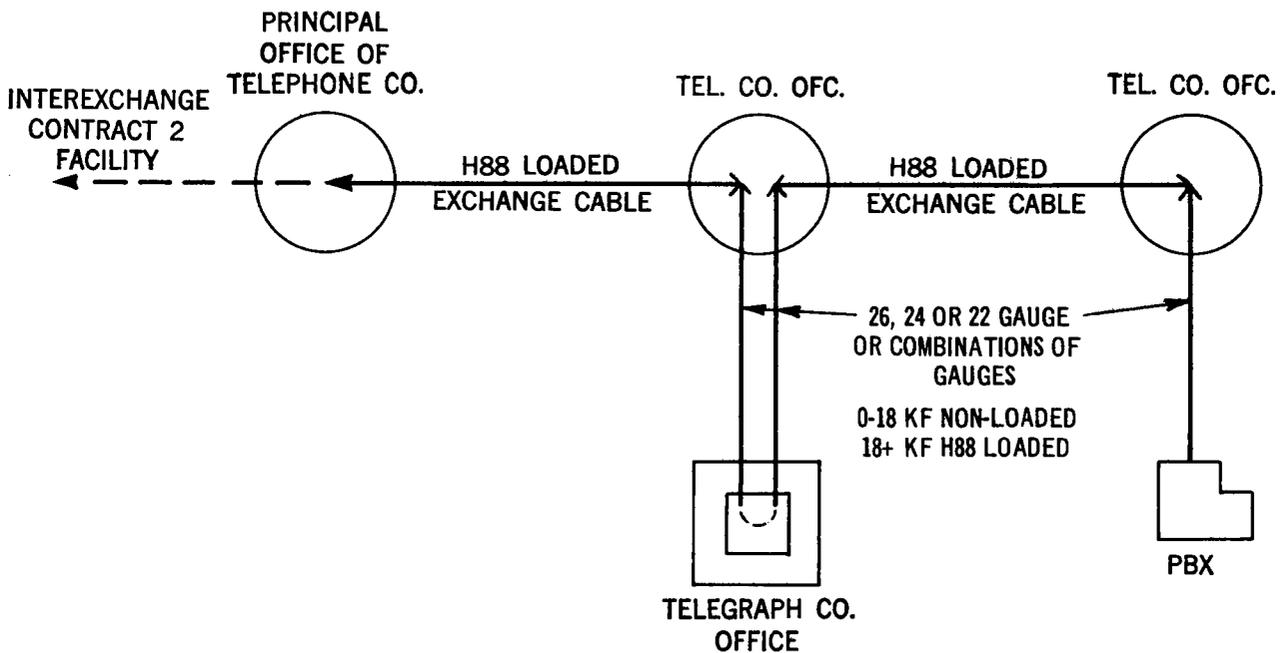
L DENOTES A SWITCH TERMINATION OF A CIRCUIT.

Fig. 5 - Typical Centrex C.O. Arrangement (Switching Equipment on Telephone Co. Premises)

**TYPICAL CABLE ARRANGEMENTS WHICH  
MIGHT BE ENCOUNTERED FOR CONTRACT 1 FACILITIES**



**Fig. 6 – Single-office Exchange**



**Fig. 7 – Multioffice Exchange**

**ENGINEERING NOTES**  
**CONTRACT NUMBERS 1 AND 2**  
**BETWEEN THE BELL SYSTEM TELEPHONE COMPANIES**  
**AND THE WESTERN UNION TELEGRAPH COMPANY**

**SECTION V**  
**INTERFERENCE AND PROTECTION**

**(A) General**

**5.01** The agreements between the Telephone Company and the Telegraph Company known as Contract Nos. 1 and 2 include the following provision in the section covering Operation and Maintenance, in regard to interference and protection.

“The characteristics and methods of operation of any equipment or circuits provided by the lessee (the Telegraph Company) and associated with the circuits furnished (by the Telephone Company) hereunder shall be such as not to interfere with or impair service over any circuits of the lessor (the Telephone Company) or the service of its associated, affiliated or connecting companies, cause damage to their plant, impair privacy of any communications over circuits of the lessor (the Telephone Company) or such companies or create hazards to the employees of any of them or the public.”

*Note:* The words in parentheses are added for the purpose of these notes.

**5.02** Telephone plant has been designed for the joint use of message telephone, private line telephone, program, data and telegraph services. This joint use of the plant has best been met by employing relatively small voltages and currents and it is necessary to limit the character of voltages and currents employed for all of those uses to values which will not:

- (a) Create a hazard to employees or to the public.
- (b) Cause the false operation of normal protective arrangements, overheating of circuits or equipment, or dielectric failure.

(c) Interfere with the normal operation of other services. This may manifest itself as noise or as false operation of devices such as ringers or echo suppressors.

In cases where circuits of the Telegraph Company are directly connected (where permitted by contract) without repeaters to circuits of the Telephone Company protection and noise problems may be introduced which require special consideration.

**5.03** Interference with the operation of other telegraph circuits, with telephone circuits or to devices such as ringers and echo suppressors is a more comprehensive problem as it is influenced by the characteristics of the disturbing circuit, the coupling between the disturbing circuit and the disturbed circuit and the susceptibility of the disturbed circuit to the induced voltages or currents impressed upon it.

