PUB 42110

PRELIMINARY

Bell System Voice Communications
TECHNICAL REFERENCE

Interface Arrangement POP Specifications

June 1981

DIRECTOR – TERMINAL SYSTEMS PERFORMANCE AND SUPPORT

(326-951)

NOTICE

This Technical Reference is published by American Telephone and Telegraph Company as a guide for the designers, developers, manufacturers, and consultants to use in designing communications systems and equipment which connect with specific Bell System communications systems or equipment. American Telephone and Telegraph Company reserves the right to revise this Technical Reference for any reason, including, but not limited to, conformity with FCC regulations; standards promulgated by ANSI, EIA, CCITT, or similar agencies; utilization of new advances in the state of the technical arts; or to reflect changes in the design of equipment or service described herein. The limits of responsibility and liability of the Bell System with respect to the use of customer-provided equipment and systems are set forth in the appropriate tariff regulation.

If further information is required, please contact:

Director - Terminal Systems Performance and Support
American Telephone and Telegraph Company
295 North Maple Avenue
Basking Ridge, NJ 07920

TECHNICAL REFERENCE

INTERFACE ARRANGEMENT POP

TABLE OF CONTENTS

List of Figures

1. GENERAL

1.1 Introduction

FCC tariffs and corresponding intrastate tariffs filed by the Bell System provide for the direct electrical connection of customer-provided voice transmitting and receiving terminal equipment and communications systems to the message telecommunications network. The tariffs also provide for the indirect (acoustic or inductive) connection of such equipment or systems.

Electrical connection for equipment not registered with the FCC is made through an Interface Arrangement and associated network control signaling unit furnished, installed, and maintained by the Telephone Company. Equipment with FCC registration may be connected without an Interface Arrangement.

1.2 Application

Interface Arrangement POP provides a means for connecting unregistered customer-provided terminal equipment (typically loud-speakers) or communications systems (typically private mobile radio systems or local radio stations, for special events) to registered equipment without affecting its registration status. This connection to the message telecommunications network is controlled by an exclusion-key equipped telephone set furnished by the Telephone Company. The Interface Arrangement is intended for transmitting and receiving voiceband signals only and may not be suitable for use with data signals or dual tone multi-frequency signals. It is only available for use with telephone sets that are equipped with an exclusion key feature.

1.3 Ordering and Identification

The connection service described in this Technical Reference is identified by the Bell System as Interface Arrangement POP.

Interface Arrangement POP may be used in single line set applications or key telephone set applications either associated with a single line or in common with all lines.

One Interface Arrangement POP should be ordered for each exclusion key equipped telephone set to which it is to be connected. The local Telephone Company Business Service Center or Marketing representative will provide information regarding availability and rates for this service.

2. DESCRIPTION

2.1 Functions

The major functions of Interface Arrangement Pop are:

(a) To limit in-band and out-of-band signals which may be applied through the Interface Arrangement to the telecommunications network. In-band and out-of-band signals are limited to conform with FCC Part 68 registration requirements.

(b) To provide longitudinal balance to conform with FCC Part 68 registration requirements.

(c) To provide voiceband analog transmission to and from the telecommunications network.

Network control signaling to the network (including dialing, on-hook, etc.) is provided by means of the associated telephone set.

2.2 Physical

The Interface Arrangement consists of a voice coupler connected to an associated Telephone Company-provided telephone set equipped with an exclusion-key (see Fig. 1). The Interface Arrangement does not require local power. The wall mounted voice coupler is 10 cm (4 inches) wide, 7 cm (2-3/4 inches) high, 4 cm (1-5/8 inches) deep, and weighs approximately #225 grams (1/2 pound). It will operate over a temperature range from 0° to 55°C and a humidity range from 5 to 95 percent.

2.3 Interface Leads

Two interface leads, terminated in a standard "phone" jack on the voice coupler, are provided in Interface Arrangement POP. The customer must provide the mating 6.35 mm (.25-inch) "phone" plug and connecting cord (see Fig. 2).

2.4 Installation

The Coupler mounts on most flat surfaces. The distance between the coupler and the associated telephone set should be no greater than 7.6 meters (25 feet).

