

# ELEMENTARY PRINCIPLES OF TELEPHONY

When any subscriber turns the crank of his magneto it places his magneto across the line and the current generated by it passes through all the bells in parallel. Whenever a receiver is taken from the hook the bell of that telephone is cut off and the secondary circuit (receiver and secondary of induction coil) put in its place. Several subscribers may talk to each other at the same time, all of their talking sets being bridged across or connected in parallel on the line.

## 32. COMMON-BATTERY TELEPHONES

The common-battery telephone must have talking apparatus, signaling apparatus, and a means of controlling the circuits. The automatic telephone requires in addition a calling device or "dial". The ringing apparatus is used to attract the attention of the subscriber when someone desires to speak to him. The dial enables the subscriber to control automatic switches at the central office, to cause them to establish connection between two telephones. The talking battery and ringing current are received from the central office. Various types of common-battery telephone systems are described in the following paragraphs.

### (a) Stone Common Battery System or Impedance Coil System

Fig. 49 shows the schematic wiring diagram of the Stone common-battery system. Current is furnished by a battery through two inductive coils called impedance coils, which are usually wound on the same iron core. The electric current divides, part going to one telephone (A) and the rest to the other (B) over a metallic circuit. Telephones A and B are of similar construction. When no one is talking the current flow is steady. If a person speaks into the transmitter it acts like a variable resistance and makes the current stronger and weaker. It is like a valve in a water pipe, but it is never wide open or tight shut. The undulating current (voice current) caused by the transmitter travels throughout the circuit composed of the two transmitters and the two receivers. Very little will pass through the impedance coils because they are inductive. The sound of the speaker's voice can be heard in both receivers. The impedance coil method

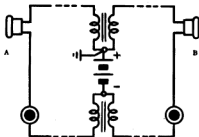


Fig. 50: Repeating Coil Common Battery System

is used almost exclusively in private branch systems where the telephone loops are all of about equal length and resistance. When the loop resistance of two connected circuits is unequal, as in the case when one is longer than the other, the line having the higher resistance receives less than the proper amount of current fed to both through the windings of the impedance coils.

### (b) Repeating Coil Common-Battery System

In the Hayes or repeating coil common-battery system, Fig. 50, the battery supplies current through a repeating coil which has four windings. All four windings are on the same iron core. Current is supplied through two windings to telephone (A) and through the other two windings to telephone (B). The battery is customarily grounded. When speaking into the transmitter, electric waves or undulating currents are created which induce an alternating current in the repeating coil windings of that telephone. This alternating current is induced in the two repeating coil windings of the other telephone. Any repeating coil possesses this property of repeating an alternating current from one circuit to another.

The repeating coil method has an advantage over the impedance coil method, because through its use the two lines are practically divided except for the inductive link formed by the windings of the repeating coil. This method is used very largely in systems with longer loops. It has the disadvantage of having the A.C. voice current pass through the battery, with the resultant possibility of picking up battery noise.

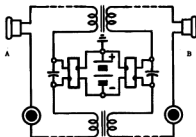


Fig. 50-A: Repeating Coil -- Impedance System

### (c) Repeating Coil--Impedance System

Fig. 50-A shows the repeating coil--impedance common battery system. This system is similar to that shown in Fig. 50 with the addition of battery feed impedance coils, which are by-passed by condensers. The A.C. voice current passes through the repeating coils and the condensers, but does not pass through the battery. The battery feed impedance coils serve the double purpose of keeping the A.C. voice current from passing through the battery, and of keeping battery noises from reaching the lines.

# STROWGER AUTOMATIC TELEPHONE SYSTEMS

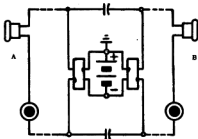


Fig. 51: Condenser Common Battery System

## (d) Condenser-Impedance Common-Battery System

In the condenser-impedance common-battery system, shown in Fig. 51, each telephone has associated with it

an impedance coil (called battery feed coils). The lines between the two telephones are connected together by condensers; the battery in most cases is grounded. When a person speaks into either transmitter the A.C. voice current caused by its varying resistance travels throughout the circuit composed of the two telephones, the lines and two condensers. Very little of this A.C. current gets through the battery feed coils because they are inductive.

The condensers keep the battery current (direct current) in one telephone line from passing to the other line. They are "open" as far as the battery current is concerned, but alternating current passes through very readily. The condenser common-battery method is also used in systems with long loops.

The condenser-impedance common-battery system has the advantage of less battery noise trouble. The talking current does not pass through the battery. The impedance coils tend to keep any battery noises from getting to the lines.

## PART 6 TYPES OF AUTOMATIC TELEPHONES

### 33. GENERAL

The automatic telephone, generally speaking, differs from the common battery manual telephone only in the addition of a dial. Automatic telephones are made up in what is known as the series and the booster types.

### 34. SERIES AUTOMATIC TELEPHONE

The series type telephone is generally used with systems having short subscriber loops, that is, where the lines from the exchange to the telephone are not long or of great resistance.

The series type telephone may be easily divided into four separate circuits for convenience in study.

Fig. 52 shows the schematic wiring diagram of the series telephone complete.