**5.04** The minimum coupling between paralleling circuits in the same line structure exists when both are operated on a balanced basis. The introductions of a serious unbalance on a circuit increases the coupling by an order of magnitude or more. When both circuits are unbalanced, the coupling is such as to generally preclude the simultaneous use of all circuits on the line. In order to permit efficient use of the line facilities, therefore, it is necessary to insure that a high degree of balance exists in any equipment which is connected to them.

**5.05** The susceptibility of a disturbed circuit to interference from a disturbing circuit is in part governed by the transmission requirements of the disturbed circuit and various eco-

conomic considerations, such as length of repeater section, gauge of wire and the selection of levels.

**5.06** Where new services are applied to existing plant, a practical method of precluding interference to existing services is to arrange the new services in such a manner that the characteristics of the wave shape applied to the transmission medium are at least no more objectionable from an interference standpoint than those of the wave shape applied by the existing services. In the application of new services to plant, careful consideration must also be given to their susceptibility to interference from existing services. Their design must take into account the normal expected interference which may result from other services sharing the same pair, cable, open wire line or from sources foreign to the telephone plant.

**5.07** One method which might be used to reduce the possibility of a new circuit interfering with existing services, is to make suitable tests to determine if the proposed circuit interferes with the existing services. If these tests indicated that interference occurs, suitable changes would be required in the new circuit and further tests would need to be made to determine if the changes corrected the conditions. Of course, the final criterion would be that no material interference would be encountered in the normal operation of service.

**5.08** In the design and operation of telegraph and telephone equipment and circuits assigned to plant jointly used for telegraph and telephone services, certain features have been incorporated in Bell System equipment. These features together with the selection of line operating current and voltage limitations have been found, in most cases, to preclude objectionable

interference between telegraph services, between a telegraph service and telephone services and between telephone services. Occasionally, cases arise where objectionable interference may be observed even though the recommended equipment features and current and voltage operating limits are employed. In these cases special coordination with existing services is required.

**(B) Protection Requirements**

**5.09** The following summarizes the protection requirements of voice-frequency telephone plant leased to the Telegraph Company. However, these requirements are subject to change and may vary slightly from one Telephone Company to another depending upon unusual local conditions.

**5.10 General**

Telephone plant is designed primarily for relatively small voltages and currents. When telephone facilities are used for remote signaling or control circuits or other nontelephone purposes it is necessary to limit the voltages and currents employed in these special circuits. This is to insure that values are used which will not cause a safety hazard, operation of normal telephone protective arrangements, overheating of circuits or equipment, dielectric failure, induction into other telephone circuits or interference with radio receivers or other apparatus.

**5.11 Voltage and Current Limitations**

The limiting values used generally by the Bell System Companies for voltages and currents impressed during operating, switching, and trouble conditions on Telephone Company channels associated with customer-owned terminal equipment are noted below.

|                                     | D-C VOLTAGE              | A-C VOLTAGE<br>(rms below 120 cps) |
|-------------------------------------|--------------------------|------------------------------------|
| Between Two Conductors of a Circuit | 270 (Mid-Point Grounded) | 0 to 120                           |
| Between Any Conductor and Ground    | 135                      | 0 to 120                           |

Maximum line current a-c (rms) or d-c — 0.250 amperes.

### 5.12 Power Supply

In connection with the source of power to the signaling or control circuits, precautions, such as those outlined below are desirable in order to avoid excessive voltages or currents under trouble or other abnormal conditions:

#### (a) *A-C or D-C Sources of over 60 Volts (Open Circuit)*

With circuits operating over 60 volts (a-c or d-c), protection arrangements include *both* a 1-ampere fuse and sufficient resistance or impedance to limit to 1 ampere the current at the point of connection to the telephone conductors. This current should be calculated as if flowing in a short circuiting termination assuming voltages impressed by normal operating conditions in the apparatus to be connected. Under these conditions the internal heating of the customer's equipment should not cause combustion. The resistance or impedance may be an integral part of the customer's terminal equipment or it may be provided external to the equipment. If this impedance is internal there is no objection in having it perform other circuit functions in the customer's equipment.

For circuits utilizing a pair of conductors, the resistance or impedance should be equally divided between the two sides of the circuit in order to preserve circuit balance.

#### (b) *A-C or D-C Source of less than 60 Volts (Open Circuit)*

If the voltage of an a-c or d-c source is less than 60 volts, either a current limiting impedance as described in Par. 512(a) or fuses in accordance with the following table, may be used.

| OPEN CKT. VOLTAGE | MAXIMUM FUSE RATING |
|-------------------|---------------------|
| 0-15              | 5 Amps.             |
| 15-30             | 3 Amps.             |
| 30-60             | 1-1/3 Amps.         |

Where a d-c source consists of dry cells, neither current limitation nor fuses are required.

### 5.13 Dielectric Strength of Apparatus

Transformers, relays and other apparatus connected between the telephone facilities and sources of power or controlled power circuits

should meet the requirements of the American Standards Association (dielectric strength of twice the line voltage plus 1000 volts). In general, apparatus listed by the Underwriters Laboratories meets these requirements. In cases where the apparatus does not meet these requirements or it cannot be ascertained readily that it does, an isolation transformer or a low voltage gap may be used to prevent excessive voltages being impressed on the telephone facilities.

