July 1, 1941. K. L. BURGENER 2,247,477

SIGNALING SYSTEM

Filed March 1, 1940 8 Sheets-Sheet 1

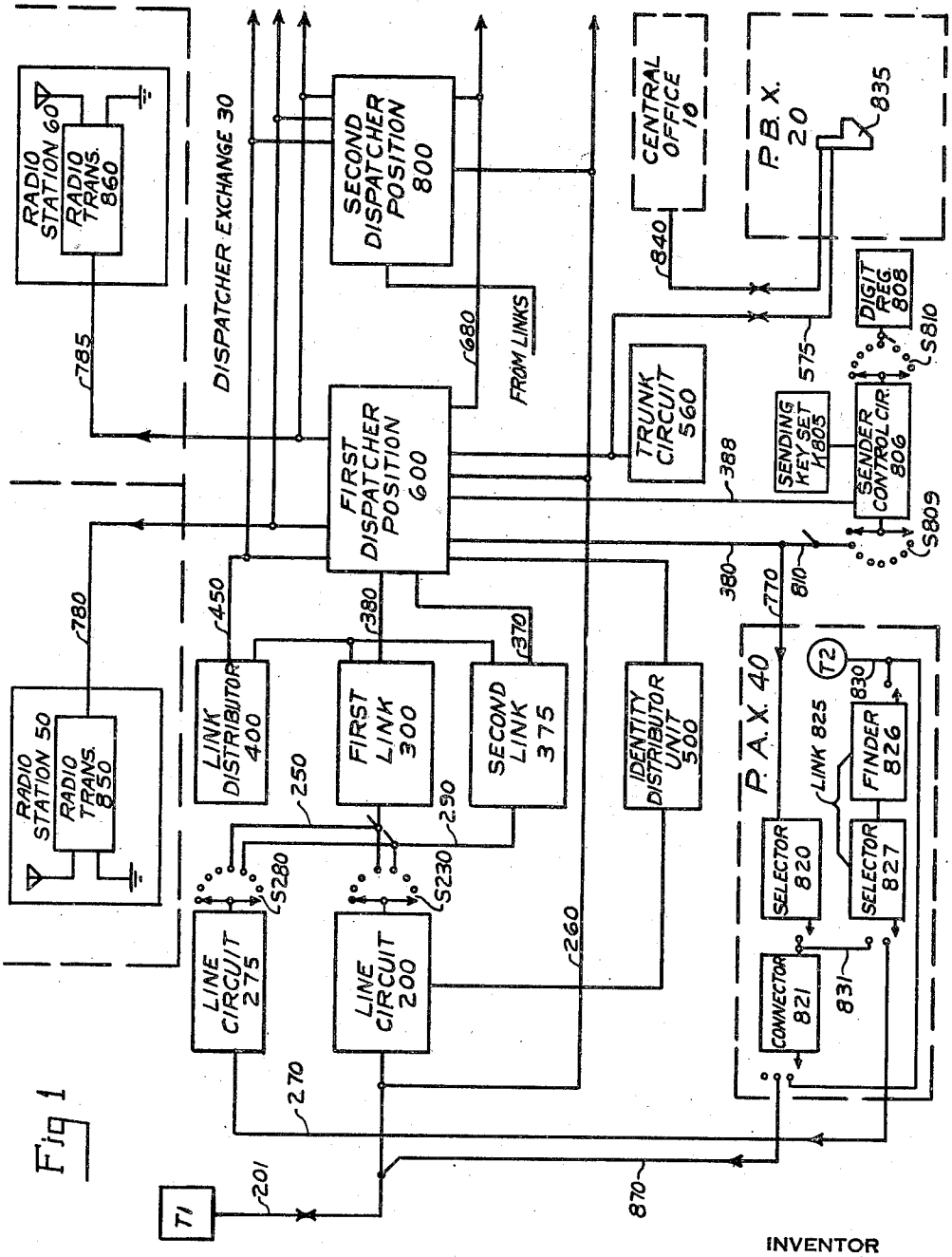

Fig 1

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SIGNALING SYSTEM

Filed March 1, 1940 8 Sheets-Sheet 2