3. OPERATION

3.1 Incoming Call

An incoming call is received in the usual way. When connection to the customer provided equipment (CPE) is desired, the customer lifts the white exclusion-key on the associated telephone set.

3.2 Outgoing Call

An outgoing call is placed in the usual way, and the customer provided equipment is connected to the line by lifting the associated telephone set exclusion-key after the call has been established. The Interface Arrangement should be in inactive mode when dialing to prevent possible dial pulse or dual tone multi-frequency distortion and transmission to the customer provided equipment.

3.3 Disconnect

The Interface Arrangement will be disconnected when the associated telephone set goes on-hook to terminate the call or when the exclusion-key is pushed down to normal position.

3.4 The telephone set remains connected to the line and is functional on both incoming and outgoing calls unless the transmitter or receiver cutoff option is in effect.

3.5 As a customer option, the transmitter and/or receiver of the associated telephone set may be disconnected when the CPE is in operation. The associated telephone set may be equipped with a cutoff turnkey or spare exclusion-key contacts used for this purpose.

3.6 When the turnkey is used to disconnect the transmitter and/or receiver, the turnkey must be in the ON position to receive or make a call and turned OFF to disconnect transmitter or receiver or both when the Interface Arrangement is used. The cutoff key must be manually restored when the call is terminated. When the exclusion-key contacts are used to disconnect the transmitter and/or receiver, lifting the exclusion-key will automatically disconnect the transmitter or receiver or both. When the call is terminated, the transmitter and/or receiver will be automatically restored.

4. SPECIFIC DESIGN CONSIDERATIONS - TRANSMISSION PATH

4.1 Insertion Loss

Interface Arrangement POP has an insertion loss at 1000 Hz with a 600 ohms termination that ranges from about 6 to 10 dB. This loss is a result of bridged condition of the voice coupler and the telephone set. The loss generally varies inversely with the loss of the telephone facility between the terminal and the Central Office, providing some equalization of levels. Disabling the receiver (by means of a cutoff turnkey or exclusion-key option) decreases this loss by about 1 dB. Disabling both the transmitter and receiver decreases the loss about 0.5 dB. Disabling only the transmitter has no effect on the loss.

4.2 Impedance

Interface Arrangement POP provides about a one-to-one impedance transformation. The impedance is a function of the Interface Arrangement impedance, the bridged telephone set, and the impedance of the line to the Central Office. For design purposes, the input impedance of this arrangement should be considered to be 600 ohms and, therefore, the impedance of the customer-provided equipment should be 600 ohms for optimum voice signal power transfer across the interface.

4.3 Bandwidth

The nominal voice-frequency bandwidth of the telecommunications network extends from about 300 to about 3000 Hz. In general, an end-to-end connection may be expected to have a loss characteristic which increases on either side of this band. This Interface Arrangement does not limit this bandwidth.

4.4 Signal Power Distribution

The telecommunications network incorporates tone signaling devices that are used for network control functions. These devices, which are connected at all times to the telephone circuit, are designed to be sensitive to a single-frequency tone at 2600 Hz. They are, however, relatively insensitive to energy at this frequency if sufficient energy is present at the same time as other frequencies in the voiceband.

In order to prevent the interruption or disconnection of a call, or interference with network control signaling, it is necessary that the signal applied by the customer-provided equipment to the Interface Arrangement at no time has energy solely in the 2450 to 2750 Hz band. If signal power is in the 2450 to 2750 Hz band, it must not exceed the power present at the same time in the 800 to 2450 Hz band.

4.5 Signal Limiting

A voice signal limiter is incorporated in the transmission path to protect the message telecommunications network from applications of abnormally high signal levels. This has no effect on normal voice applications. A filter which limits out-of-band energy is also included.

5. GENERAL DESIGN CONSIDERATIONS

5.1 Foreign and Surge Voltage Protection

Where telephone lines are exposed to foreign voltages by direct contact or induction (e.g., power line crosses or lightning), protecting devices are installed at the Central Office and on the customer's premises that will provide a path to ground for foreign voltages that exceed about 600 volts peak. Since the customer's equipment is connected to the telephone line through the Interface Arrangement, the customer's equipment is protected from longitudinal surges by transformer isolation.

