PRELIMINARY

Bell System Voice Communications
TECHNICAL REFERENCE

Voice Connecting Arrangement

RCZ

Interface Specification

JUNE, 1970

ENGINEERING DIRECTOR - CUSTOMER TELEPHONE SYSTEMS

PRELIMINARY

NOTICE

This Technical Reference is specifically intended for the developers and designers of telephone voice communications systems and equipment which interface with the Bell System telecommunications network and for technical consultants to use in designing communications systems and arrangements requiring connections to the Bell System telecommunications network. The right to revise this Technical Reference for any reason, including conformity with USASI, EIA, CCITT or other standards, to utilize new advances in the state of the technical arts, or to reflect changes in the design of the equipment and/or service described herein, is expressly reserved.

If further information is required, please contact:

Engineering Director - Customer Telephone Systems
American Telephone and Telegraph Company
195 Broadway
New York, New York 10007

PREFACE

The material in this Technical Reference is intended for use by designers and manufacturers of telephone equipment who expect to connect their communications equipment to the Bell System telecommunications network. This material covers guides which, if followed, should permit the transmission and reception of voice signals without interference to other Telephone Company services.

The responsibility of the Bell System with respect to the use of customer-provided equipment is as set forth in the appropriate Tariff regulations.

In furnishing this material, the Bell System Telephone Companies make no claims or representations and assume no responsibility, beyond that set forth in the Tariff regulations, for the suitability of the transmission path or the performance of the telecommunications system. The Bell System is in no way responsible for the design, performance, installation, operation or maintenance of the communications systems or equipment provided by others which are connected to the telecommunications network and does not endorse or approve any such system or equipment. The material in this Technical Reference is furnished in the interest of preventing interference to other Telephone Company services and users, and is not furnished with the intent to provide complete design specifications or parameters, or to assure the quality or performance of customer-provided telephone systems and equipment.

TABLE OF CONTENTS

LIST OF FIGURES

1. GENERAL

F.C.C. Tariff No. 263 and corresponding intrastate Tariffs filed by the Bell System, provide for the direct connection of customer-provided voice transmitting and receiving terminal equipment and communications systems to the Bell System telecommunications network. Direct electrical connection is made through a voice connecting arrangement furnished, installed, and maintained by the Telephone Company. The Tariffs also provide for the indirect (acoustic or inductive) connection of such equipment or systems.

In addition, the Bell System retains responsibility for network control signaling. This includes the switchhook, dialing and control functions, as well as responsibility for the protective function of voice signal limiting and isolation of Central Office battery from the customer-provided equipment.

The connection service described in this Technical Reference is identified by the Bell System as Voice Connecting Arrangement RCZ and should be ordered as such. Contact your local Telephone Company business office or Marketing representative for information regarding rates for, and the availability of, this voice connecting arrangement for both new and additional service.

2. SYSTEM DESIGN CONSIDERATIONS

2.1 Voice Connecting Arrangement RCZ

Voice Connecting Arrangement RCZ (Recorder-Connector) is intended to be used on the customer's premises to provide the means, as required by the Federal Communications Commission for recording of two-way telephone conversations, for the connection of a customer-provided recorder-reproducer to the telephone line. The purpose of this equipment is to

serve as a protective voice connecting arrangement between the telecommunications network and the customer's equipment; to provide a high impedance balanced bridging connection to the telephone line; to provide a transmission path from the telephone line to the customer's equipment with amplification and optional automatic volume control (AVC); and to provide a "beep" tone of 1400 Hz at approximately 15-second intervals to alert both parties that recording is taking place. The "beep" tone need not be recorded on the customer's recorder-reproducer recording medium.