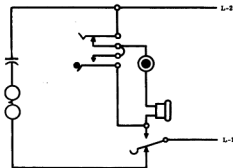
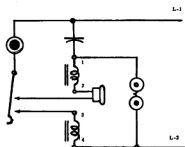


Fig. 52: Series Automatic Telephone

# ELEMENTARY PRINCIPLES OF TELEPHONY



Schematic

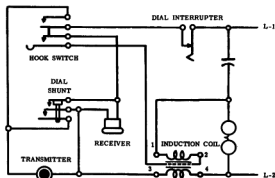


Fig. 53: Booster Automatic Telephone

## 35. BOOSTER AUTOMATIC TELEPHONE

The booster telephone circuit, shown in Fig. 53, is especially effective on long lines. It has an induction coil of the two winding type so connected in the circuit that it will assist the transmitter in sending. Fig. 53 also differs from Fig. 52 in that the ringing apparatus is bridged permanently across the line, and the receiver is of the permanent magnet type which requires no direct current to make it operative. Also, three dial shunt springs are necessary to short circuit the transmitter and receiver.

In order to understand the operation of the booster circuit during speech transmission, two distinct circuits

must be kept in mind: (a) the main talking circuit which includes the two limbs of the line, L-1 and L-2, the transmitter, and the secondary winding (3-4) of the induction coil; and (b) the local talking circuit, purely local to the substation, which includes the transmitter, receiver, primary winding (1-2), and the condenser. It will be readily seen that when talking into the transmitter, two distinct sets of current undulations will be set up: (a) those directly produced in the line due to the variations in resistance of the transmitter; and (b) those produced in the local talking circuit by the charging and discharging of the condenser, due to the varying potential drop across the transmitter. The local talking circuit current undulations will be better understood if it be kept in mind that the condenser is connected across the terminals of the transmitter, directly on one side and through the receiver and primary winding (1-2) on the other side. The effect of the small direct current through the ringer is negligible, and it is evident from the above connections that the potential difference across the condenser will be varied by variations in potential across the transmitter. Alternating currents will then flow in the local circuit as the condenser adjusts its charge to the varying difference of potential across the transmitter and across its own terminals.

The alternating currents flowing in the primary winding (1-2) will induce currents in the secondary winding (3-4). Thus, if the two windings (1-2) and (3-4) of the induction coil are connected in proper relation to each other, the induced currents will reinforce or "boost" the currents which are directly produced in the line by the transmitter--hence the name "booster circuit".

During the reception of speech the action of the induction coil is that of an ordinary transformer. The line winding (3-4) becomes the primary, and what was the primary winding (1-2), during the transmission of speech, becomes the secondary. The incoming voice current flows from the positive line through the primary winding (3-4) of the induction coil, and the transmitter to the negative line and vice versa. There is a tendency for a very small portion of the incoming voice current to reach the negative line over the path composed of the receiver, the secondary winding of the induction coil, and the condenser, as well as through the transmitter; but it is prevented from flowing over this path, because the voice current, in passing through the primary winding (3-4), induces a stronger current in opposition to it, into the secondary winding (1-2). The induced current flows through the receiver over the local circuit embracing the transmitter, condenser, and secondary winding (1-2) of the induction coil.

## 36. ANTI-SIDE TONE CIRCUIT

The anti-side tone circuit has been designed to either eliminate or suppress sidetone. Sidetone is the sound reproduced in the speaker's receiver by his voice current acting through his own transmitter.

# STROWGER AUTOMATIC TELEPHONE SYSTEMS

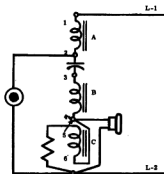


Fig. 54: Anti-Sidetone

Referring to Fig. 54, the windings "A" and "B" act like an auto-transformer. If the average of all the voice frequencies is taken as 1000 cycles per second, it will permit the matching of impedances at this frequency. The matching of impedances is the circuit condition necessary to get the maximum electrical power transfer from a generator to a connected load.

The condenser (blocks direct current) is employed to keep the talking current out of the receiver. The voltage generated in the winding "C" leads the current past the receiver instead of through it.

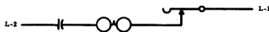


Fig. 55: Ringer Circuit

Fig. 55 shows the ringer circuit with the condenser and the bells in series. These permit the apparent flow of alternating current only.

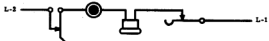


Fig. 56: Talking Circuit

Fig. 56 shows the talking circuit with the receiver, transmitter and impulse springs in series. The circuit shown is completed when the receiver has been removed from the hook and the dial is at normal.

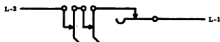


Fig. 57: Impulse Circuit

Fig. 57 shows the impulse circuit with impulse springs and shunt springs in series. The circuit completed to the impulse springs is interrupted a number of times corresponding to the number dialed. The opening of the circuit, or the impulses, which are sent out, cause the switches at the central office to operate to complete the connection to the called number.

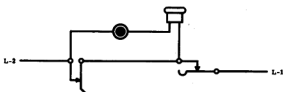


Fig. 58: Shunt Circuit

Fig. 58 shows the shunt circuit, completed whenever the dial is in an operated position. The shunt springs upon making their contacts shunt out the receiver and transmitter to prevent the impulses from being heard in the receiver of that telephone. This shunt circuit is completed only while the dial is other than in its normal position.

