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TELEPHONE SYSTEM

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FIG. 1

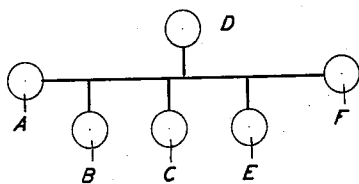


FIG. 2

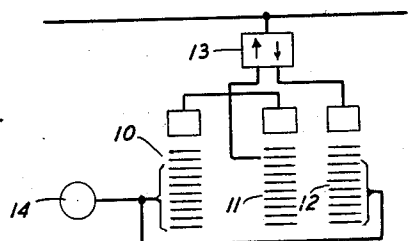
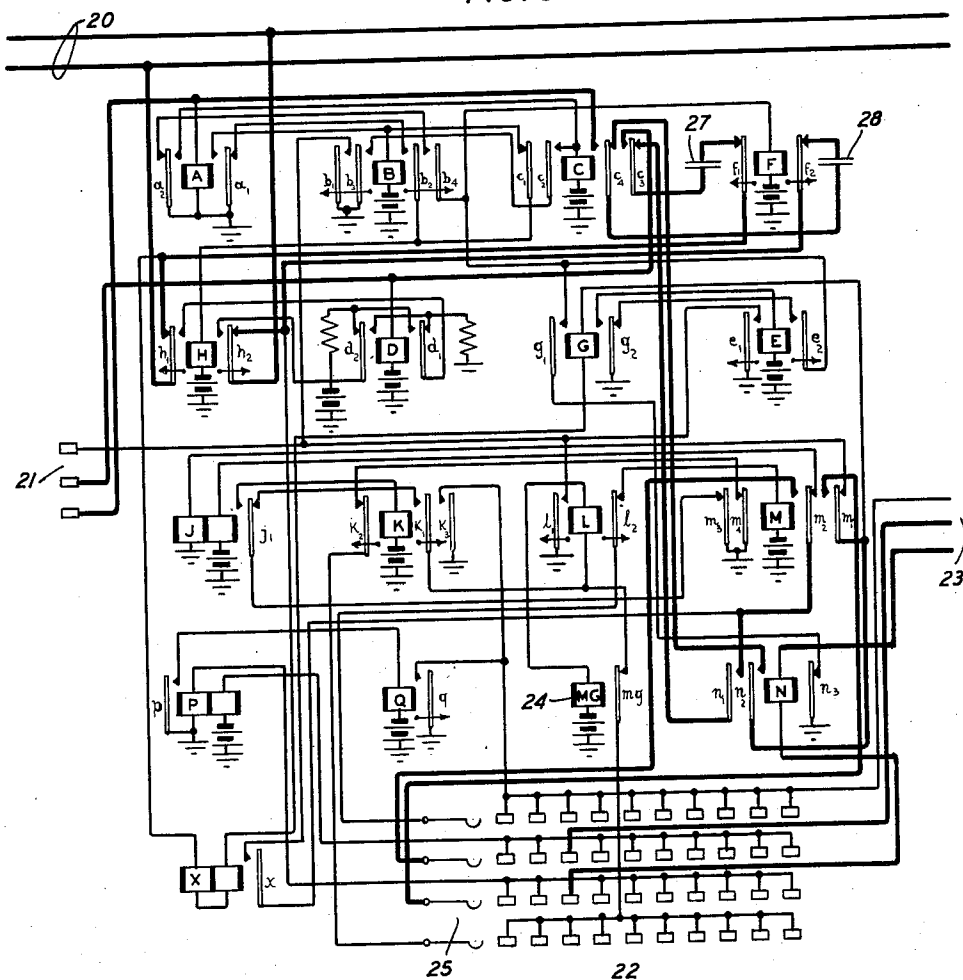


FIG. 3



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TELEPHONE SYSTEM

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This invention relates to telephone systems and in particular to automatic telephone exchange systems in which a plurality of automatic offices are associated with a number of common trunk lines for communication between subscribers at the various offices.

An object of the invention is to obtain in automatic telephone exchange systems an economical arrangement of common trunk lines for intercommunication between offices.