The customer is responsible for providing protection, internal to the customer's equipment and facilities, against foreign and hazardous voltages from the customer's equipment and facilities being applied to the Interface Arrangement.

5.2 Grounding

It is expected that the customer's equipment, if powered from commercial power, will be grounded in accordance with applicable electrical codes such as the National Electrical Code, (NEC).

5.3 Telecommunications Network Characteristics

5.31 End-to-End Electrical Loss

The end-to-end electrical loss of a connection is a function of the impedances of both end terminations, and the losses of the interoffice trunks, the serving Central Offices and the facilities to the serving offices. The information found in the REFERENCES in Appendix B may be used to determine statistical loss distributions for different types of calling patterns on the telephone network.

5.32 Nonlinearities

Nonlinearities such as compression, clipping, and harmonic distortion can exist on the telecommunication network. Normally, these are low enough to be ignored. It is expected that harmonic distortions will result in single tones which are no greater than about 5% of the fundamental.

6. SERVICE AND MAINTENANCE CONSIDERATIONS

6.1 Responsibility of the Customer

The tariffs permitting connection of customer-provided terminal equipment or communications systems state that:

(1) The Customer shall be responsible for the installation, operation and maintenance of any customer-provided terminal equipment or communications system. No combinations of Customer-provided terminal equipment or communications systems shall require change in or alteration of the equipment or services of the Telephone Company, cause electrical hazards to Telephone Company personnel, damage to Telephone Company equipment, malfunction of Telephone Company billing equipment, or degradation of service to persons other than the user of the subject terminal equipment or communications system, his calling or called party.

(2) Upon notice from the Telephone Company that a customer-provided terminal equipment or communications system is causing such hazard, damage, malfunction or degradation of service, the customer shall make such changes as shall be necessary to remove or prevent such hazard, damage, malfunction or degradation of service.

6.2 Responsibility of the Telephone Company

The tariffs permitting connection of customer-provided terminal equipment or communications systems state that:

(1) Telecommunications services are not represented as adapted to the use of customer-provided terminal equipment or communcations systems. Where customer-provided terminal equipment or communications systems are used with telecommunications services, the responsibility of the Telephone Company shall be limited to the furnishing of service components suitable for telecommunications services and to the maintenance and operation of service components in a manner proper for such services. Subject to this responsibility the Telephone Company shall not be responsible for (i) the through transmission of signals generated by the customer-provided terminal equipment or communications systems or for the quality of, or defects in, such transmission, or (ii) the reception of signals by customer-provided terminal equipment or communications systems, or (iii) address signaling where such signaling is performed by customer-provided signaling equipment.

(2) The Telephone Company may make changes in its telecommunications services, equipment, operations or procedures, where such action is not inconsistent with Part 68 of the Federal Communication's Rules and Regulations. If such changes can be reasonably expected to render any customer's terminal equipment or communications system incompatible with telecommunications services, or require modification of alteration of such customer-provided terminal equipment or communications systems, or otherwise materially affect its use or performance, the customer will be given adequate notice, in writing, to allow the customer an opportunity to maintain uninterrupted service.

6.3 Trouble Reporting Procedure

When trouble is experienced with this service, the customer should perform the necessary testing on the customer side of the interface to sectionalize the difficulty, i.e., determine whether the service impairment is located in the customer-provided equipment. If it is determined that the trouble is in the customer-provided equipment, the equipment should be disconnected until repaired. If the tests indicate that the trouble is not in the customer-provided equipment, the Telephone Company should be promptly informed. Trouble reports should be called into the listed "Repair Service" number which can be found in the front of the telephone directory. The repair attendant should be given the following information:

(a) Customer's name

(b) Customer's address

(c) Listed telephone number

(d) Description of the trouble

(e) Customer's contact for additional information

If a Telephone Company service call determines that the location of the trouble is in the customer-provided equipment, the customer will be billed a Maintenance of Service charge.

APPENDIX A

GLOSSARY

COMMUNICATIONS SYSTEM - denotes channels and other facilities which are capable, when not connected to the Long Distance Message Telecommunications service or private line service, of communications between customer-provided terminal equipment or Telephone Company stations.