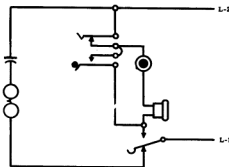


Fig. 52: (Repeated) Series Automatic Telephone

## 37. HOOKSWITCH

The hookswitch, as shown in Fig. 52, has a lever spring which touches the bottom contact when the receiver is

# ELEMENTARY PRINCIPLES OF TELEPHONY

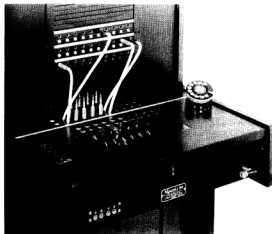
hanging on the hook. When the receiver is removed from the hook, the lever spring leaves the bottom contact and touches the upper contact. The two line wires from the central office enter the telephone at L-1 and L-2. The receiver is non-polarized and requires direct current flowing through it to make it capable of operating.

When the receiver is on the hook, no battery current from the central office can get through the telephone. There is, however, a path through the condenser and bell through which alternating current may flow. To signal the subscriber, the central office apparatus sends out alternating current, which passes through the condenser and the bell and rings the latter. If a subscriber wishes to make a call, he first takes the receiver off the hook.

This cuts the bell out and cuts the talking apparatus into the circuit. Battery now flows from L-2, through the calling device, transmitter, receiver, upper contact of hook lever spring to L-1. To operate the switches, the subscriber operates the calling device, which causes the circuit to be interrupted at the impulse springs at the rate of approximately ten per second. To prevent these interruptions from making a disagreeable noise in the receiver and to provide a uniform resistance in the impulsing circuit, the shunt springs come together and short circuit both transmitter and receiver.

The plunger switch on the Monophone type of telephone instrument corresponds to the hookswitch.

## PART 7 TELEPHONE SWITCHBOARDS



*Manual Switchboard*

### 38. MANUAL

The telephone lines in a simple manual system terminate in individual answering jacks on the manual switchboard. When the subscriber removes the receiver, a signal appears opposite his answering jack. The operator inserts the plug of the answering cord into the answering jack and requests the desired number. She then inserts the plug of the calling cord into the multiple jack of the desired number and signals the called telephone. When the conversation is completed and the subscribers replace their receivers on the hook, the operator receives a disconnect signal. She then breaks the connection between the two telephones by removing the cords, which are then free to handle another call.

Each position of a manual board is usually equipped with from 10 to 15 cords. The number of positions is dependent upon the number of lines in the system and the amount of traffic handled.

### 39. AUTOMATIC

The automatic switchboard differs from the manual in that connections are set up automatically through a series of switches located in the central office, and controlled from the dial at the subscriber's telephone.

The central office equipment or switchboard, in a simple automatic system, consists of lineswitches (or linefinder switches), selectors, and connectors. All co-operate in establishing a connection between two lines.

### 40. THE LINESWITCH

The lineswitch is a switch attached to each subscriber's line which automatically serves to connect the line to a trunk leading to an idle connector in a one hundred line system or an idle first selector in a larger system, as soon as the receiver is removed from the hook.

### 41. THE LINEFINDER SWITCH

The linefinder switch is another means of connecting a subscriber's line to a trunk leading to an idle connector, or selector depending upon the size of the system. The principle of operation of a linefinder switch is simple, and as the name implies, this switch "finds" the calling line.

Instead of an individual lineswitch for each subscriber's line, the linefinder switch is common to a group of lines. When the receiver is removed from the hook of a telephone in the group of lines, the linefinder switch

# STROWGER AUTOMATIC TELEPHONE SYSTEMS

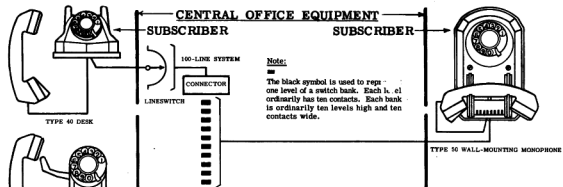


FIG. 59

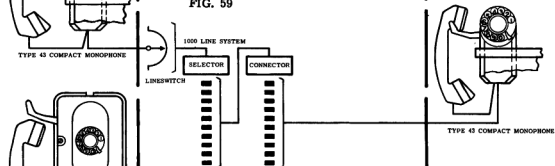


FIG. 60

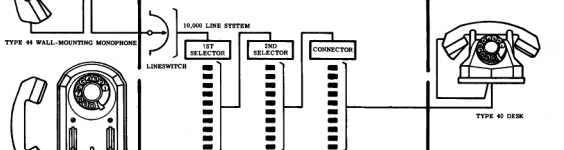


FIG. 61

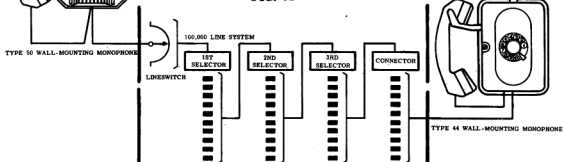


FIG. 62

Figs. 59 to 62: Strowger Automatic Telephone Systems

# ELEMENTARY PRINCIPLES OF TELEPHONY

automatically "finds" the calling line. The calling subscriber's line is now extended directly through to the succeeding switch (connector or selector), which is connected directly to the linefinder switch.