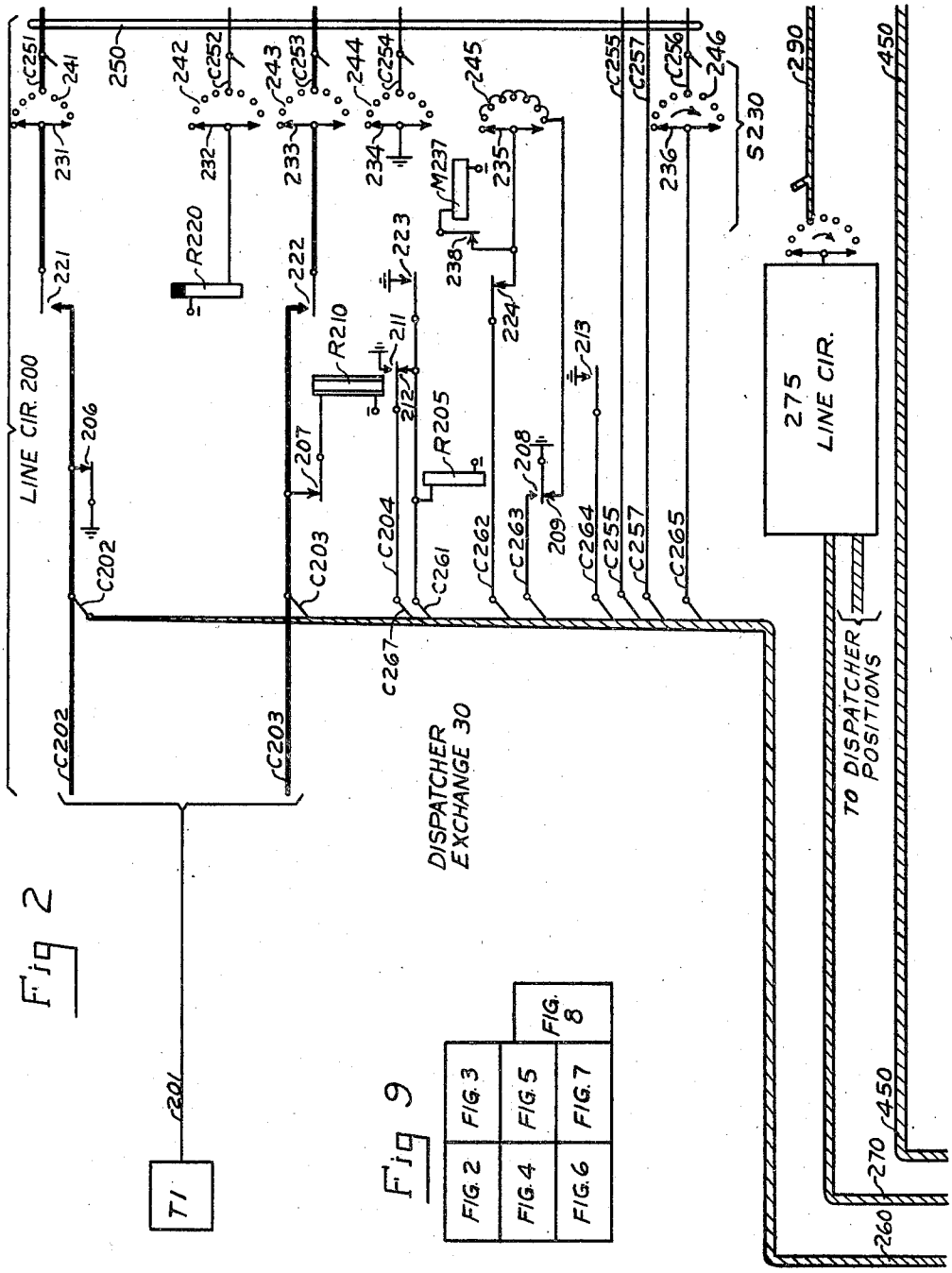

Fig 2

Fig 9

FIG. 2	FIG. 3	FIG. 8
FIG. 4	FIG. 5	FIG. 7
FIG. 6		

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SIGNALING SYSTEM

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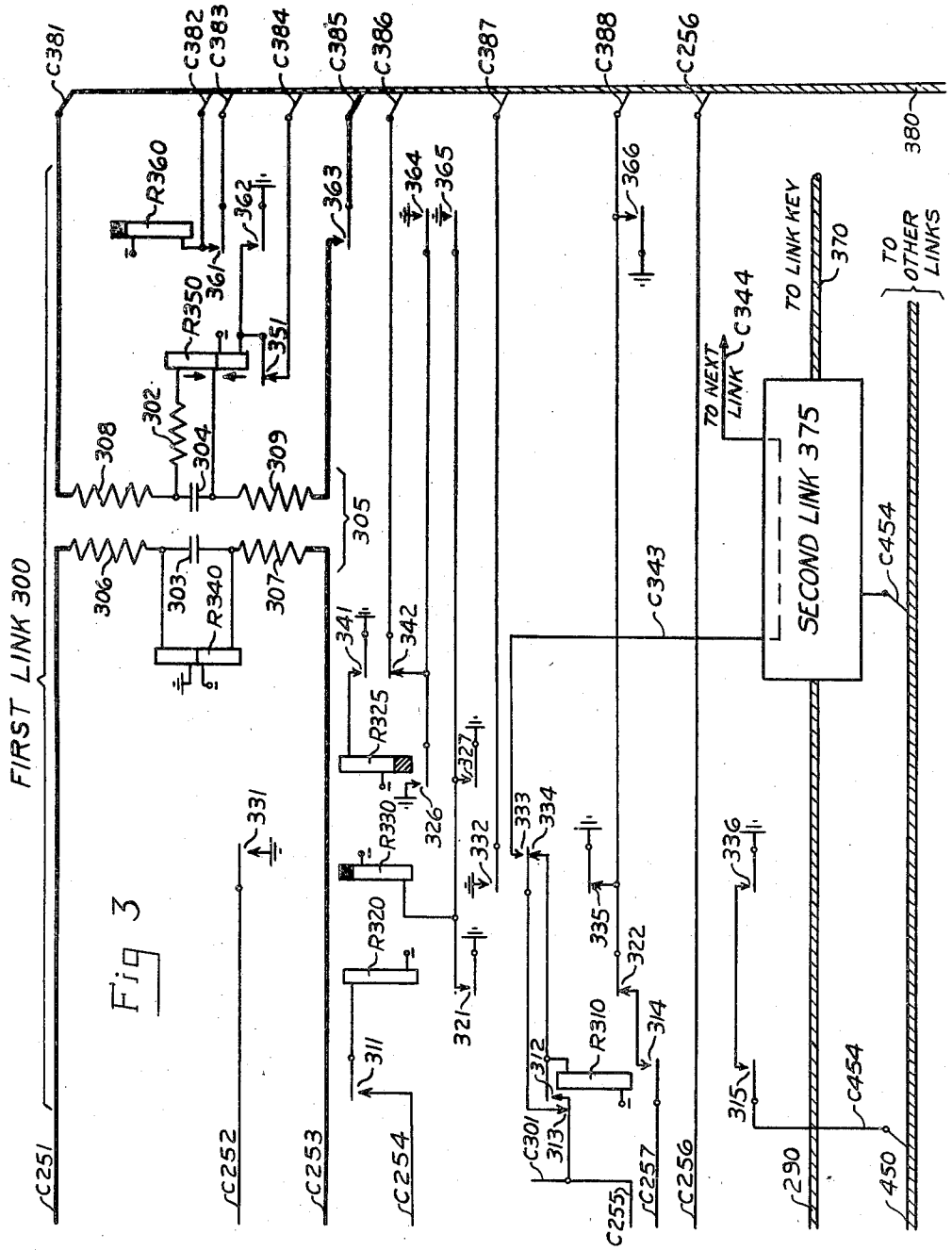