Heretofore systems have been provided in which stations on common lines may be selectively called by means of impulses operating step-by-step apparatus to select different positions. Systems have also been provided at which intercommunication between stations over a common power line may be established between subscribers by selecting stations by impulses and communicating over the common power line.

A feature of the present system is an arrangement in which a number of trunks are common to a number of automatic exchanges in which normally there is connected a single line relay for each trunk at each exchange, in which when a subscriber at one exchange desires to establish a connection with a subscriber in another exchange, a source of current is connected at the call originating exchange for the transmission of impulses, while after the connection has been established this source is disconnected and in which when the talking connection has been established no other apparatus except the line relays are connected to the trunk used at any of the other exchanges.

Referring now to the drawing, Fig. 1 shows one example of an arrangement of a plurality of automatic telephone exchange offices and a common trunk line connecting said offices.

Fig. 2 shows diagrammatically the relation between the equipment at each automatic exchange as connected to a single common trunk line.

Fig. 3 shows in detail a common trunk line and the equipment associated therewith at one office for calling by means of impulses a desired subscriber's line in another office and for establishing a connection to a desired subscriber's line in this office.

Referring now to the drawing in detail:

Fig. 1 shows in diagrammatic form a number of exchanges A, B, C, D, E and F connected together by common trunk lines.

Fig. 2 shows the equipment in one of these automatic telephone exchanges in diagrammatic form where the number of subscribers' lines is less than one hundred for example. It shows a

line finder 10, a local connector 11 and an incoming connector 12 with the means for establishing a connection to a common trunk line for incoming and outgoing calls indicated by a box 13. Such line finders and connectors may be of any well known type. It may also be assumed that an ordinary step-by-step system is used in which the ninth level of the local connector 11 is employed as a selector for selecting an idle common trunk. For example, if a subscriber of line 14 desires to make an outgoing call, the line finder 10 will be operated when the subscriber removes his receiver from the switchhook in the usual manner and a connection will be established to a local connector 11. If an outgoing call number is then dialed, the first digit will advance the brushes of the connector 11 to the ninth level and the brushes will then hunt in the usual manner for an idle outgoing trunk. Connections will then be established through the equipment 13 out over the trunk and when the subscriber dials the desired subscriber's number at another exchange he will transmit series of impulses out over the trunk line to select the desired exchange and the desired subscriber's line therein. The first series of outgoing impulses represents the exchange and the two succeeding series represent the desired subscriber's number. The first series selects through an equipment such as 13 the desired exchange and the two succeeding series operate an incoming connector such as 12 to complete the connection to the desired subscriber's line and ring this subscriber in the usual manner common in the step-by-step automatic art.

Description will now be made of the operation of the system in connection with Fig. 3 which shows one of the common trunk lines 20 and the equipment at one exchange in sufficient detail to afford a clear understanding of the detail of the present invention. One set of terminals in the ninth level of the connector 11 is shown at 21. To these terminals connections may be established from calling subscribers in the exchange for calls outgoing over the trunk line 20 to another exchange. A selector switch 22 is shown that is individual to the trunk line 20 and through which connections may be made for incoming calls to this exchange over the tip and ring conductors shown at 23 that lead to the brushes of a connector such as 12 through which the connection may be established to a desired subscriber in this exchange. The selector switch 22 is of the single movement rotary type well known in the art, the stepping magnet being shown at 24 and the brushes at 25.