### 5.14 Protection on the Telephone Facilities

The Telephone Company usually provides the protection on its facilities similar to that which would normally be provided for telephone equipment at the same locations. At the customer's premises, this generally consists of a protector block (3 mil gap) between each conductor and ground. This protector block normally operates at 350 rms a-c volts (about 500 volts peak). Apparatus to be connected to telephone facilities should, therefore, be able to withstand voltages below this value without overheating or dielectric failure.

If there are unusual protection problems (such as the ground potential problems sometimes encountered in connection with circuits into or near power stations or where the circuits are connected to other circuits exposed to high voltages), special protective arrangements are worked out after the conditions are analyzed cooperatively.

### (C) Determination of Interference by Test

#### TELEGRAPH

### 5.15 General

The likelihood of objectionable interference between direct current telegraph circuits (crossfire), between a direct current telegraph circuit and a telephone circuit (thump or noise) and false operation of such devices as ringers and echo suppressors by telegraph circuits can, in general, be predetermined. The objectionable conditions may be avoided by designing the telegraph equipment and arranging its operation so that the wavefront impressed on the telegraph channel is not too steep. The methods used to avoid the objectionable conditions are the result of experience in the successful design and

operation of plant used jointly for telephone, telegraph and other services over a period of considerable time.

**5.16** Telegraph equipment of the types used in the Bell System generally includes arrangements known as "spark killers" and "noise killers" which consist of simple networks of capacity and resistance or inductance connected in the line relay contact circuits and line circuits. The attached Figs. 1A to 1E, inclusive, indicate "noise killer" and "spark killer" arrangements used in various telegraph repeaters in the Bell System. The inductance indicated for the coils used assumes that the coils have stable characteristics, i.e., the inductance does not vary appreciably with current so that harmonic generation is minimized. If coils of unknown characteristics are used thump tests should be made on the "noise killer." Also indicated are the normal maximum operating line currents. These arrangements reduce the higher frequency components and thereby make the transitions from one condition to another less abrupt. The operating telegraph line current is usually controlled to a specified value by an adjustable resistance on the line side of the sending relay. The net effect of these equipment features and operating current limitations is to provide arrangements which in most cases permit the joint use of plant without objectionable interference and still provide satisfactory telegraph layouts which meet the requirements of the Bell System telegraph services. If these arrangements and telegraph line current values are used in new services, it would be reasonable to assume that little objectionable interference would be encountered.

**5.17** Crossfire between two telegraph circuits depends on voltages and currents induced by the disturbing circuit into the disturbed circuit. The controlling voltages and currents induced are, in general, in the frequency range below 180 cycles. Crossfire may be between two circuits assigned to the same quad in cable or in an open wire group. It may be either sending end crossfire or receiving end crossfire or both, depending upon which end of the section is influenced by the disturbing circuit. Crossfire may also obtain between circuits operated on different quads in cable or on different open wire

groups. In this case sending end crossfire is usually controlling.

**5.18** Following are methods presently used in measuring crossfire between telegraph services in the Bell System. Apply to the disturbing circuits, telegraph reversals through a telegraph repeater of the type normally used on the disturbing circuit, of a frequency equal to the dotting frequency of the disturbing circuit (23 cycles per second for 60 speed teletypewriter). A 161A1 telegraph test set is connected in series with the disturbed circuit and the bias current in the test set telegraph relay is continuously increased until the relay stops chattering. The amount of bias current as noted on the milliammeter is a measure of the crossfire current. The actual amount of crossfire current which can be tolerated in the disturbed telegraph circuit depends on the increase in the amount of telegraph distortion measured due to the introduction of crossfire from the disturbing circuit. In general, this increase in distortion should not exceed about 5%. The increase in distortion due to crossfire may be measured directly with a 118-type telegraph transmission measuring set. Due to the fact that both the disturbing and disturbed circuits have to be available to make this test, investigation of crossfire will of necessity require special consideration.

**5.19** The use of plant for the transmission of speech at voice frequencies is now being supplemented by data transmission and the extent of such operation is expanding rapidly. These fundamentally different types of transmission vary radically in their susceptibility to noise and require different instrumentations and techniques for measuring and evaluating the severity of the interference.

**5.20** Interference to voice-frequency telephone (including facsimile, voice-frequency telegraph, etc.) introduced by telegraph operation as observed by listening on a telephone receiver at the terminal of a circuit may be easily identified due to its characteristic. When this noise is introduced into the telephone circuit by a direct current telegraph circuit applied to the same line conductors it is known as thump. If the interference is introduced by a circuit operating on another pair or quad on the same open wire line or cable it is known as noise. The result at the

telephone receiver is similar in either case. Quantitative determination of such interference is made in the Bell System by the use of a 3A noise measuring set. This arrangement when connected to an idle telephone circuit under observation provides an indication on a meter of the noise level existing on the circuit weighted for the interfering effect at the receiver of the various frequencies present on the circuit. Information regarding the operation, method of use and characteristics of the 3A noise measuring set is included in instructions furnished with the set.