Fig 3

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SIGNALING SYSTEM

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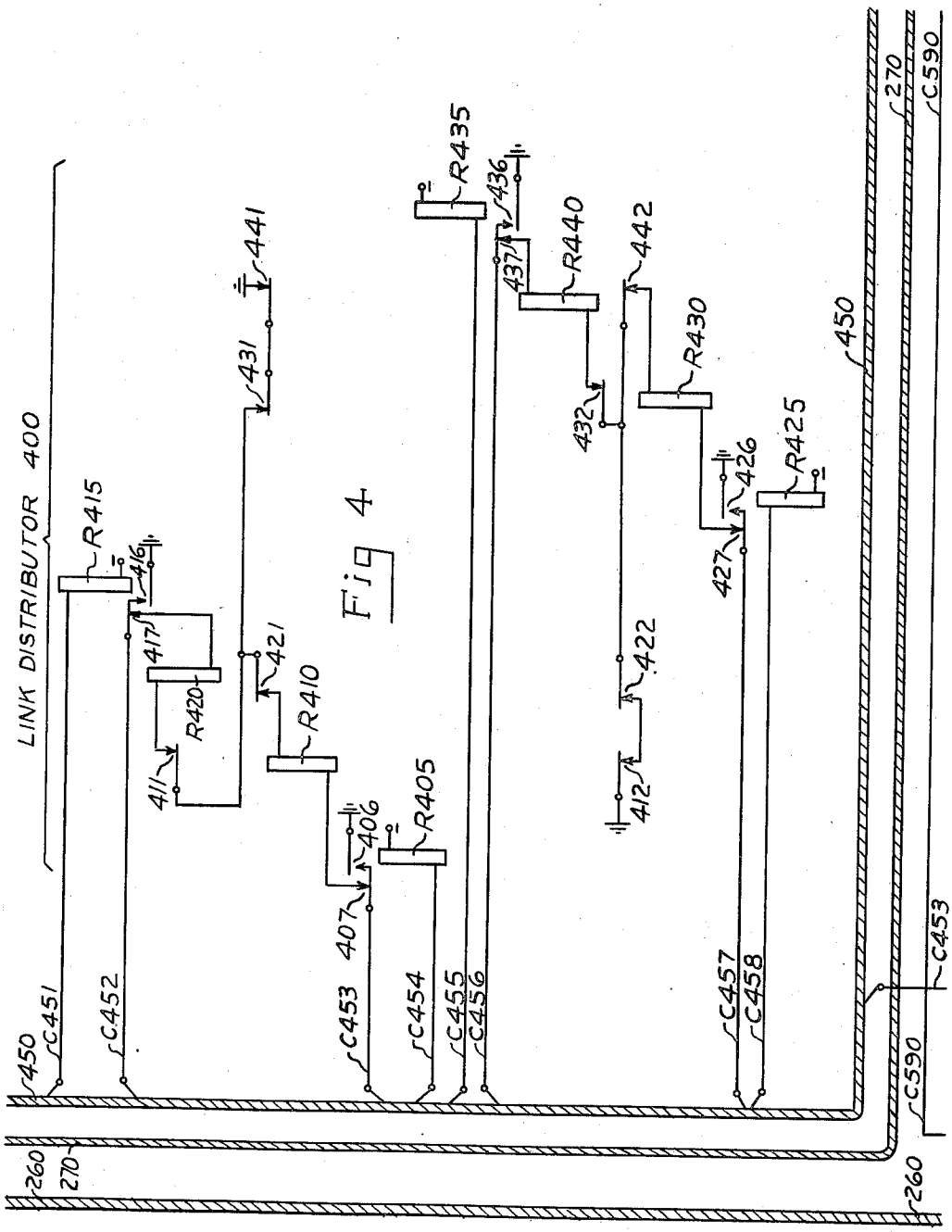