CUSTOMER - denotes the person, firm or corporation which orders service. The customer is responsible for the payment of charges and compliance with all Telephone Company regulations.

CUSTOMER-PROVIDED TERMINAL EQUIPMENT - denotes devices or apparatus and their associated wiring, provided by a customer, which do not constitute a communications system and which, when connected to the communications path of the telecommunications network, are so connected either electrically, acoustically, or inductively.

INTERFACE ARRANGEMENT - equipment provided by the Telephone Company to accomplish the electrical connection of customer-provided equipment and the telecommunications network

NETWORK CONTROL SIGNALING - denotes the transmission of signals used in the telecommunications network which perform functions such as supervision (control, status, and charging signals), address signaling (dialing, both rotary and DTMF signaling), calling and called number identification, audible tone signals (call progress signals indicating reorder or busy conditions, alerting, coin denomination, coin collect and return tones) to control the operations of switching machines in the telecommunications network.

NETWORK CONTROL SIGNALING UNIT - denotes the terminal equipment furnished, installed, and maintained by the Telephone Company for the provisioning of network control signaling.

SUPERVISORY SIGNALS - signals used to initiate a request for service by the calling party (off-hook); to indicate a disconnect (on-hook); and to recall an operator or distant party to a connection (switchhook flash).

TELECOMMUNICATIONS NETWORK - the Bell System voice switching equipment, associated interconnecting facilities, and station equipment which provide Long Distance message Telecommunications service or private line service.

TELEPHONE COMPANY - denotes the American Telephone and Telegraph Company, the Long Lines Department, its concurring carriers, and its connecting carriers, either individually or collectively.

VOICE COUPLER - the part of the Interface Arrangement which connects the transmission path from the customer-provided equipment to the telecommunications network.

MAINTENANCE OF SERVICE CHARGE - The charge applied by the Telephone Company for any visit required because of a service difficulty which, in the judgement of the telephone company employee, was caused by or resulted from the use of customer provided equipment.

APPENDIX B

REFERENCES

Some references describing various transmissions characteristics of the telecommunications network are listed below:

*(a) McAdoo, K.L., "Speech Volumes on Bell System Message Circuits - 1960 Survey," Bell System Technical Journal (BSTJ), Vol. 42, No. 5 (September 1963), p. 1999.

*(b) Nasell, I., "The 1962 Survey of Noise and Loss on Toll Connections," BSTJ, Vol. 42, No. 2 (March 1964), p. 697.

*(c) Nasell, I., "Some Transmission Characteristics of Bell System Toll Connections," BSTJ, Vol. 47, No. 6 (July-August 1968), p. 1001.

*(d) Nasell, I., Ellison, C.R.; and Homstrom, R., "The Transmission Performance of Bell System Intertoll Trunks," BSTJ, Vol. 47, No. 8 (October 1968), p. 1561.

*(e) Gresh, P.A., "Physical and Transmission Characteristics of Customer Loop Plant," BSTJ, Vol. 48, No. 10 (December 1969), p. 3337.

*(f) Alexander, A.A., Gryb, R.M.; and Nast D.N., "Capabilities of the Telephone Network for Data Transmission," BSTJ, Vol. 39, No. 3 (May 1960), p. 431.

*(g) Breen, C., and Dalhbom, C.A., "Signaling Systems for the Control of Telephone Switching," BSTJ, Vol. 39, No. 6 (November 1960), p. 1381.

*(h) Bodle, D.W., and Gresh, P.A., "Lightning Surges in Paired Telephone Cable Facilities," BSTJ, Vol. 40, No. 2 (March 1961), p. 547.

**(i) "Principles of Electricity Applied to Telephone and Telegraph Work", by American Telephone and Telegraph Company, New York, New York.

**(j) "Switching Systems," by American Telephone and Telegraph Company, New York, New York.

**(k) "Notes on the Network - 1980" by American Telephone & Telegraph Company, New York, New York.

**(l) "Transmission Systems for Communications," by Bell Telephone Laboratories, Inc.

***(m) AT&T Technical Reference PUB 47001-Electrical Characteristics of Bell System Network Facilities at the Interface with Voiceband Ancillary and Data Equipment - Preliminary - August 1976.