**5.21** Current practices followed in the Bell System are as follows:

(a) **Thump Tests.** A 3A noise measuring set is connected to the telephone circuit at the switchboard. Telegraph signals are applied to one or both of the composite legs. With the noise set arranged for C message line weighting the reading in dbrn on the meter and attenuator dial is noted.

(b) **Noise Influence Tests.** A 3A noise measuring set is connected through a "noise influence coupler" (Fig. 2A) to the point of interconnection of the disturbing telegraph circuit and the telegraph line facility. Telegraph signals are applied to the line facility in the normal manner. With the noise set arranged for C message line weighting the reading in db on the meter and attenuator dial is noted as above in the case of "thump measurements."

Both of the above tests require the availability of the telegraph circuit and in addition the thump test requires access to the terminal of the telephone circuit which shares the same line conductors as the telegraph circuit. Thump tests are involved only on direct current telegraph circuits obtained through the use of the composite arrangement. Noise influence is not controlling due to the filtering action of the composite set. Noise influence tests are involved on direct current telegraph circuits obtained by means other than the composite arrangement and thump tests are not required as noise on circuits on other wires is usually controlling.

**5.22** In many cases it is desirable to obtain in advance of connection to the telegraph circuit an estimate of the relative amounts of noise which would be produced in the telephone

circuit by the operation of the telegraph circuit. The attached Appendix A gives details of an arrangement which may be connected to a telegraph repeater and a 3A noise measuring set to obtain such an estimate. Symmetrical telegraph reversals of a frequency corresponding to the telegraph line signaling speed (23 dot cycles per second for 60 speed teletypewriter signals) are transmitted into this arrangement. An indication on the 3A noise measuring set of either the thump or noise influence will be obtained. This will correspond closely to that which would be obtained if the procedures in Paragraph 5.20 were followed. This arrangement consists of suitable line terminating and:

- (a) A noise influence coupling network. (Fig. 2A.)
- (b) A thump coupling network. (Fig. 2B.)

This arrangement is not suitable for making thump measurements on low current metallic composited circuits.

Comparative tests between measurements made by the methods indicated in Paragraphs 5.21 and 5.22 indicate a fairly close correlation of results. The average difference by the two methods is in the order of 2 db.

**5.23** Because of the wide range and the unpredictable values of coupling existing between the terminals of any particular disturbing and disturbed circuit, it is undesirable to set any maximum value of noise influence or thump as measured on a 3A noise measuring set with the arrangement indicated in Paragraph 5.22. If a low value were chosen which insured freedom from interference under the most unfavorable coupling conditions it would be unnecessarily low for the majority of cases. On the other hand, if a value were chosen which would preclude interference only under most favorable coupling conditions difficulties probably would be encountered in a considerable proportion of the circuits with the result that an undue amount of specific investigation and corrective work would be required.

**5.24** The most practicable approach to this problem seems to be to establish "classes" which would combine noise influence and thump with probable conditions so that the probability of difficulty with any specific case can be roughly

estimated. These "classes" have been selected and the significance of each are as follows:

Class 1 — Very unlikely to cause interference.

Class 2 — Indeterminate.

Class 3 — Very likely to result in interference.

The ranges of noise influence and thump as determined by test lying within these classes are roughly as follows:

|         | C MESSAGE<br>NOISE INFLUENCE | C MESSAGE<br>THUMP     |
|---------|------------------------------|------------------------|
| Class 1 | Less than<br>26 dbrn C       | Less than<br>31 dbrn C |
| Class 2 | 26-41 dbrn C                 | 31-36 dbrn C           |
| Class 3 | Over 41 dbrn C               | Over 36 dbrn C         |

(dbrn C means db above reference noise of -90 dbm, C message weighting)

It must be recognized that the above figures are designed to apply to the majority of cases. Occasionally, an unfavorable combination of circumstances may exist and noise influence or thump in Class 1 may cause trouble. Similarly, if circumstances are especially favorable, it may be possible to operate a circuit with Class 3 influence without trouble. These figures are set up on the basis of noise interference on telephone message circuits from a source of telegraph signals consisting of symmetrical reversals. If the source of telegraph signals consists of random teletype-writer characters of a speed comparable to the reversals, the reading indicated on the 3A noise measuring set will be about 3 db less. Where program or other special circuits that are more susceptible to noise are involved, the classifications may not hold and further experience may indicate the need of measurements to reflect the increased susceptibility to interference of these types of circuits. The figures apply only to direct current telegraph circuits employing grounded battery. If special telegraph circuits that are fully balanced with respect to ground at voice frequencies are contemplated, the figures for the classes under "noise influence" in the above table may be increased. Such cases can best be handled on a special basis.