2.2 Service and Maintenance Considerations

2.21 Responsibility of the Customer

The Tariffs permitting direct electrical connection of customer-provided terminal equipment state that:

> Where long distance message telecommunications service is available under this Tariff for use in connection with customer-provided equipment, the operating characteristics of such equipment shall be such as not to interfere with any of the services offered by the Telephone Company. Such use is subject to the further provisions that the customer-provided equipment does not endanger the safety of Telephone Company employees or the public; damage, require change in or alteration of, the equipment or other facilities of the Telephone Company; interfere with the proper functioning of such equipment or facilities; impair the operation of the telecommunications system or otherwise injure the public in its use of the Telephone

Company's services. Upon notice from the Telephone Company that the customer-provided equipment is causing or is likely to cause such hazard or interference the customer shall make such change as shall be necessary to remove or prevent such hazard or interference.

2.22 Responsibility of the Telephone Company

The Tariffs permitting direct electrical connection of customer-provided terminal equipment state that:

The Telephone Company shall not be responsible for the installation, operation, or maintenance of any customer-provided terminal equipment. Long distance message telecommunications service is not represented as adapted to the use of customer-provided equipment and where such equipment is connected to Telephone Company facilities the responsibility of the Telephone Company shall be limited to the furnishing of facilities suitable for long distance message telecommunications service and to the maintenance and operation of such facilities in a manner proper for such telecommunications service; subject to this responsibility the Telephone Company shall not be responsible for (i) the through transmission of signals generated by the customer-provided equipment or for the quality of, or defects in, such transmission, or (ii) the reception of signals by customer-provided systems.

The Telephone Company shall not be responsible to the customer or otherwise if changes in the criteria contained in the Tariffs

and Paragraph 4 of this Technical Reference, or in any of the facilities, operations, or procedures of the Telephone Company render any customer-provided facilities obsolete or require modification or alteration of such equipment or otherwise affect its use or performance.

2.23 Trouble Reporting Procedure

When trouble is experienced with this service, the customer should perform the necessary testing to sectionalize the difficulty, i.e., determined whether the service impairment is located in the customer-provided equipment or in the equipment provided by the Telephone Company. If the tests indicate that the trouble is in the Telephone Company-provided equipment, it should be promptly reported to the Telephone Company. 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:

(a) Customer's name.

(b) Customer's address.

(c) Listed telephone number.

(d) Description of the trouble.

(e) Customer's contact for additional information.

2.3 Foreign and Surge Voltage Protection

Where telephone lines are exposed to lightning, power circuit contact, or induction, protective 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 voice connecting arrangement, the customer's equipment is protected from longitudinal surges by transformer isolation. The maximum surge between the conductors at the coupler jack terminal that the customer's equipment may encounter due to foreign potential is 30 volts.

The customer is responsible for providing protection, internal to his equipment and facilities, against foreign and surge voltages from his equipment and facilities being applied to the voice connecting arrangement. The surge potential on the transmission leads shall be limited to 30 volts. The surge potential on the other conductors shall be limited to 600 volts peak between conductors or from one conductor to ground.

2.4 Hazardous Voltage Limitations

When it is necessary for the customer to apply an operational voltage to facilities interconnected with telephone facilities, certain voltage limitations shall be observed. These limitations are for the purpose of providing adequate protection to personnel and plant facilities. Unless otherwise specified in Paragraph 4 of this Technical Reference, steady-state voltages applied by customer-provided equipment to conductors connected to Voice Connecting Arrangement RCZ should not exceed the following:

	dc	ac(RMS)
Maximum voltage, any conductor to ground	135	50
Maximum voltage, conductor to conductor	(135	(50
	(270*	(100*

*Permitted only if voltage source is center-tapped to ground.

The power supplies and wiring methods used in the customer-provided equipment should meet the provisions of the National Electrical Code (NEC), Article 725, for Class 2 remote control and signal circuits.