***(n) AT&T Technical Reference PUB 47002 Electrical Characteristics of Bell System PBX and Key Equipment at the Interface with Voiceband Ancillary and Data Equipment - Preliminary - August 1976.

#(o) FCC Rules and Regulations - Part 68

APPENDIX C

WHERE TO OBTAIN REFERENCE MATERIAL

* Bell System Technical Journals (BSTJ)

These journals may be purchased by writing to:

Bell Laboratories
Circulation Group
Whippany Road
Whippany, NJ 07981

** Bell System Technical Reference

These references may be purchased by writing to:

Western Electric Company, Inc.
Commercial Sales
Guilford Center
P.O. Box 20046
Greensboro, N.C. 27420

Attn. Sales Specialist (919) 697-5712

*** These references can be purchased by writing to:

Publishers' Data Center, Inc.
P.O. Box C738
Pratt Street Station
Brooklyn, NY 11205

\# This reference can be purchased by writing to:

Superintendent of Documents
Government Printing Office
Washington, D.C. 20402

INTERFACE ARRANGEMENT POP

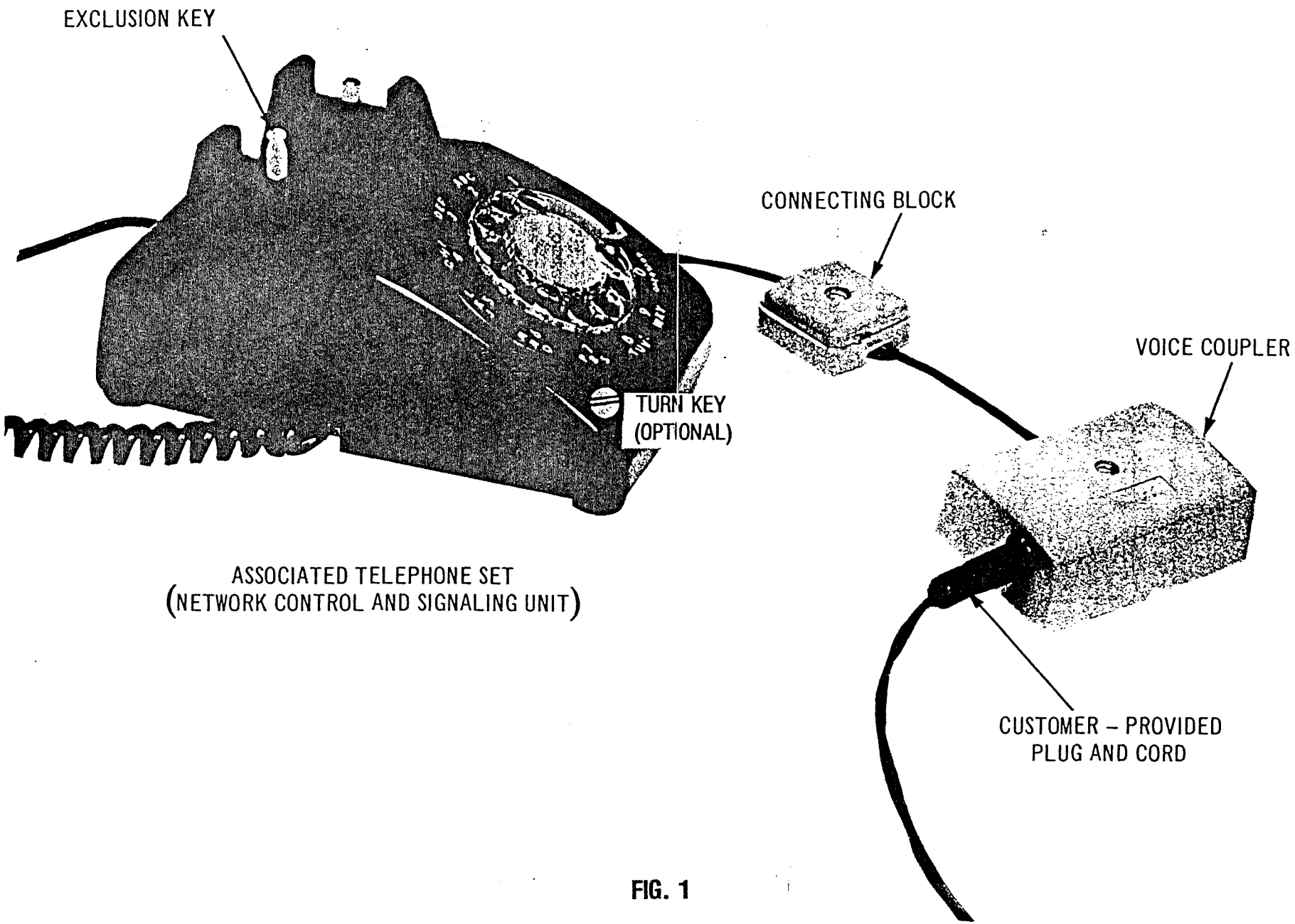
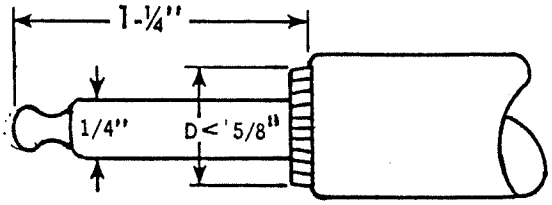
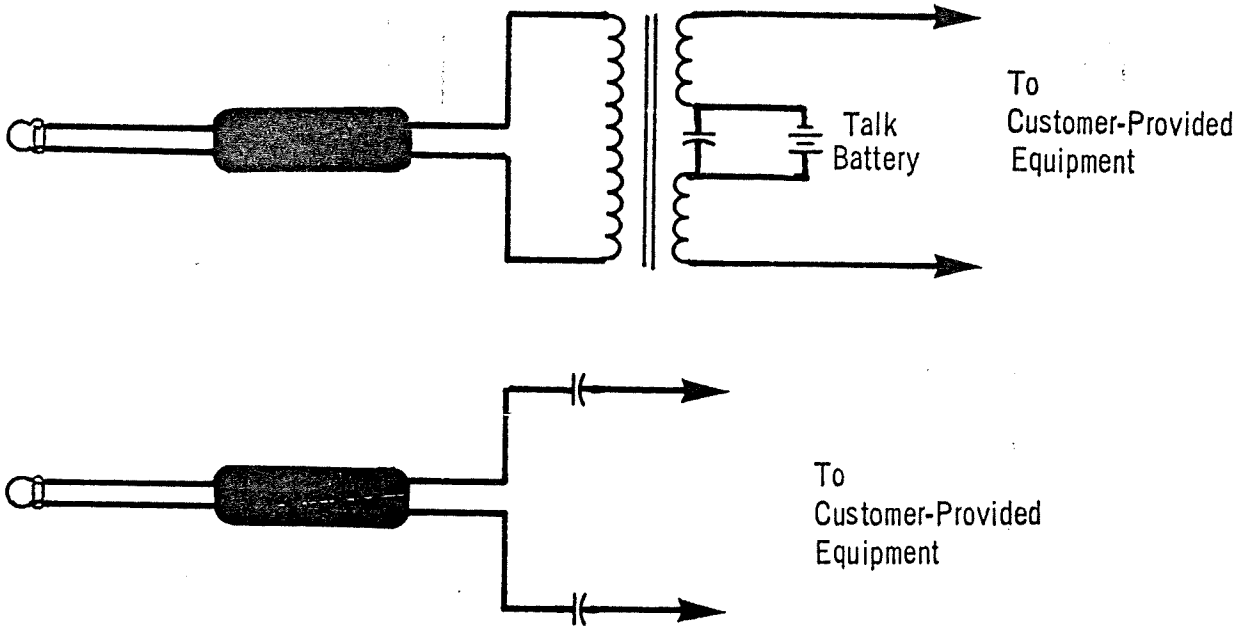