Fig 4

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SIGNALING SYSTEM

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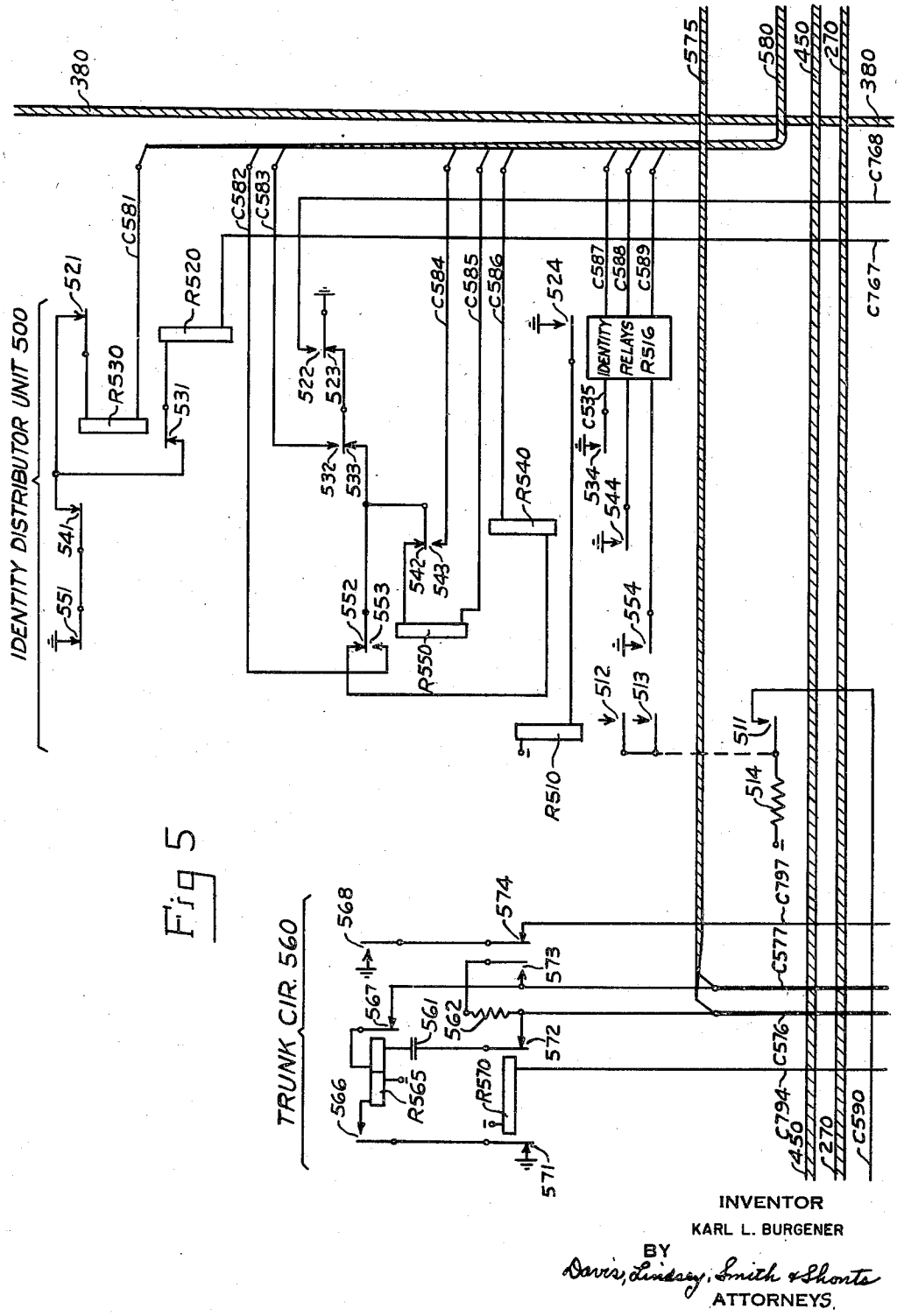

Fig 5

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SIGNALING SYSTEM

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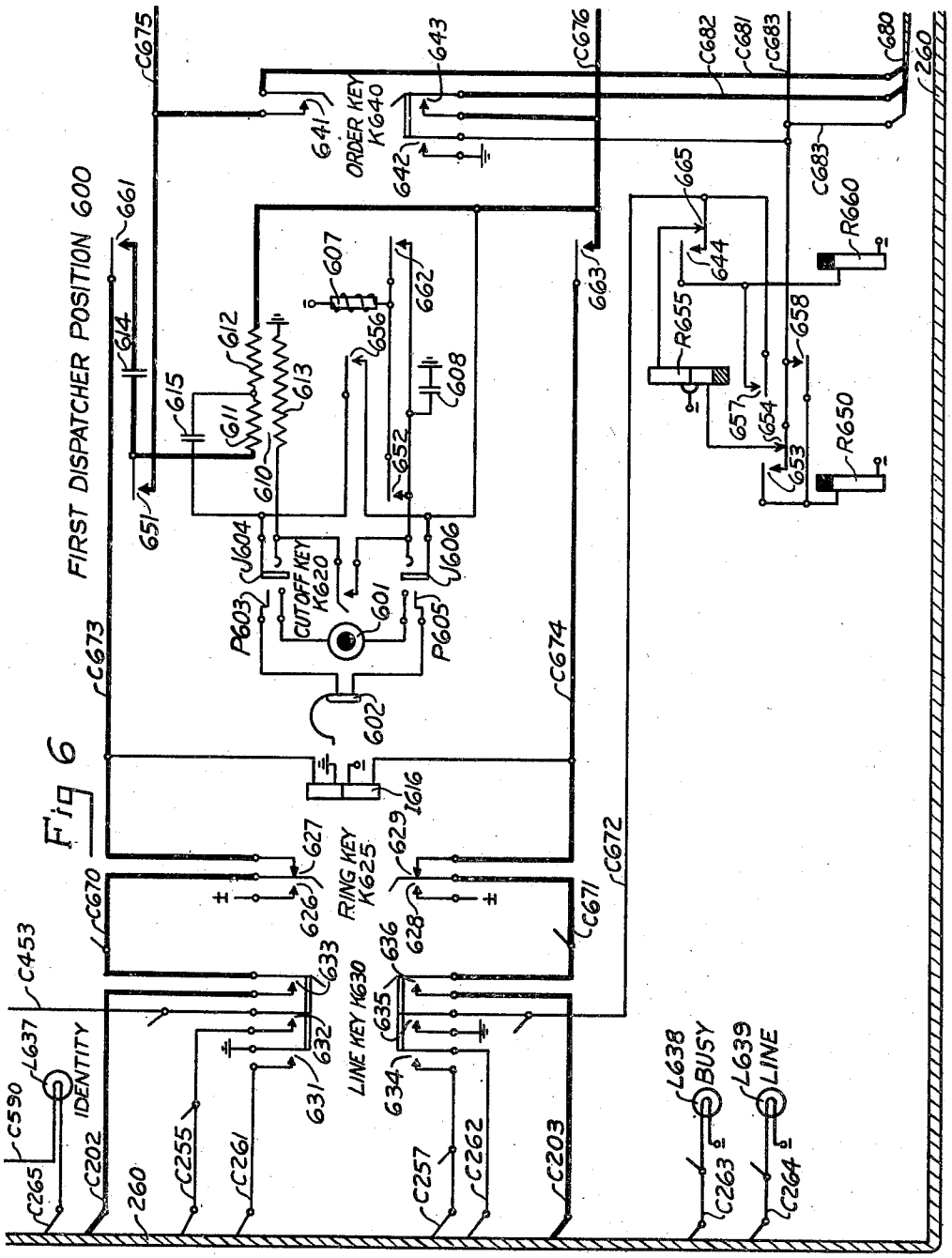