## 42. THE SELECTOR

The selector is also a selecting mechanism of entirely different construction, which makes the intermediate connections. A group of selectors is provided for each of the figures of the call number except the last two. A three-digit number like 345 requires a group of selectors for the first figure. A four digit number like 2345 requires a group of selectors for the first figure and another group of selectors for the second figure. The first movement of the selector, the vertical, is under the control of the subscriber's dial. When the shaft has been elevated in response to the digit dialed, it automatically rotates and connects to an idle trunk in the group selected by the digit dialed. In other words, the rotary steps of a selector are not under the control of the subscriber's dial, but are automatic until an idle trunk is reached.

## 43. THE CONNECTOR

The connector is the "Operator" of the Strowger Automatic System. It is similar in general mechanical appearance and construction to the selector. The action of the connector is controlled by the dialing of the last two digits of the call number. The connector switch makes the final connection to the desired line. It can connect with any one of the one hundred subscriber lines. When 100 lines or less are included in a system, connector switches only are required.

## 44. FUNCTIONS OF THE CONNECTOR

Each telephone is connected to the switchboard by two wires. By means of a calling device on the telephone, the subscriber controls the selector and connector switches, and causes them to connect this telephone line to the line of any other subscriber. This is the act of switching. The connector tests the called line for busy. If that line is busy, a busy tone is connected to the calling subscriber's line as an indication that the desired line is in use. If the called line is not busy, the connector switch completes the ringing circuit to signal the called subscriber. When the called party answers, the direct current circuit for transmission purposes is completed by the connector. When both subscribers hang up their receivers, all the automatic switches return to their normal position, releasing the connection. It takes from three (3) to six (6) seconds to dial a connection and less than one (1) second to release it.

## 45. HUNDRED LINE SYSTEM

The hundred line system, shown in Fig. 59, consists of lineswitches (one for each telephone line) and connectors. The process of setting up a call is briefly as follows:

(a) The calling subscriber either removes his Monophone handset from the switch-hook, or from the Monophone cradle, preparatory to dialing.

(b) The lineswitch associated with his line operates to select an idle connector switch. "Dial tone" is sent back to the calling subscriber as a signal to commence dialing.

(c) The subscriber dials the first figure of the call number, thus causing the connector to select the desired "tens" group.

(d) The subscriber dials the second or last figure of the call number, thus causing the connector to select the desired "unit".

(e) The connector tests the called line. If the line is already engaged, it sends a "busy tone" back to the dialing party. If the line is not engaged, it sends ringing current to signal the called party.

(f) The called subscriber answers and conversation takes place.

(g) Both subscribers hang up their receivers upon which all switches in the connection release and are immediately ready to be used for another call.

## 46. THOUSAND LINE SYSTEM

The thousand line system shown in Fig. 60 is similar to the one hundred line system except for the addition of selector switches between the lineswitches and connectors. The purpose of the selector is to provide a means of selecting the particular hundred group being called. For example, if 345 is the number to be called, the selector extends the calling line to an idle connector in the three hundred group. The call then proceeds in the same manner as in a one hundred line system.

All selectors and connectors may be used by any subscriber. The lineswitch alone is individual to the subscriber.

## 47. TEN THOUSAND LINE SYSTEM

The ten thousand line system shown in Fig. 61, is made up of tens groups, each having one thousand lines. It requires "first selectors" to select any one of the thousand line groups. It requires in each thousand line group "second selectors" to select the desired hundred line group in that thousand. It differs from the thousand line system only in the addition of a second group or train of selectors to choose the desired thousand group.

## 48. MULTI-OFFICE SYSTEM

A telephone system larger than ten thousand lines is generally divided into more than one office, primarily to save cable. A system of this type, called a multi-office

# STROWGER AUTOMATIC TELEPHONE SYSTEMS

exchange, is one whose apparatus is grouped at several centers instead of being located at one place. Each center is termed an "office", it is not an exchange but is part of an exchange. The apparatus is sub-divided so that the length of the subscriber's line may be as short as possible. It often occurs that an exchange smaller than this can, to advantage, be operated in several centers.

A complete diagram showing the interlinking of a large multi-office exchange is too complicated for our present study. Fig. 62 shows the connections in a one hundred thousand line system. It will be noticed that it is similar to the ten thousand line system except for the addition of another group of selectors. The "first selectors" in this case choose the desired 10,000 group or office.

## PART 8

### GLOSSARY OF TELEPHONE TERMS

(Conforming in part with American Standards Association's "Electrical Definitions")

- A -

An "A" OPERATOR is an operator assigned to an "A" switchboard.

A-C-D-C RINGING is ringing in which a combination of alternating and direct currents is utilized, the direct current being provided to facilitate the functioning of the relay which stops the ringing.

An ALARM SIGNAL is a device for attracting attention to some abnormal condition.