A description will now be made of the establishing of a connection out over trunk 20 from a calling subscriber in this exchange. The calling subscriber's line will be connected through the line finder to a local connector when the subscriber lifts the receiver off the switchhook. The subscriber will then dial the numeral 9. This will advance the brushes of the connector to the ninth level where it hunts for an idle trunk. An idle set of terminals leading to an idle trunk 20 is indicated as stated at 21. If it is assumed then that the calling subscriber's line has been connected to these terminals, relays A and D will be operated over the circuit completed through the tip and ring conductors. When relay D operates it connects ground to the ring lead and battery to the tip lead of the common trunk line 20. When relay A operates, it causes relays B and H to operate through contacts a_1 . When relay B is operated it connects ground to the sleeve terminal at 21 and thus makes the trunk line 20 busy to other calls and it also prepares a circuit which causes the relays F and H to operate and prepares a holding circuit for relay C when relay A is restored. When relay H is operated it changes over the contacts h_1 and h_2 and disconnects the line relay X from the trunk 20 and connects the trunk to the contacts d_1 and d_2 and hence the ground is connected to the ring conductor and battery to the tip conductor so that at the other exchanges the line relays X are all operated to establish selecting circuits for the operation of the exchange selecting switches 22. Relay C in the trunk is slow to operate and will, therefore, operate a short interval after the relay A so that the operating circuit for relay H is opened and this relay released. The battery and ground connections to the tip and ring conductors of trunk 20 are disconnected by the release of relay H. Relay X may be of the non-biased type in which the armature remains in the one position or the other by energization and when relay H removes battery and ground from the trunk the armatures of these relays remain in the position to which they were last operated.

Now when the calling subscriber dials a code number indicating the exchange desired, relays H and F are operated each time that relay A is restored. Relay D also operates and restores in unison with relay H. The battery and ground connections for the trunk 20 are therefore connected, but in reverse direction due to the switching of the contacts d_1 and d_2 , thus causing the relays at all other exchanges to be operated accordingly. The operation at these exchanges will be described hereinafter. During the sending of this series of impulses relays B, H and F remain operated due to their slow to release characteristics.

When the dialing ceases relays H and F are restored and the tip and ring conductors are thereby connected for conversation to the trunk 20 through contacts h_1 , h_2 , f_1 , f_2 , c_3 , c_4 to the calling subscriber's line through condensers 27 and 28.

When the calling subscriber hangs up his receiver at the end of the conversation, relays A and D are restored and relay H is caused to operate by the restoring of relay A so that a ground is connected to the tip conductor and battery to the ring conductor of the trunk in the reverse direction. Thus the relays X at the other exchanges are operated in the opposite direction to cause operation to take place to restore the circuits thereat to normal as will be described hereinafter. At the calling exchange relay B is re-

stored a short interval after relay A and consequently also relays C, H and F so that the trunk 20 will be released for use for other calls.

A description will now be made of a call from some other exchange incoming over trunk 20 to select this exchange. In this case ground is connected to the ring conductor and battery to the tip conductor of the trunk 20 to operate relay X and thus cause relays G and J to operate which in turn causes relays E, F and K to operate. The arrangement is such that when relay F is operated it opens the talking circuit so that the pulsing will not interfere. When relay E is operated it makes this trunk 20 busy to the terminals at 21 and prepares a circuit for the holding of relay F operated when relay G is restored.

When relay K is operated, it prepares a circuit for receiving and selecting the exchange number. When the direction of current in the trunk line is changed by the dialing of the calling subscriber, relay X opens and closes its contacts and energizes relay L and the stepping magnet 24 in series each time relay J is restored, which causes the magnet 24 to step its brushes 25 to the terminals corresponding to the dialed number which is assumed to be number 3. Relay L is of the slow to release type and is maintained operated during dialing, thus holding the circuit for relay M opened during this period. As shown, this exchange is assumed to be selected by a single digit, but arrangements could readily be made for using two digits by the use of a different stepping switch arrangement. When relay L is restored at the end of dialing relay M operates from ground at contact k_3 and changes the connection over the circuit connected to the tip and ring conductors 23 which terminate in the connector such as 12. At the exchanges not called the operations are identical up to this stage. When the brushes of the switches at these exchanges corresponding to the switch 22 land on the third set of terminals, relays corresponding to relay P are operated, and these relays cause the relays corresponding to relay Q to be maintained operated. Relays Q are slow to release and remain operated while the subscriber dials the next number. The equipments associated with the trunk 20 at these other exchanges are therefore held in this set condition until the call is terminated so that when the calling subscriber hangs up his receiver, the relays X are released to cause relays P and Q to restore, thus causing relays M to be restored. There is then established a self-interrupting circuit for the stepping magnets 24 in series with relays L and when the brushes of the switches are returned to normal position, this circuit is opened. While the relays L are operated, they hold the trunk line 20 in busy condition.