Fig 6

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SIGNALING SYSTEM

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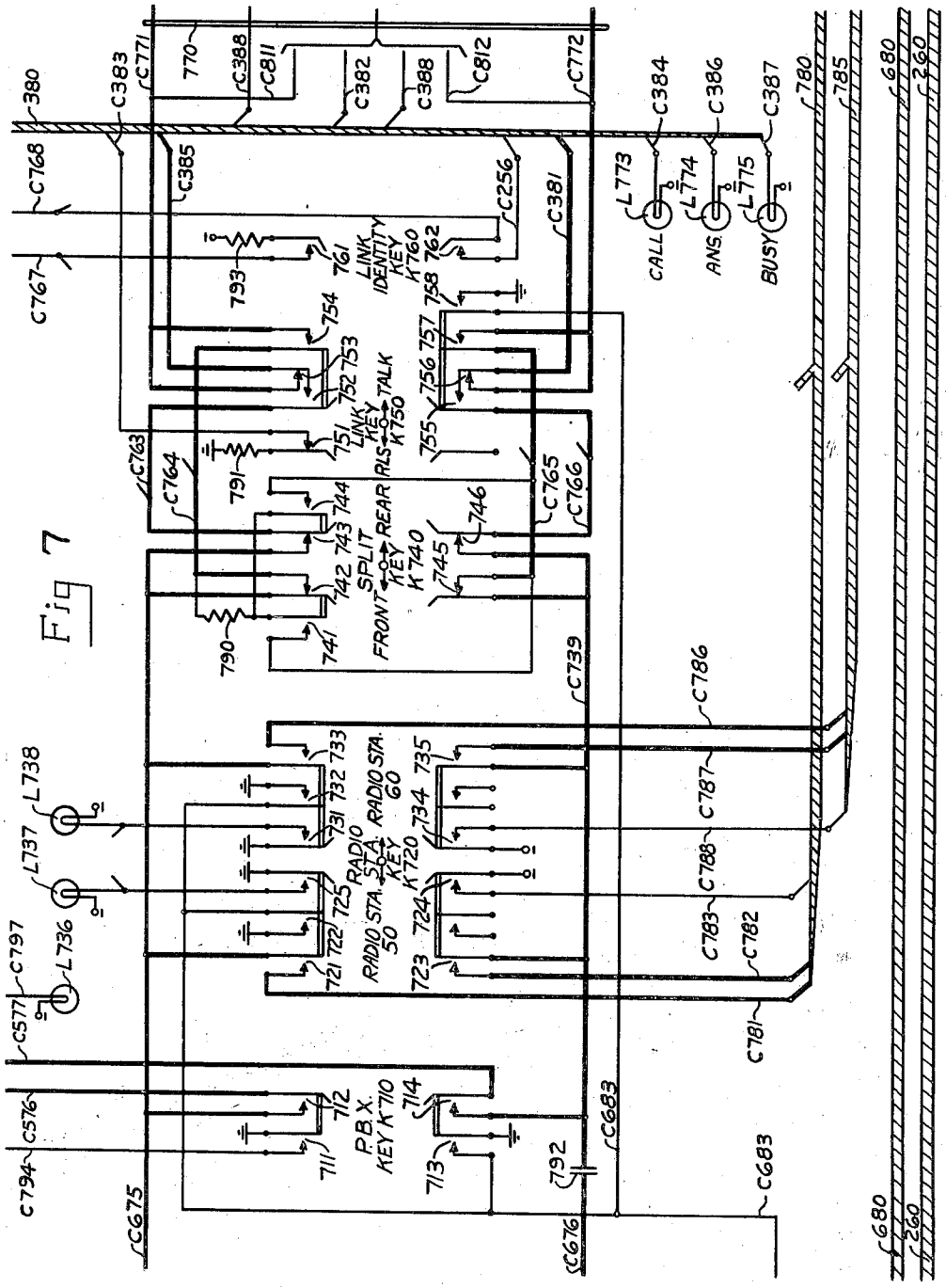