**5.25** The measurement of noise to evaluate its interfering effect on data transmission is in its infancy. The development of suitable instruments and the establishment of objectives is proceeding actively and it is likely that changes in both will occur rapidly during the future. For the present, the best available technique is to measure amplitude distribution of the peaks in the interfering voltage. The present instrumentation for this type of evaluation is the Western Electric type 6A Impulse Counter and the present exchange loop objective is:

**Impulse Noise Objectives (OTLP)**

| STATION LOOPS<br>COUNTS IN 30 MINUTES | DBRN (Voice-Band Weighting) |
|---------------------------------------|-----------------------------|
| 90                                    | 52                          |

**VOICE**

**5.26 General**

To minimize the possibility of crosstalk or noise induction from the leased channel into other telephone voice grade circuits in the same cable or on the same pole line, it is necessary to limit the maximum levels of speech or other signals which may be impressed on the leased channel. In order to prevent the induction of crosstalk from other circuits into the leased channel, it is likewise necessary to restrict the minimum levels to which the signals may drop on the leased channels. This latter consideration affects the permissible length of circuit without intermediate amplification.

The values of transmitting levels given in the following, based on experience will be applicable to the general case. In special situations, depending on local plant conditions, some deviations may be permissible after discussion with the local Telephone Company of all the factors involved.

**5.27 Speech Volume Levels**

Speech volume levels impressed on the leased channel should not exceed +8 vu as measured with a standard volume indicator.\* If the same signal is to be transmitted over more than one channel simultaneously, permissible levels lower than +8 vu will be specified by the Telephone Company.

\* Refer to "A New Standard Volume Indicator and Reference Level," Bell System Technical Journal Jan. 1940 or Proceedings of Institute of Radio Engineers Jan. 1940.

**5.28 Single-Frequency Control Currents and Code Signals**

The interfering effect of single-frequency tones is a function of frequency, and the balance to ground of the terminal equipment. Fig. 3 indicates recommended rms single-frequency voltages when impressed metallicly with well-balanced terminal equipment. It reflects the requirements of both speech and data transmission.

When the terminal equipment is not balanced, the values of Fig. 3 should be multiplied by 0.3. When the signal is impressed by means of a ground return circuit (or return over another pair) the values should be multiplied by 0.2. These three types of circuits are shown in the sketch below.

Although Fig. 3 applies to a single-frequency voltage, it may be applied to two or more simultaneous single-frequency voltages in the following manner:

The individual single-frequency voltages are referred to 1000 cps by multiplying each by the ratio of the limiting value of Fig. 3 for 1000 cps to the limiting value for the actual frequency of the voltage. The root-sum-square of the referred voltages may be compared to

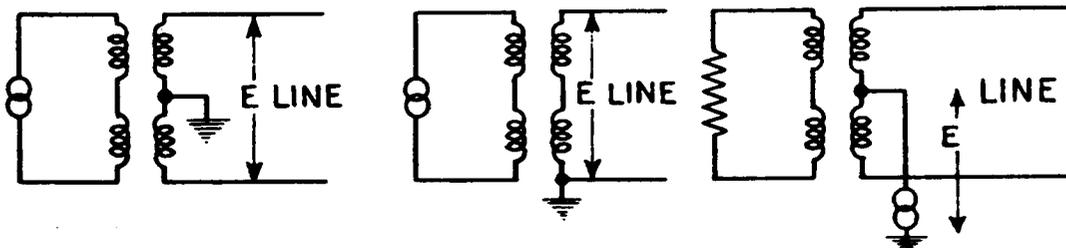
the 1000 cps limiting value of Fig. 3 to determine the relative interfering effect of the simultaneous voltages.

**5.29 Complex Tones**

The interfering effect of tones which are too complex to analyze as in Par. 5.28 is normally measured using a Telephone Company noise influence coupler (Fig. 2A) and a Western Electric 3A Type Noise Meter. This combination will properly weigh the signal according to the relationships of Fig. 3. See Par. 5.24, C message noise influence, for a discussion of expected interference between the disturbed and the disturbing circuit which may arise because of various measured interference values on voice services.

**DATA AND OTHERS**

**5.30** When a leased channel is to be used for the transmission of data, telemetering, facsimile or any other special type of services, it may be necessary to provide special protective measures within the central offices and throughout the length of the facility for electrical protection, security and man-made interference. Interference and protection requirements for these types of services are in general more stringent and may require special handling.



**BALANCED**  
Use Fig. 3 Directly

**UNBALANCED**  
Fig. 3 x 0.3

**GROUND RETURN**  
Fig. 3 x 0.2

**Attachment:**  
**Appendix**

## Appendix to Section V

### DESCRIPTION OF APPARATUS AND METHODS OF MEASUREMENT

#### 1. Noise Influence Coupling Network

Fig. 2A shows a schematic diagram of the noise influence coupling network. The capacitor and noninductive resistor may be of small size since little power is involved. They should, however, be reasonably accurate and substantial. The coupler should be checked by measuring its loss between 600-ohm impedances at several frequencies. These losses should be as follows:

| FREQUENCY | LOSS (db) |
|-----------|-----------|
| 250       | 60 ±1     |
| 500       | 54 ±1     |
| 1000      | 48 ±1     |
| 2000      | 42 ±1     |
| 4000      | 36 ±1     |

The loss may be measured by means of a variable frequency oscillator having a 600-ohm output impedance and the 3A noise measuring set as follows:

- (a) Calibrate the 3A noise measuring set and arrange it to measure on "15 KC FLAT WEIGHTING" as described in the information accompanying the set.
- (b) Connect a 600-ohm noninductive resistance across the input terminals of the coupler. ("Line" and "Grd." terminals)
- (c) Connect the oscillator to the 3A noise measuring set arranged as in (a) above and, at a given frequency, adjust the oscillator output so that the 3A noise measuring set gives a reading of about 70 dbrn. (This corresponds to about 30 db below 1 milliwatt.) Call this "reading No. 1."
- (d) With the oscillator adjusted to the above output, connect it to the input terminals of the coupler arranged as in (b) above.
- (e) Connect the 3A noise measuring set to the output terminals of the coupler and obtain the meter reading. Call this "reading No. 2."