If, on the other hand, the exchange called is the exchange illustrated in Fig. 3, the brushes of switch 22 will land on the third set of terminals which are connected through leads 23 to a connector such as 12. In this case, relays M and N are operated. This causes relay F to be restored and establish the talking circuit through the condensers 27 and 28 from the calling exchange over trunk 20 through the contacts n_1 and n_2 . Now when the calling subscriber dials the number of the desired subscriber the connector 12 is operated to establish its connection in the usual manner. Although relay F is in its operated condition through the contacts g_2 and e_2 while the calling subscriber is dialing, yet when the dialing is ended, relay F is restored by the operated condition of relays G and N so that the

talking circuit is established at the end of the dialing and the calling subscriber will therefore hear a calling tone. When the called subscriber is rung in the usual manner and answered, conversation may take place.

When the calling subscriber hangs up his receiver at the end of the conversation, relays X open their contacts by current flowing in the opposite direction through the trunk as hereinbefore described so that the connector 12 will be restored and the selector 22 and all selectors at the other exchanges will restore in the usual manner as hereinbefore described.

While the present invention has been disclosed in connection with but a single system it should be understood that it could readily be embodied in a plurality of other similar systems without departing from the spirit thereof.

What is claimed is:

1. In a telephone system, a plurality of offices, subscribers' lines at said offices, a plurality of trunk lines connecting said offices, means operative at said offices for establishing a connection between the subscribers' lines in one office and a subscriber's line in another office over an idle trunk, a source of current at each office, a relay at each office, said means operating to include the source of current at the call originating office in the trunk used for the establishing of a connection during the establishing of said connection and operative to include the relays only in said trunk after the establishing of a connection.

2. In a telephone system, a plurality of offices, subscribers' lines at said offices, common trunk lines connecting said offices, means operative at said offices for establishing a connection between a subscriber's line in one office and a desired subscriber's line in another office over an idle common trunk line and for thereafter preventing other such connections from being established over this trunk line, said means including a direct current source connected to this trunk at the call originating office during the establishing of said connection only and including a relay connected to this trunk at each office after said connection has been established.

3. In a telephone system, a plurality of offices, a plurality of common trunk lines connecting said offices, subscribers' lines at said offices, a line relay normally connected to each trunk at each office, a source of current associated with

each trunk at each office but normally disconnected therefrom, means at a call originating office for seizing an idle trunk on an outgoing call including disconnecting the associated line relay and connecting the associated source of current to the seized trunk at said call originating office, means for transmitting series of impulses from said source over said seized trunk, means responsive to one series of impulses for selecting a desired office and responsive to other series of impulses for selecting a desired line therein including the operation of the associated line relays, and means responsive when the desired subscriber's line has been connected to the trunk for disconnecting the current source and reconnecting the line relay to the trunk at the call originating office.

4. In a telephone system, a plurality of offices, subscribers' lines at said offices, common trunk lines connecting said offices, a relay connected to each trunk at each office, a source of current associated with each trunk at each office, but normally disconnected therefrom, means operative at said offices for establishing a connection between a subscriber's line in one office and a desired subscriber's line in another office over an idle trunk line, means for preventing other such connections from being established over said trunk, means operative on an outgoing call at the call originating office for disconnecting the relay from the trunk used and for connecting the source of current to the trunk used during the establishing of said connection.

5. In a telephone system, a plurality of offices, subscribers' lines at said offices, common trunk lines connecting said offices, a relay in the trunk lines at each office, a source of current associated with each trunk line at each office, means operative at said offices for establishing a connection between a subscriber's line in one office and a desired subscriber's line in another office over an idle trunk, means operative on an outgoing call at the call originating office for disconnecting the relay from the trunk used and for connecting the source of current to the trunk used during the establishing of said connection, and means for reconnecting said relay and disconnecting said source of current from the trunk used after the call has been established.

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