Fig 7

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SIGNALING SYSTEM

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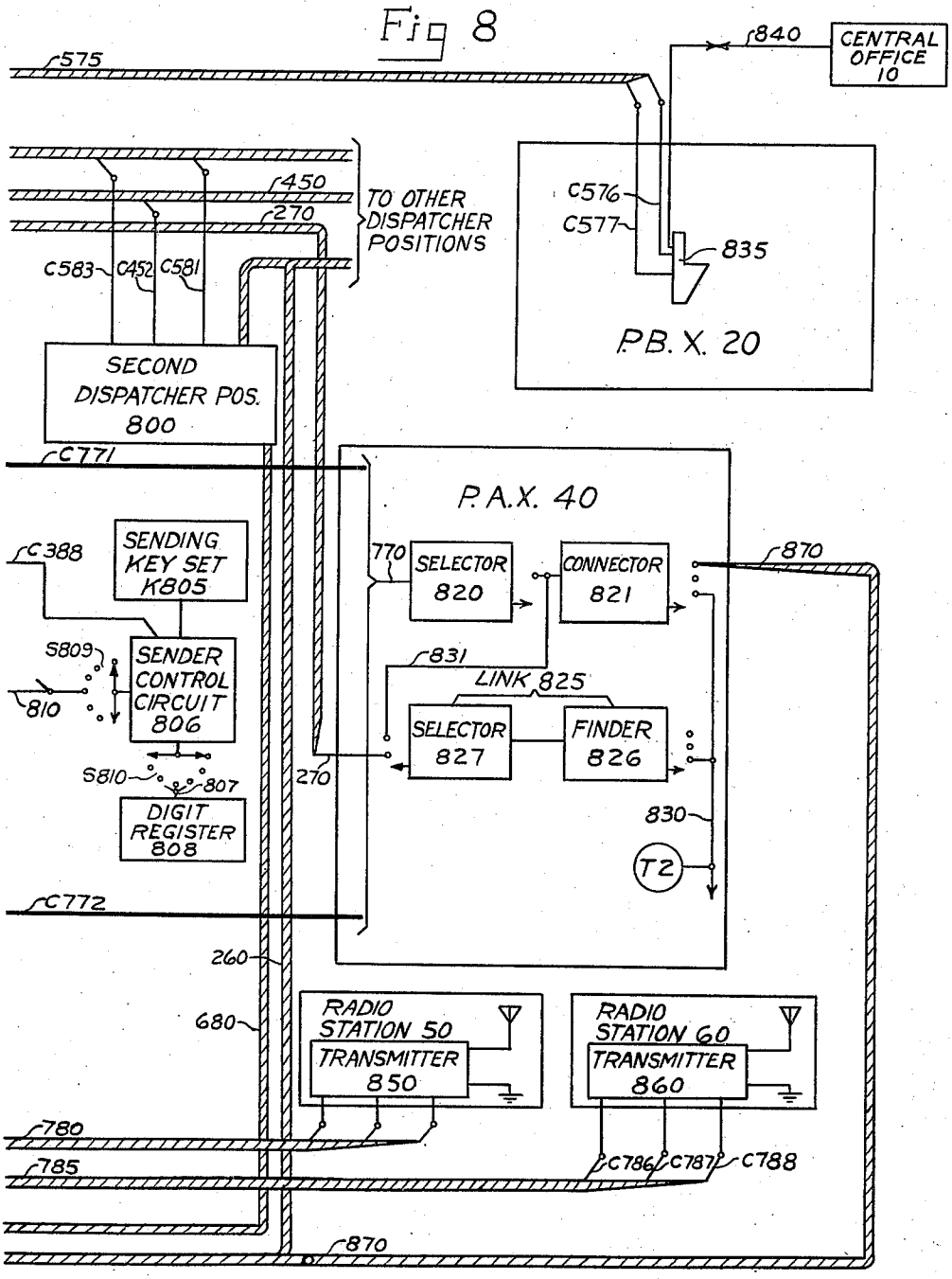
Fig 8



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Patented July 1, 1941 2,247,477

UNITED STATES PATENT OFFICE

2,247,477

SIGNALING SYSTEM

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Application March 1, 1940, Serial No. 321,660

31 Claims. (Cl. 179—5)

The present invention relates to signaling systems and, more particularly, to improvements in telephone systems for use in police dispatching systems.

A conventional police dispatching system comprises a dispatcher position at which calls on telephone lines extending to telephone stations disposed in police boxes are answered, and from which calls are extended over trunk lines to different destinations. In a system of this type the dispatcher at the dispatcher position first operates apparatus to answer a call and subsequently operates apparatus to extend the call to the required destination; and in the event a message is to be broadcast in response to the call answered, the dispatcher at the dispatcher position either extends the call to an announcer position at an associated radio station or initiates a new call which is extended to the announcer position. In any event the actual message is broadcast by the announcer at the announcer position in the radio station.

While a dispatching system of the type described is reasonably satisfactory in service, considerably more time is required in handling calls at the dispatcher position than is desirable.

Accordingly, it is an object of the present invention to provide in a dispatching system including a dispatcher position, improved circuit apparatus which is so connected and arranged that the handling of calls at the dispatcher position is rendered exceedingly fast.