An ANTI-SIDETONE TELEPHONE INSTRUMENT is a telephone instrument which includes a balancing network for the purpose of reducing sidetone.

An "A" SWITCHBOARD is a switchboard in a local central office arranged primarily for receiving from subscribers orders for telephone connections, for the completion of these connections, either at the same switchboard or by way of trunks to other switching equipment, and for their supervision.

An AUDIBLE BUSY SIGNAL is a signal audible to the calling party, indicating that the called party's line is in use.

An AUDIBLE RINGING SIGNAL is a signal audible to the calling party to indicate that the called station is being rung.

An AUTOMATIC CENTRAL OFFICE is a central office of an Automatic telephone system.

An AUTOMATIC TELEPHONE INSTRUMENT is a telephone equipped with a dial for the purpose of selecting a called party.

An AUTOMATIC TELEPHONE SYSTEM is a telephone system in which telephone connections between customers are ordinarily established by electric and mechanical apparatus controlled by manipulations of dials operated by the calling parties ("done by a machine that which was formerly done by hand").

- B -

A BANK is an assemblage of fixed contacts formed into a single rigid unit to which permanent electric connections may be made and over which, or assigned sections of which, may move the wipers or brushes of a selector or switch capable of making electric connections with the contacts.

A "B" OPERATOR is an operator assigned to a "B" switchboard.

A "B" SWITCHBOARD is a switchboard in a local central office arranged primarily for receiving and completing to subscriber lines telephone connections which have been routed over trunks from other switchboards or Automatic switching equipment.

A BUSY TEST is a test made to find out whether or not certain facilities which may be desired, such as a subscriber line or trunk, are available for use.

- C -

A CALLING DEVICE is an apparatus which generates the pulses required for establishing connections in an Automatic system.

A CENTRAL OFFICE is an office in a telephone system providing service to the general public where orders for or signals controlling telephone connections are received and connections established.

Note: The term "central office", as applied to either manual or Automatic equipment used in switching subscriber lines, includes any unit of equipment having a separate office name or code and in addition having independent incoming trunks and switching equipment for switching subscriber lines. A central office may serve some subscribers on a theoretical office basis with additional names or codes. In this case for special reasons some separate incoming trunk groups may be provided for the traffic to the theoretical offices. There may be one or more central offices in a central office building.



# ELEMENTARY PRINCIPLES OF TELEPHONY

CLEAR (see release)

- F -

**CODE RINGING** is party-line ringing wherein the number of rings, or their duration, or both, indicate which subscriber is being called.

Note: The term code ringing is not used to cover semi-selective ringing, although the latter employs a form of code ringing.

**A COMMON BATTERY CENTRAL OFFICE** is a central office which supplies transmitter and signaling currents for its associated stations and current for the central office equipment from batteries located in the central office.

**A COMMON BATTERY TELEPHONE INSTRUMENT** is a telephone instrument for which both the telephone transmitter and the signaling currents are supplied from a central office, private branch exchange or other centralized power source.

**A CONNECTOR** is a switching mechanism designed to connect a trunk to a desired subscriber line or PBX extension and often having facilities to hunt for an idle terminal when the terminals are grouped.

**A CORD CIRCUIT** is a connecting circuit terminating in a plug at one or both ends and used at switchboard positions in establishing telephone connections.

- D -

**A DIAL** is a type of calling device, which, when wound up and released, generates pulses required for establishing connections in an Automatic system.

**DIAL TONE** is a tone employed in Automatic telephone systems to indicate that the equipment is ready for the dialing operation.

DISCONNECT (see release)

**A DISTRIBUTING FRAME** is a structure for terminating permanent wires of a central office, private branch exchange or private exchange and for permitting the easy change of connections between them by means of cross-connecting wires.

- E -

**An EXTENSION STATION** is a telephone station associated with a main station through connection to the same subscriber line and having the same call number designation as the associated main station.

**An EXCHANGE (telephone)** is a telephone system for providing telephone communication within a particular local area, usually within or embracing a city, town or village, and environs.

**A FINDER SWITCH** is a switching mechanism, (a machine doing the work formerly done by hand) associated with a circuit, designed to move over a number of terminals to which are connected circuits, over any one of which a signal to start the switch may be transmitted, in order to find the specific circuit from which the starting signal has come and connect it to the circuit associated with this finder switch.

- H -

**A HANDSET** (Monophone-Automatic Electric Co. Trade Name) is a combination of a telephone transmitter and a telephone receiver mounted on a handle.

**A HANDSET TELEPHONE INSTRUMENT** (Monophone - Automatic Electric Co. Trade Name) is one having a handset and a mounting which serves to support the handset when the latter is not in use.

Note: The prefix "desk", "wall", "compact", etc., may be applied to the term handset telephone instrument to indicate the type of mounting.

**HARMONIC SELECTIVE RINGING** is selective ringing which employs currents of several frequencies and ringers, each tuned mechanically or electrically to the frequency of one of the ringing currents, so that only the desired ringer may be actuated.

- I -

**An INDIVIDUAL LINE** is a subscriber line arranged to serve only one main station although additional stations may be connected to the line as extensions.