3. DESCRIPTION OF VOICE CONNECTING ARRANGEMENT RCZ

3.1 Physical

Voice Connecting Arrangement RCZ is contained in a wall mounted apparatus box measuring approximately 6-7/8 inches wide, 7-3/8 inches high, and 3-3/8 inches deep (Fig.1). The arrangement weighs approximately four pounds. A receptacle is provided at the bottom of the unit to connect the speech and remote control leads to the customer's equipment. The customer must provide the connecting cable and mating interface receptacle (SK-M7-21C Common Plug or equivalent) (Figs. 2 and 3). A Telephone Company-provided plug-in transformer connected to a 115 volt, 60 HZ power source is required in order to supply the low voltage ac power for this arrangement.

3.2 Functions

The major functions of this voice connecting arrangement are:

(a) To protect Telephone Company personnel and equipment from hazardous voltages which may be applied at the interface.

(b) To provide the means for compliance with the Federal Communications Commission regulation requiring a "beep" tone alerting signal to both parties of a telephone conversation that is being recorded.

(c) To provide a high impedance bridging connection to the telephone line.

(d) To provide a unidirectional voice transmission path with amplification and optional automatic volume control (AVC) from the telephone line to the customer's recorder.

(e) To provide a rejection filter (inserted only during the "beep" tone) to eliminate the "beep" tone signal from the input signal to the customer-provided recorder.

(f) To provide a means for the customer-provided equipment to activate the voice connecting arrangement.

3.3 Interface Leads

Four interface leads per circuit are provided from Voice Connecting Arrangement RCZ for the customer's use (Fig. 2). These leads are:

START (Leads ST1 and ST2) - When a closure is applied and maintained by the customer's equipment, these leads will activate the voice connecting arrangement when the handset of the associated telephone is off-hook. This contact in the customer's equipment should be capable of handling 40 volts dc and 20 milliamperes.

SPEECH (Leads CT and CR) - These leads provide a one-way transmission path from the telephone line to the customer's recorder when a closure is applied across leads ST1 and ST2.

3.4 Originating and Receiving Calls

A call using Voice Connecting Arrangement RCZ is placed in a manner similar to a regular telephone call. To initiate a call, the customer lifts the handset of the associated telephone set, assures that dial tone is being received, and dials the desired telephone number.

During the calling process, the voice connecting arrangement is set automatically in a standby condition. When dialing is completed and the call acknowledged, the customer can activate the voice connecting arrangement by applying and maintaining a closure between the START leads. This customer-provided closure automatically bridges the voice connecting arrangement across the SPEECH leads of the telephone line. At 15-second intervals the voice connecting arrangement transmits a 1400 Hz "beep" tone on the telephone network to inform both parties that recording is taking place. Voice Connecting Arrangement RCZ is deactivated by the removal of the closure from between the ST1 and ST2 leads and/or by replacing the handset on the cradle.

A call received by a customer with Voice Connecting Arrangement RCZ is answered in a manner similar to a regular telephone call. If a recording is desired the customer applies and maintains the closure of the START leads activating the voice connecting arrangement and automatically connecting it to the telephone line. After completion of the call, the customer can deactivate Voice Connecting Arrangement RCZ by removing the closure from between the ST1 and ST2 leads and/or replacing the handset on the cradle.

If the customer wishes to have the voice connecting arrangement activated for every call, leads ST1 and ST2 may be strapped in the customer-provided equipment; the arrangement will then be activated every time the switchhook of the associated telephone set is operated.

4. ELECTRICAL CHARACTERISTICS

4.1 Transmission Path

Since Voice Connecting Arrangement RCZ provides transmission from the telephone line to the customer's equipment over a frequency range between 150 to 10,000 Hz, the limitations on the bandwidth is determined by the characteristics of the telecommunications network. It has voice signal amplification and an automatic volume control feature which, when fully activated, provides a relatively constant amplifier output level to the customer's recorder of approximately 0 VU at output leads CT and CR for input signals from the telephone line ranging from -40 to 0 VU. The range of compression of the automatic volume control circuit may be adjusted by the Telephone Company. When the automatic volume control circuit is deactivated and the volume control of the circuit is readjusted by the Telephone Company, the unit will produce unity gain between the input terminals T and R and the output terminals CT and CR.