Another object of this invention is to provide in a telephone system including an operator position provided with apparatus for answering calls on associated telephone lines and apparatus for extending calls over associated trunk lines, a control arrangement responsive to the operation of the call-answering apparatus for operating, at least partially, the call-extending apparatus.

Another object of the invention is to provide in a telephone exchange including an operator position provided with apparatus for answering calls on associated telephone lines, improved switching apparatus for extending the calls which is governed jointly by automatic means and manual means under the control of the operator at the operator position.

A further object of the invention is to provide in a signaling system comprising an operator position and a radio broadcasting station including a radio transmitter, improved switching apparatus controllable from the operator position for answering calls on associated telephone lines and for completing direct connections to the radio transmitter.

A further object of the invention is to provide in a telephone system comprising a number of operator positions, each including apparatus for answering calls on associated telephone lines and apparatus for completing connections over associated links, improved apparatus controllable from each operator position to identify a telephone line including in a connection completed over any one of the associated links.

The features of the present invention are illustrated as being incorporated in a signaling system comprising a dispatcher exchange of the combination manual and automatic type including a number of dispatcher positions and terminating a plurality of manual telephone lines, a private exchange of the automatic type including an automatic switch train and terminating a plurality of automatic telephone lines, and a radio broadcasting station of conventional type including a radio transmitter.

In accordance with one feature of the invention the system comprises a plurality of lines, a plurality of links, a plurality of trunks individually associated with the lines, an operator position, means selectively controllable from the operator position for connecting the operator position to any one of the lines, thereby to answer a call on the one line, means controlled when the operator position is connected to one of the lines for connecting the one line to an idle one of the links, an impulse sender controllable from the operator position, means controlled when the one line is connected to the one link for connecting the impulse sender to the one of the trunks associated with the one link, impulse responsive switching apparatus associated with the one trunk, and means for connecting the one link to the one trunk.

In accordance with another feature of the invention, the operator position is disposed in a dispatcher exchange and the automatic switch train associated with the trunks is disposed in a private exchange, the operator position being provided with a plurality of line keys individually associated with the lines and a plurality of link-trunk keys individually associated with the links and the trunks. More particularly, each of the line keys is operable to connect the operator position to the associated line; and each of the link-trunk keys is operable to connect the operator position to the associated link and trunk. Also an arrangement comprising a link distributor is provided for assigning idle ones of the

links for use in a predetermined order, the link distributor being controlled when one of the links taken for use is connected to the associated one of the trunks to assign another idle one of the links, the connection of the link to the associated trunk being controlled by the impulse sender.

In accordance with another feature of the invention the system comprises a plurality of police telephone stations, telephone lines individually extending between the police telephone stations and a dispatcher exchange, a radio broadcasting station including a radio transmitter, and a trunk extending between the dispatcher exchange and the radio transmitter. Means is provided at each of the police telephone stations for initiating a call on the associated telephone lines; and means is provided in the dispatcher exchange which is controlled from the dispatcher position for connecting position equipment provided thereat to the trunk, the position equipment including a telephone instrument. Finally means is provided in the system which is controlled when the position equipment is connected to the trunk for rendering the radio transmitter operative for broadcast purposes.

In accordance with a further feature of the invention, the system comprising a plurality of operator positions, a plurality of groups of links individually associated with the operator positions, a plurality of groups of trunks individually associated with the groups of links, whereby the individual trunks in a given group of trunks are individually associated with the links in the corresponding group of links, means selectively controllable from any one of the operator positions for connecting the operator position to any one of the lines, means controllable when one of the operator positions is connected to one of the lines for connecting the one line to an idle one of the links in the associated one of the groups of links, an impulse sender controllable from the one operator position, means controlled when the one line is connected to the one link in the one group of links for connecting the impulse sender to the associated one of the trunks in the one group of trunks, impulse responsive switching apparatus associated with the one trunk in the one group of trunks, and means for connecting the one link in the one group of links to the one trunk in the one group of trunks.

In accordance with a further feature of the invention, the system comprises a plurality of automatic switches individually associated with the lines, means controlled when a call on one of the lines is answered at one of the operator positions for marking an idle one of the links in the associated one of the groups of links and for initiating operation of the associated one of the switches, means controlled when the one switch seizes the marked link for removing the marking from the last-mentioned link and for arresting operation of the one switch, thereby to complete a connection between the one line and the one link in the one group of links, means controlled when one of the switches is operating for preventing operation of the other of the switches, and means controlled when a link in one of the groups of links is marked for preventing marking of a link in any other of the groups of links.

In accordance with a further feature of the invention, the system comprises a plurality of lines, a plurality of operator positions, a plurality of groups of links individually associated with the operator positions, means at each operator position for extending a number of different connections from the lines over the different links in the associated group of links, a plurality of identity apparatus individually corresponding to the operator positions, each identity apparatus being operative selectively to identify the particular lines included in the different connections extended over the links in the group of links associated with the corresponding operator position, normally effective means at each operator position for selectively operating the corresponding identity apparatus, and means including an identity distributor controlled by the operation of one of the identity apparatus for preventing operation of the other of the identity apparatus. More particularly, the identity distributor is connected and arranged to prevent simultaneous operations of two of the identity apparatus in spite of the fact that the two identity apparatus are seized substantially simultaneously at the two corresponding operator positions.