FIG. 1

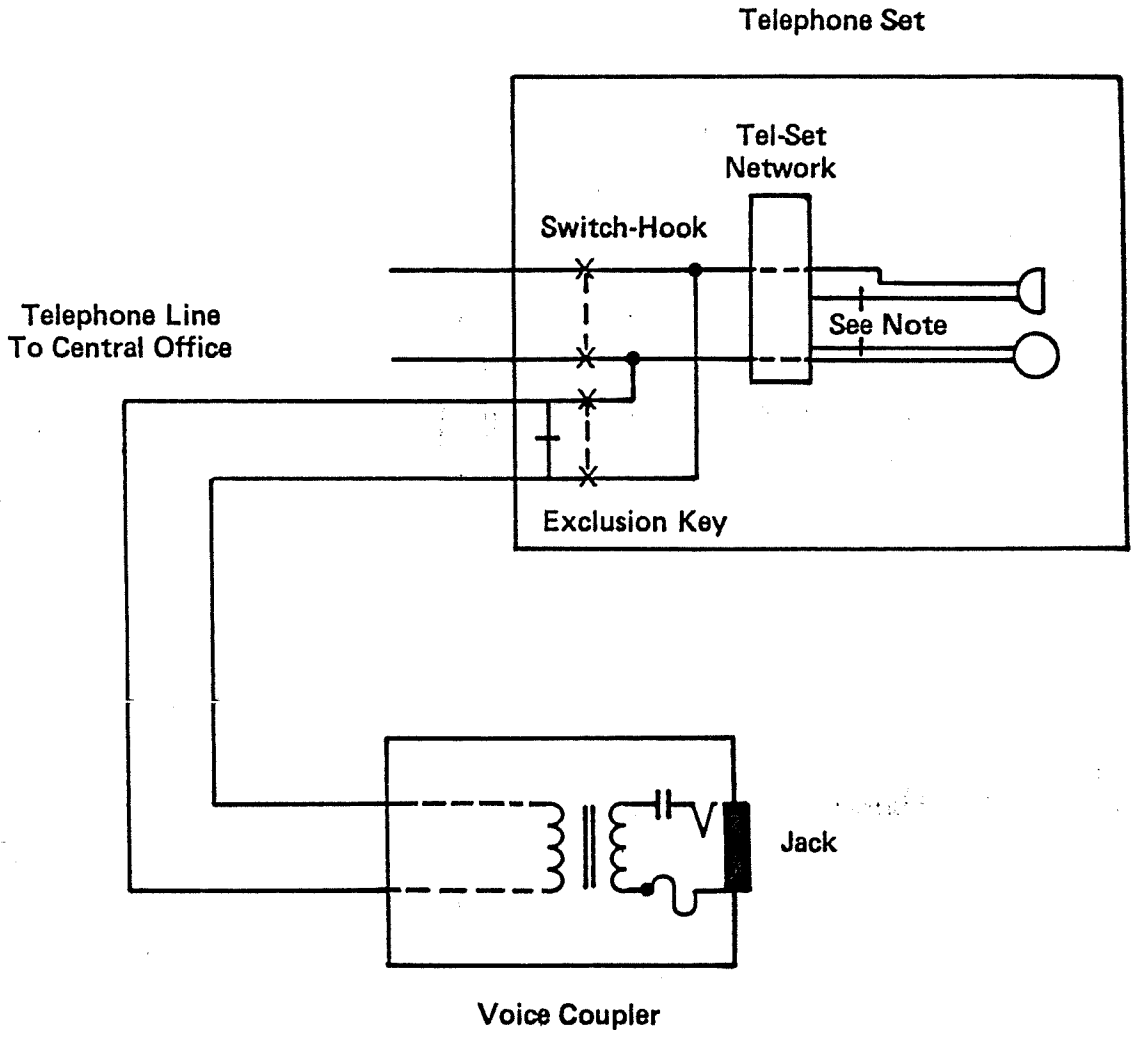


¼ inch "Phone" plug – Switchcraft 240 or equivalent



TYPICAL CONNECTIONS
TO BE PROVIDED BY CUSTOMERS
Fig. 2

SIMPLIFIED SCHEMATIC — INTERFACE ARRANGEMENT POP



Note: Disable Function Using Turnkey Or Part Of Exclusion Key

FIG. 3