4.2 Impedance

An output impedance of 600 ohms is presented to the customer's equipment.

4.3 "Beep" Tone Signal

Voice Connecting Arrangement RCZ when activated, generates the "beep" tone required by the Federal Communications Commission regulation whenever two-way telephone conversations are being recorded. This tone is defined to be one of 1400 Hz, lasting for .5 second and recurring every 15 seconds. The "beep" tone must be audible to both parties to the conversation but it can be filtered from the recording itself.

4.4 Grounding

In general, it is desirable that circuits in the customer's equipment which connect to the voice connecting arrangement have some path to ground. A direct or resistive ground on the side of the power supply would be an example of such a path. This practice avoids the possibility of the entire circuit involved being at an indeterminate potential with respect to ground. Such a potential, perhaps as a result of electrostatic induction, could result in an insulation breakdown in this arrangement. It is expected that the customer's equipment, if powered from commercial power, will be grounded in accordance with applicable electrical codes (NEC). Self-powered or passive customer's equipment need not be grounded.

5. TELECOMMUNICATIONS NETWORK CHARACTERISTICS

5.1 Transmission Parameters

Information describing the component parts and operating characteristics of the Bell System telecommunications network has been published. Various articles listed in Paragraph 8 have discussed statistical information on talker volumes (a), end-office losses and noise (b-d), loop characteristics (e), and other characteristics (f-g). In addition five general information texts are listed.

The 1000 Hz insertion loss between the Central Office and the CT and CR terminals on the Interface Connector for this voice connecting arrangement will average about 4 dB with a standard deviation of about 1 dB.

5.2 End-to-End Electrical Loss

The end-to-end electrical loss of a connection is a function of the impedance of both and terminations, the losses of the loops at both

ends, and the end-office loss. The information given in the REFERENCES may be used to determine statistical loss distributions for different types of calling patterns of the telephone network.

5.3 Bandwidth and Frequency Response

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 increased with increasing frequencies in the upper half of the band. This voice connecting arrangement does not limit this bandwidth.

5.4 Nonlinearities

Nonlinearities such as compression, clipping, and harmonic distortion can exist on the telecommunications network. Normally, these are low enough to be ignored. It is expected that total harmonic distortions no greater than about 5 percent of the fundamental will normally be encountered.

6. REFERENCES

Some references describing various transmission 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. 43, 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) Hinderliter, R. G., "Transmission Characteristics of Bell System Subscriber Loop Plant," IEEE Transactions, Communications, and Electronics, September 1963, p. 464.

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

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

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

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

(j) "Notes on Transmission Engineering," by United States Independent Telephone Association, Washington, D.C.

*(k) "Notes on Distance Dialing - 1968," by American Telephone and Telegraph Company, New York, New York.

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

*Available through Graybar Electric Company.

9. GLOSSARY*

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

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 system, are so connected either electrically, acoustically or inductively.

INTERFACE CONNECTOR - the jack in the connecting arrangement and the customer-provided plug used to connect the customer-provided equipment to the connecting arrangement.