Note: An individual line is not arranged for discriminatory ringing with respect to the stations on that line.

**An INTERMEDIATE DISTRIBUTING FRAME** in a switchboard, is a terminating device, for cross-connecting lines and trunks to equalize traffic.

**An INTEROFFICE TRUNK** is a direct trunk between local central offices in the same exchange.

- J -

**A JACK** is a connecting device to which the wires of a circuit may be attached and which is arranged for the insertion of a plug. The jacks most generally used have three separate contacting parts: the tip spring, the ring spring and the sleeve, which make contact with the corresponding parts of the plug.

# STROWGER AUTOMATIC TELEPHONE SYSTEMS

- K -

A **KEY** is a hand operated switching device ordinarily formed of concealed spring contacts with an exposed handle or push button, capable of switching one or more parts of a circuit.

**KEYLESS RINGING** is a form of machine ringing used in manual central offices which does not require that an operator press a key in order to select the desired station but the ringing is automatically started by the insertion of the plug of the completing cord into the jack of the called party's line.

- L -

**LINE** (Open Wire) consists of one wire and ground return or two wires strung on poles and customarily spaced approximately from 8 to 10 inches apart.

A **LOCAL BATTERY TELEPHONE INSTRUMENT** is a telephone for which the transmitter current is supplied from a battery, or other current supply circuit, individual to the telephone set. The signaling current may be supplied from a local hand generator or from a centralized power source.

A **LOCAL CENTRAL OFFICE** is a central office arranged for terminating subscriber lines and provided with trunks for establishing connections to and from other central offices.

- M -

**MACHINE RINGING** is ringing which is started either mechanically or by an operator, after which it continues automatically until a response to the signal has been obtained or until stopped by disconnection upon abandoning the call.

A **MAGNETO CENTRAL OFFICE** is a central office serving stations each of which is provided with a local battery for talking and a magneto (generator) for signaling.

A **MAGNETO TELEPHONE INSTRUMENT** is a local battery telephone instrument provided with a hand magneto generator, for supplying signaling current.

A **MAIN DISTRIBUTING FRAME** (abbreviated MDF) is a distributing frame, on one part of which terminate the permanent outside lines entering the central office building and on another part of which terminate the subscriber line multiple cabling, trunk multiple cabling, etc., used for associating any outside line with any desired terminal in such a multiple or with any other outside line. It usually carries the central office protective devices and functions as a test point between line and office. In a private exchange the main distributing frame is for similar purposes.

A **MAIN STATION** is a telephone station with a distinct call number designation, directly connected to a central office.

A **MANUAL CENTRAL OFFICE** is a central office housing a manual switchboard.

**MANUAL RINGING** is ringing which is effected by the manual operation of a key, and continues only during the time the key is held operated.

A **MANUAL SWITCHBOARD** is one in which the connections are made by hand by operators', customarily in accordance with the subscriber's verbal request.

A **MANUAL TELEPHONE** is a telephone instrument not equipped with a dial.

A **MANUAL TELEPHONE SYSTEM** is one which employs manual switchboard.

A **MONITORING KEY** is a key which when operated makes it possible for an attendant or operator to "monitor" or to listen on a telephone circuit without appreciably impairing transmission on the circuit.

A **MULTIOFFICE EXCHANGE** is an exchange served by more than one local central office.

(a) (Noun) A **MULTIPLE** is a group of terminals arranged to make a circuit or group of circuits accessible at a number of points at any one of which connection can be made.

(b) (Verb) To **MULTIPLE** is to render a circuit accessible at a number of points at any one of which connection can be made.

- O -

An **OPERATING ROOM** is a room in which operators handle calls by means of a switchboard.

An **OPERATOR'S TELEPHONE EQUIPMENT** consists of all the apparatus necessary for talking and listening.

- P -

A **PARTY LINE** is a telephone line arranged to serve more than one main station.

A **PLUG** is a device to which may be attached the conductors of a cord and which by insertion in a jack, establishes contact between the conductors of the attached cord and the conductors connected permanently to the jack. The plug most generally used has three separate contacting parts: the tip, the ring and the sleeve.

A **PRIVATE BRANCH EXCHANGE** (abbreviated PBX) is a telephone system, usually installed on the premises of a subscriber, having centralized switching equipment for interconnecting the stations of the subscriber and for connecting these stations to lines to a central office.

# ELEMENTARY PRINCIPLES OF TELEPHONY

A **PRIVATE EXCHANGE** is a telephone system which serves one business organization or individual, and is not connected to a public central office.

**PRIVATE TELEPHONE LINE** is a telephone line which is not connected to any public telephone system.

A **PUBLIC TELEPHONE STATION** (often referred to as a "pay station") is a telephone available for use by the public generally on the payment of a fee which is deposited in a coin collector or is paid to an attendant.

A **PULSE** (for relay operation) is a sudden change of brief duration, produced in the current or voltage of a circuit in order to actuate or control a switch or relay.

(Impulse)\*

\* Deprecated.

A **PULSE REPEATER** is an arrangement of apparatus used in Automatic telephone systems for receiving pulses from one circuit and retransmitting corresponding pulses into another circuit. It may also correct the wave form of the pulses and perform other functions such as supplying transmitter current to stations, repeating a supervisory condition, etc.