- (f) The loss of the coupler is given by the difference between "reading No. 1" and "reading No. 2."

#### 2. Thump Coupling Network

A schematic diagram of the thump coupling network is shown in Fig. 2B. As in the case of the noise influence coupling network the capacitor and resistors may be of small size. The 8 henry coil should, however, be such that important harmonic components will not be generated within it. Its resistance should be about 200 ohms. One winding of a Western Electric Company 71A retardation coil is suitable. While it is not especially critical, some adjustment may have to be made in the .2 mf capacitor in order for the coupler to have the following losses when connected between 600-ohm impedances.

| FREQUENCY | LOSS (db) |
|-----------|-----------|
| 60        | 28 ±1     |
| 100       | 19 ±2     |
| 250       | 29 ±1     |
| 500       | 38 ±1     |
| 1000      | 45 ±1     |

These losses may be measured in the same manner as described above for the noise influence coupling network.

#### 3. Terminating Networks

For best results, the equipment to be tested should be terminated in its intended line facility. Where the line facility is not available, however, the following networks may be used to obtain an approximate indication:

- (a) *Line Simulating Network for Noise Influence Measurements.* Fig. 2C shows a network that is used for these tests, as an approximate termination to simulate cable simplex phantoms or single wire cable circuits, terminated in telegraph apparatus at the distant end, when the circuit resistance lies be-

tween 300 and 1000 ohms.  $R_2$  is adjusted so that its resistance plus that of the 12 henry coil (12H) is equal to the resistance of the line facility, including the resistance to ground at the far end.  $R_2$  and the 12H coil must be capable of handling telegraph line currents. The resistance of the 12H coil must be close to 200 ohms. Two Western Electric Company 149E retardation coils in series, each connected series aiding, are satisfactory for the 12 henry coil.

(b) ***Circuit Simulating Network for Thump Measurements.*** Fig. 2D shows a terminating network for thump measurements. For these tests, it is used to simulate the impedance looking into the telegraph leg of an open wire composite set connected to an open wire circuit 50 to 200 miles in length. The variable resistor  $R_2$  is adjusted so that it, plus the 12H coil

resistance, equals the direct current resistance in the actual telegraph circuit.

#### **4. Combined Couplers and Simulating Networks**

It may be convenient to incorporate the couplers and terminating networks in a single unit. Fig. 2E shows a schematic diagram of such a unit.

Switch 1, in addition to providing a means for selecting either the thump coupler or the noise influence coupler, is arranged to alter the terminating network branch to provide the corresponding impedance termination. Switch 2 merely provides a means for opening the terminating network branch when the couplers are used with the actual line facility. The adjustable resistance is not included internally since it will generally be desirable to use a decade resistance box for this branch.