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

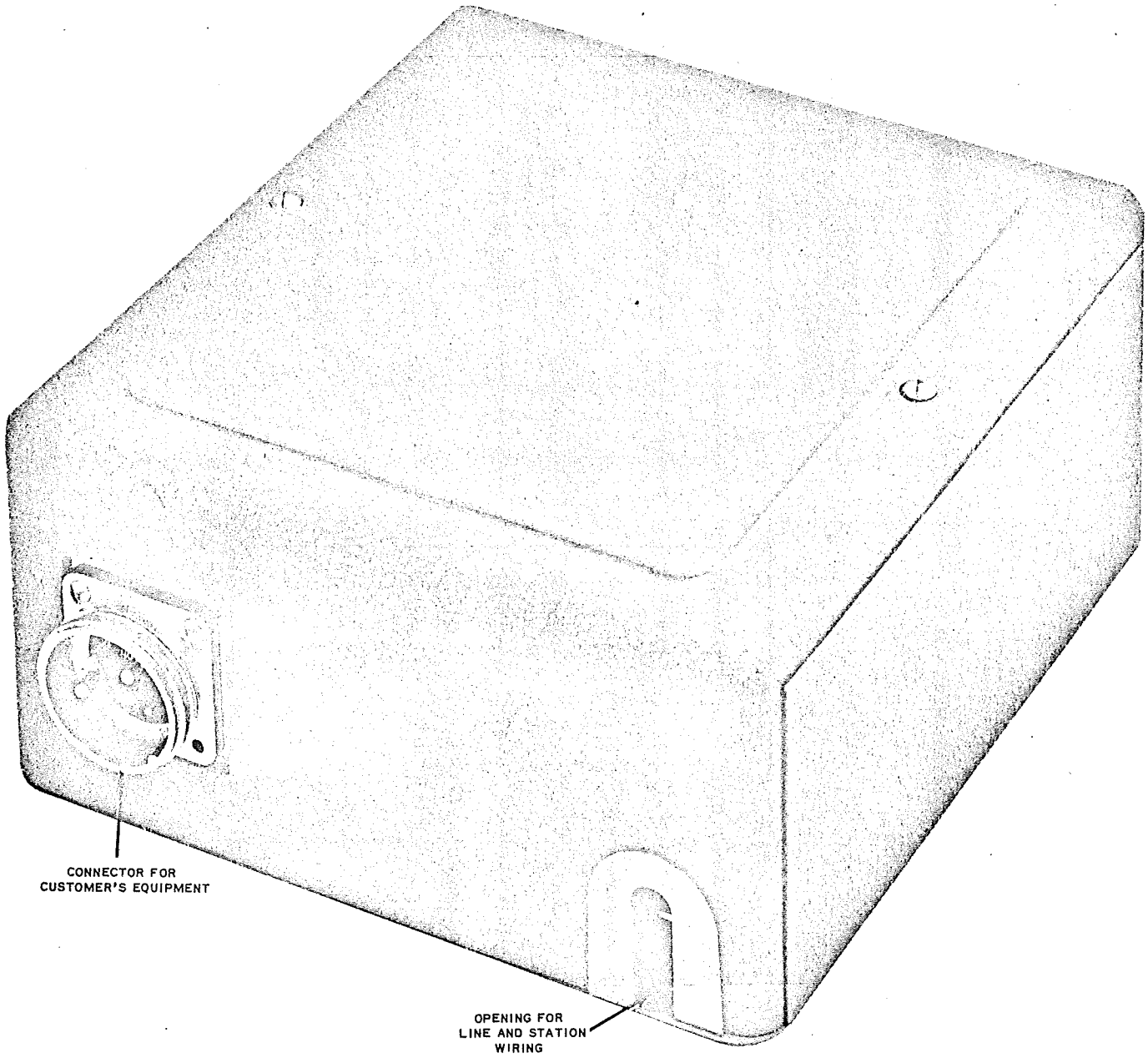
*May differ in letter from exact wording as used in the Tariffs.

RECORDER - CONNECTOR - historical term used to describe Voice Connecting Arrangement RCZ.