- R -

To **RELEASE**, to disconnect or to clear is to disengage the apparatus used in a telephone connection and to restore it to its condition when not in use.

The **RING** of a plug is the ring-shaped contacting part of the plug immediately back of the tip.

**RINGING** is the production of an audible or visual signal at a station or switchboard by means of an alternating, pulsating, or sometimes direct current.

- S -

A **SELECTOR SWITCH** is a switching mechanism, associated with a circuit, designed to move over a number of terminals to which are connected groups of circuits in order to select a particular group of circuits in accordance with signals received over the circuit associated with this selector, and then to choose from the group an idle circuit and connect to it the circuit associated with this selector.

**SELECTIVE RINGING** is party-line ringing wherein only the ringer of the called subscriber's station (or stations) is rung.

**SEMI-SELECTIVE RINGING** is party-line ringing wherein the ringers of two subscribers' stations are rung, differentiation between subscribers being by a one-ring, two-ring code.

A **SIDETONE TELEPHONE INSTRUMENT** is a telephone instrument which does not include a balancing network for the purpose of reducing sidetone.

A **SINGLE-OFFICE EXCHANGE** is an exchange served by a single central office.

The **SLEEVE** of a plug is the cylindrical contacting part of the plug immediately back of the ring.

A **STATION RINGER** is an alternating-current electric bell or similar device associated with a telephone station for indicating a telephone call to the station.

A **STROWER AUTOMATIC TELEPHONE SYSTEM** is a type of Automatic (the doing of work by a machine which was formerly done by hand) telephone system in which the switching apparatus is generally characterized by the following features:

- (1) The wipers of the selecting mechanisms are moved both vertically and in horizontal circular arcs.
- (2) The selecting mechanisms are individually driven by a combination of electromagnet and ratchet mechanisms.
- (3) The dial pulses may either actuate the successive selecting mechanisms directly or may be received and stored by controlling mechanisms, which, in turn, actuate the selecting mechanisms by pulses similar to dial pulses.

**SUPERPOSED RINGING** is party-line ringing in which a combination of alternating and direct currents is utilized, the direct currents, of both polarities, being provided for selective ringing.

A **SUBSCRIBER LINE** (sometimes called a "subscriber loop" or "central office line") is a telephone line between a central office and a station, private branch exchange or other subscriber switching equipment.

A **SUPERVISORY RELAY** is a relay which, during a call, is generally controlled by the transmitter current supplied to a subscriber line in order to receive from the associated station directing signals which control the actions of operators or switching mechanisms with regard to the connection.

A **SUPERVISORY SIGNAL** is a device for attracting attention of an attendant to a duty in connection with the switching apparatus or its accessories.

A **SWITCHBOARD CORD** is a cord which is used in conjunction with switchboard apparatus to complete or build up a telephone connection.

# STROWGER AUTOMATIC TELEPHONE SYSTEMS

**A SWITCHBOARD LAMP** is a small electric lamp associated with the wiring of a switchboard in such a way as to give a visual indication of the status of a call, or to give information concerning the condition of trunks, subscriber lines, apparatus, etc.

**A SWITCHBOARD POSITION** is that part of a switchboard designed for the use of one operator.

**A SWITCHBOARD SECTION** is a structural unit, providing for one or more operator positions. A complete switchboard may consist of one or more sections.

**A SWITCHBOARD** (telephone) is a switchboard for interconnecting telephone lines and associated circuits.

**A SWITCH ROOM** is that part of a central office building which contains an assemblage of Automatic switches and the associated apparatus of the Automatic central office, group of Automatic central offices, Automatic private branch exchange or private Automatic exchange.

**A SYSTEM** (telephone) is an assemblage of telephones, lines, channels and switching arrangements for their interconnection, together with all the accessories for providing telephone communication.

- T -

**A TALKING KEY** is a key which when operated makes it possible for the person operating the key to converse on the circuit with which the contacts of the key are associated.

**A TANDEM OFFICE** is a central office used exclusively for interconnection of other central offices within the same exchange and nearby exchanges.

**A TELEPHONE CONNECTION** is a two-way telephone channel completed between two points by means of suitable switching apparatus and arranged for the transmission of telephone currents, together with the associated arrangements for its functioning with the other parts of a telephone system in switching and signaling operations.

**Note:** The term is also sometimes used to mean a two-way telephone channel permanently established between two telephone stations.

**A TELEPHONE CURRENT** is an electric current produced or controlled by the operation of a telephone transmitter.

**A TELEPHONE INSTRUMENT** (often abbreviated "telephone") is an assemblage of apparatus including a telephone transmitter, a telephone receiver, and usually a switch, and the immediately associated apparatus, wiring and signaling arrangements for the use of these instruments in telephony.

**A TELEPHONE INSTRUMENT** (Automatic) equipped with a dial for the purpose of selecting the called party.

**TELEPHONE LINE** is a general term used in communication practice in several different senses, the more important of which are:

- (a) The conductor or conductors and supporting or containing structures extending between subscriber stations and central offices or between central offices whether they be in the same or different communities.
- (b) The conductors and circuit apparatus associated with a particular communication channel.