**Attachment:**  
**Figs. 1 through 3**

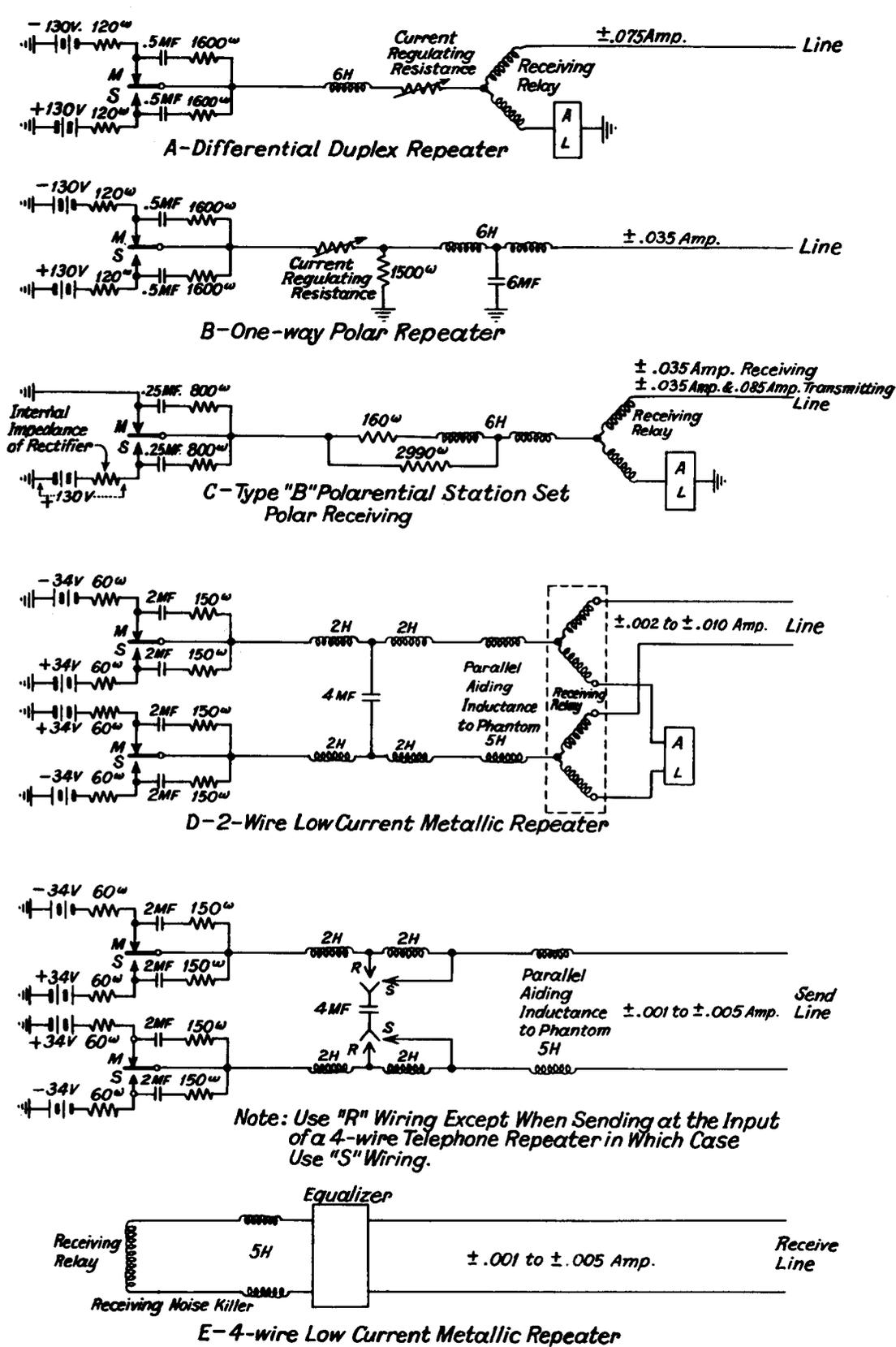


Fig. 1 - Typical Bell System Telegraph Repeater Line Circuits. Schematic Diagrams of Noise and Spark Killer Features

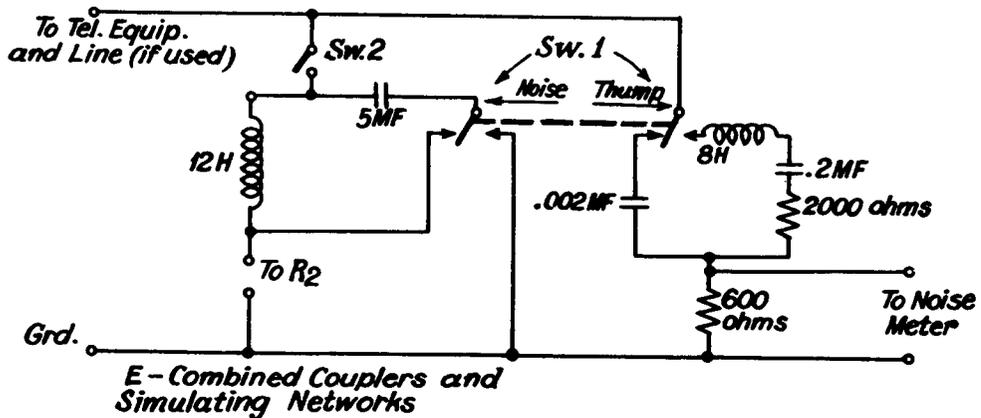
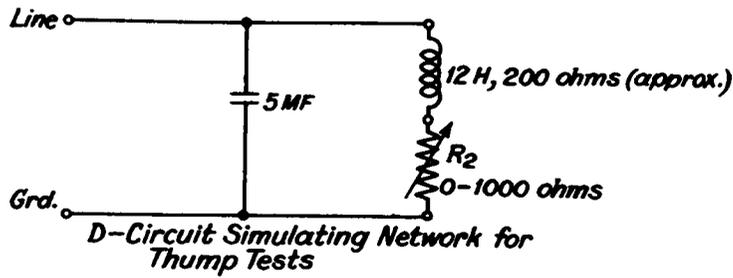
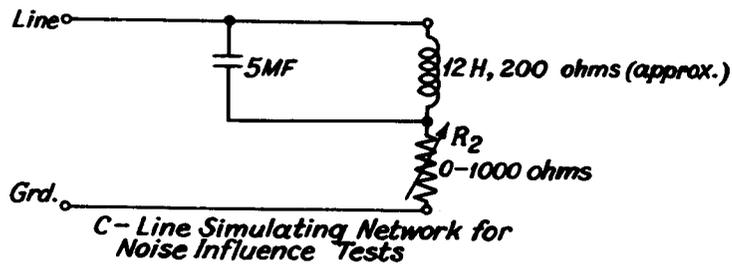
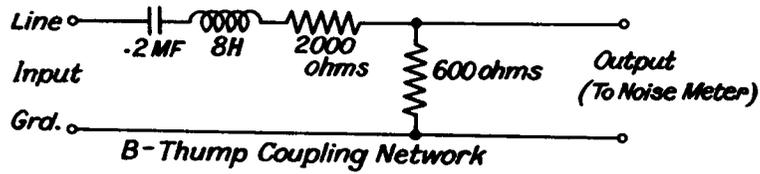
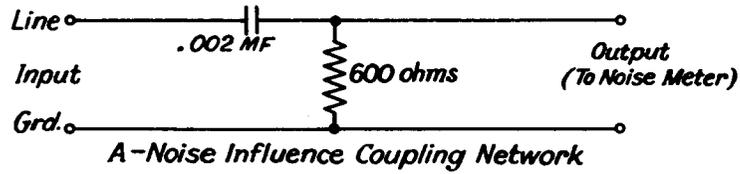