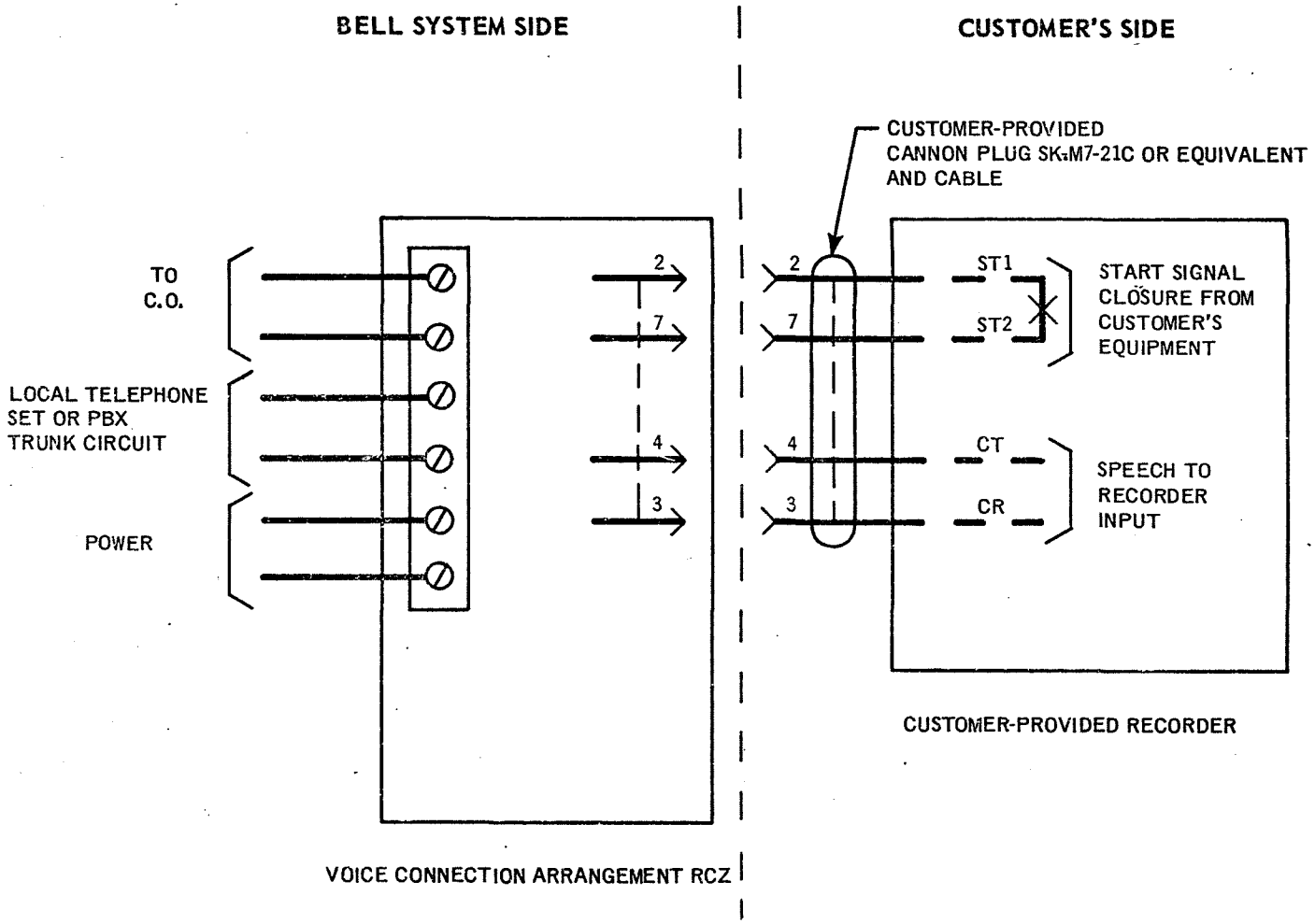
TELECOMMUNICATIONS NETWORK - the Bell System voice switching equipment, associated interconnecting facilities and station equipment which connected its customers together.

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

VOICE CONNECTING ARRANGEMENT - Voice Connecting Arrangement RCZ provided by the Telephone Company to accomplish the direct electrical connection of customer-provided facilities with the facilities of the Telephone Company.



VOICE CONNECTING ARRANGEMENT RCZ
FIG. 1



TYPICAL CONNECTIONS FOR VOICE CONNECTING ARRANGEMENT RCZ
AND CUSTOMER-PROVIDED RECORDER
FIG. 2