**A TELEPHONE STATION** is an installed telephone instrument and associated wiring and apparatus, in service for telephone communication.

**Note:** As generally applied, this term does not include the telephone equipment employed by central office operators and by certain other personnel in the operation and maintenance of a telephone system.

**A TELEPHONE SWITCHBOARD** is a switchboard for interconnecting telephone lines and associated circuits.

**A TELEPHONE OPERATOR** is a person who handles switching and signaling operations needed to establish telephone connections between stations or who performs various auxiliary functions associated therewith.

**Note:** An operator at a private branch exchange is called an "attendant".

**A TERMINAL ROOM** is a room, associated with a central office, private branch exchange or private exchange, which contains distributing frames, relays and similar apparatus except that mounted in the switchboard sections.

**A TELEPHONE SUBSCRIBER** is a customer of a telephone system who is served by the system under a specific agreement or contract.

**A TEST BOARD** is a switchboard equipped with testing apparatus, so arranged that connections can be made from it to telephone lines or central office equipment for testing purposes.

**A TIE TRUNK** is a telephone line or channel directly connecting two private branch exchanges.

**A TRUNK** is a telephone line or channel between two central offices or switching devices, which is used in providing telephone connections between subscribers generally.

# ELEMENTARY PRINCIPLES OF TELEPHONY

**TRUNK HUNTING** is the operation of a selector, or other similar device, in moving its wipers or brushes to a terminal or contact associated with an idle circuit of a chosen group. This is usually accomplished by successively testing terminals associated with this group until a terminal is found which has an electrical condition indicating it to be idle.

The **TIP** of a plug is the contacting part at the end of the plug.

A **TOLL BOARD** is a switchboard used primarily for establishing connections over toll lines.

A **TOLL LINE** is a telephone line or channel between two central offices in different exchanges.

JWS:av  
Revised 8-49

A **TOLL OFFICE** is a central office primarily arranged for terminating toll lines, toll switching trunks, recording trunks and recording-completing trunks and for their interconnection with each other as necessary for the purpose of establishing connections over toll lines.

A **TOLL SWITCHING TRUNK** is a trunk extending from a toll office to a local central office for connecting toll lines to subscriber lines.

- W -

A **WALL TELEPHONE INSTRUMENT** is a telephone instrument arranged for wall mounting.

A **WIPER OR BRUSH** is that portion of the moving member of a selector, or other similar device, which makes contact with the terminals of a bank.

Printed in U.S.A. By John S. Swift Co. Inc.,--2M-3-50

# MEMORANDA

# AUTOMATIC ELECTRIC

*Originators and Developers of the Strowger Step-by-Step "Director" for Register-Sender-Translator Operation . . . . . Machine Switching Automatic Dial Systems  
Makers of Telephone, Signaling and Communication Apparatus...Electrical Engineers, Designers and Consultants*

Factory and General Offices: 1033 West Van Buren Street, Chicago 7, U.S.A.

## DISTRIBUTORS IN U. S. AND POSSESSIONS

### AUTOMATIC ELECTRIC SALES CORPORATION

1033 West Van Buren Street, Chicago 7, U.S.A.

*Sales Offices in All Principal Cities*

## AFFILIATED MANUFACTURERS

Phillips Electrical Works Limited . . . . . Brockville, Ont., Canada  
Automatique Electrique, S.A. . . . . Antwerp, Belgium  
Autelco Mediterranea. S.A.T.A.P. . . . . Milan, Italy

## GENERAL EXPORT DISTRIBUTORS

### INTERNATIONAL AUTOMATIC ELECTRIC CORPORATION

1033 West Van Buren Street, Chicago 7, U.S.A.

## REGIONAL DISTRIBUTING COMPANIES AND REPRESENTATIVES

### ARGENTINA, URUGUAY AND PARAGUAY

Luis Pitigliani  
25 de Mayo 489, Buenos Aires, Argentina

### AUSTRALIA

Automatic Electric Telephones Limited  
Box 1883 K, G.P.O., Sydney, Australia

### BELGIUM, LUXEMBOURG; FRANCE AND SCANDINAVIA

Automatique Electrique, S.A.  
22 Rue du Verger, Antwerp, Belgium

### BRAZIL

Automatic Telephones Limited of Brazil  
194 Avenida Franklin Roosevelt, Rio de Janeiro,  
Brazil

### CANADA

Automatic Electric (Canada) Limited  
284 King Street West, Toronto, Ontario, Canada

### CARIBBEAN AREA AND CENTRAL AMERICA

Cia. Industrial de Telefonos, S.A.  
Apartado Aereo 263, Barranquilla, Colombia, S.A.

### ITALY

Autelco Mediterranea, S.A.T.A.P.  
Via Confalonieri, 38, Milan, Italy

### MEDITERRANEAN AREA AND NEAR EAST

International Automatic Electric Sales Company,  
S.P.A. Via di San Basilio 41, Rome, Italy

### NETHERLANDS

Automatique Electrique, S.A.  
Huygenstraat 6  
The Hague, Netherlands

*Other Sales Representatives and Agents Throughout the World*

June 1, 1949