Fig. 2 - Noise Influence and Thump Coupling Networks and Terminating Networks

GENERAL GUIDE FOR SINGLE FREQUENCY METALLIC VOLTAGE  
 IMPRESSED ON TOLL OR LOCAL TELEPHONE FACILITIES  
 WITH BALANCED TERMINAL EQUIPMENT  
 FOR REMOTE CHANCE OF INTERFERENCE

3-1-63 HNL

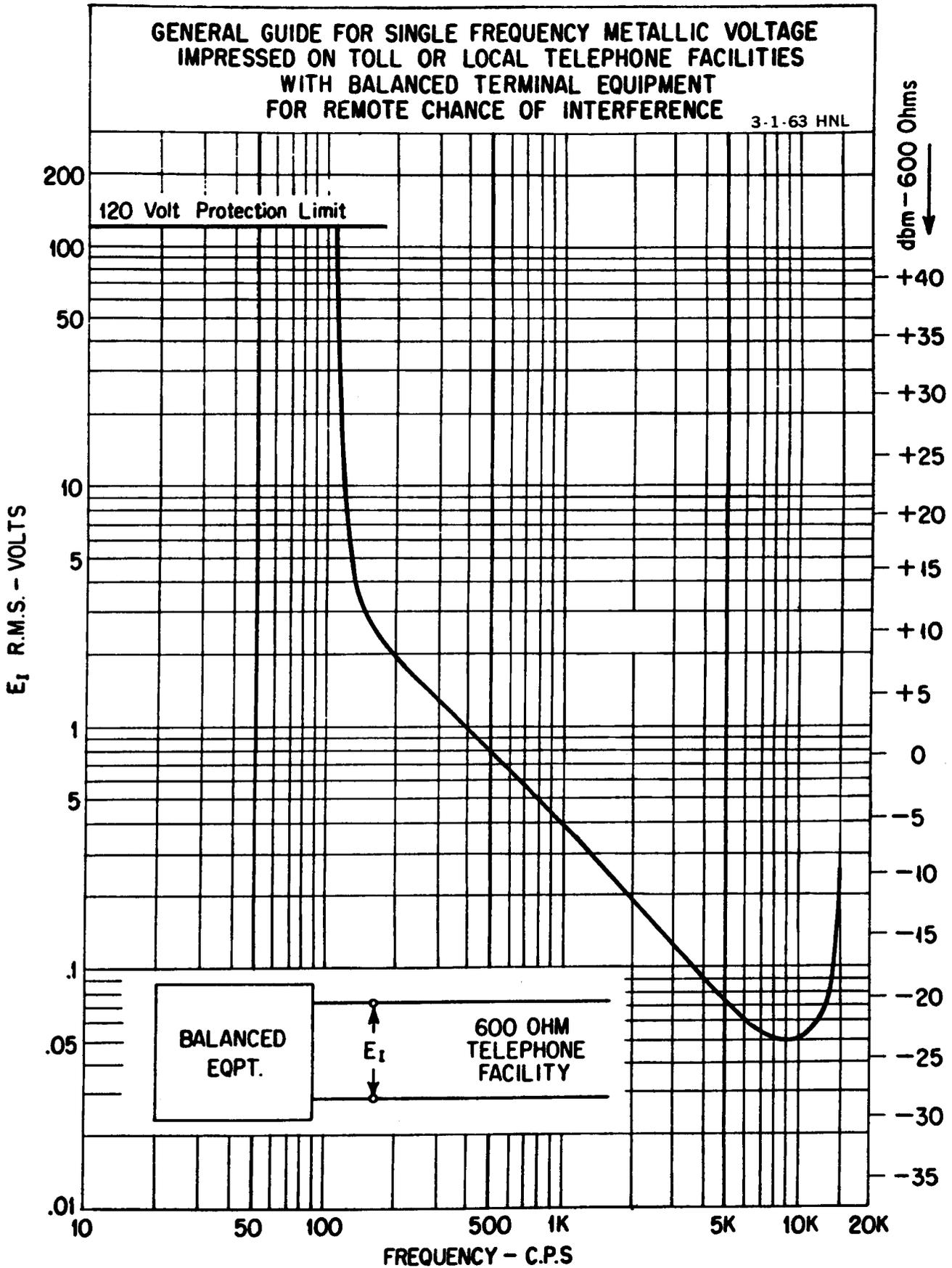


Fig. 3