Further features of the invention pertain to the particular arrangement of the circuit elements thereof, whereby the above-outlined and additional operating features are attained.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings in which Figure 1 illustrates the general arrangement of a signaling system including a central office, a private branch exchange or P. B. X, a dispatcher exchange, a private automatic exchange or P. A. X and two radio stations and embodying the present invention; Figs. 2 to 8, inclusive, taken together, illustrate the details of a signaling system having incorporated therein the features of the invention, as briefly outlined above; and Fig. 9 illustrates the mode of combining Figs. 2 to 8, inclusive, of the drawings to form a unified system.

Description of the apparatus incorporated in the signaling system

Referring now more particularly to Fig. 1 of the drawings the signaling system there illustrated comprises a central office 10, a P. B. X 20, a dispatcher exchange 30, a P. A. X 40 and two radio stations 50 and 60. The central office 10 may be of any well-known type; the P. B. X 20 is of the manual type; the dispatcher exchange 30 is of the combination manual and automatic type; the P. A. X 40 is of the automatic type; and the radio stations 50 and 60 are of a conventional type. The P. B. X 20 comprises an operator position 235 at which a group of two-way trunk lines, including the trunk line 240 extending between the central office 10 and the P. B. X 20, is terminated.

The dispatcher exchange 30 serves a number of telephone stations, including the telephone station Tf, and comprises four dispatcher positions, including the first dispatcher position 600 and the second dispatcher position 300. A telephone line having a line circuit individually associated therewith extends to each telephone station in the dispatcher exchange 30. The telephone line 201 extends to the telephone station Tf and has the line circuit 200 individually associated therewith. Each of the telephone stations in the dispatcher exchange 30 is located in a police box and comprises the usual telephone station equipment including a telephone instrument and a ringer.

Also a group of two-way trunk lines extends

between the operator position 835 in the P. B. X 20 and each dispatcher position in the dispatcher exchange 30. For example, the group of trunk lines extending between the operator position 835 in the P. B. X 20 and the first dispatcher position 600 in the dispatcher exchange 30 includes the trunk line 575. Each trunk line extending between the P. B. X 20 and the dispatcher exchange 30 has a trunk circuit individually associated therewith, the trunk circuit 560 being individually associated with the trunk line 575. Further a group of one-way trunk lines extends from each dispatcher position in the dispatcher exchange 30 to the P. A. X 40. For example, the group of trunk lines extending from the first dispatcher position 600 in the dispatcher exchange 30 to the P. A. X 40 includes the trunk line 770. Each trunk line extending from a dispatcher position in the dispatcher exchange 30 to the P. A. X 40 terminates in a selector switch in the P. A. X 40, the trunk line 770 terminating in the selector switch 820 in the P. A. X 40. Also a first group of one-way trunk lines, including the trunk line 270, and a second group of one-way trunk lines, including the trunk line 870, extend between the P. A. X 40 and the dispatcher exchange 30. Each of the trunk lines in the first group is provided wth an individual line circuit in the dispatcher exchange 30, the line circuit 275 being individual to the trunk line 270; while each of the trunk lines in the second group is directly connected to a corresponding one of the telephone lines in the dispatcher exchange 30, the trunk line 870 being directly connected by way of the cable 260 to the telephone line 261 extending to the telephone station T1. Finally the dispatcher exchange 30 and the radio stations 50 and 60 are interconnected by the trunk lines 780 and 785, the trunk line 780 extending from each dispatcher position in the dispatcher exchange 30 to the radio station 50 and the trunk line 785 extending from each dispatcher position in the dispatcher exchange 30 to the radio station 60.

The P. A. X 40 serves a number of subscriber substations, including the subscriber substation T2, and comprises an automatic switch train including a number of finder-selector links, a number of connector switches and a number of groups of selector switches respectively terminating the groups of trunk lines extending from the various dispatcher positions in the dispatcher exchange 30 to the P. A. X 40. More particularly, the switch train comprises the finder-selector link 825, including the finder switch 826 and the selector switch 827, the connector switch 821 and the selector switch 820. Finally it is noted that a telephone line 830 extends to the subscriber substation T2. The finder switch 826 has access to each telephone line in the P. A. X 40; while the selector switch 827 has access to each trunk line in the first group of trunk lines extending between the P. A. X 40 and the dispatcher exchange 30 and to each connector switch in the P. A. X 40. The connector switch 821 has access to each telephone line in the P. A. X 40 and to each trunk line in the second group of trunk lines extending between the P. A. X 40 and the dispatcher exchange 30. Finally the selector switch 820 has access to each connector switch in the P. A. X 40. Each subscriber substation in the P. A. X 40 is provided with the usual substation equipment including a telephone instrument, a dial and a ringer.

Also the dispatcher exchange 30 comprises a number of groups of links individually associated with the various dispatcher positions, the first link 300 and the second link 375 being included in a group of links individually associated with the first dispatcher position 600. Also it is noted that the line circuits terminating the telephone lines in the dispatcher exchange 30 and the line circuits terminating the trunk lines in the first group of trunk lines extending from the P. A. X 40 to the dispatcher exchange 30 comprise finder switches having access to the links in each group of links. For example, the line circuit 200 comprises a finder switch S230 and the line circuit 275 comprises a finder switch S230, the finder switches S230 and S280 having access to the first link 300 and the second link 375 in the group of links individually associated with the first dispatcher position 600 in the dispatcher exchange 30.

Finally the dispatcher exchange 30 comprises a link distributor 400 and an identity distributor unit 500 commonly associated with the various dispatcher positions, which are utilized for purposes more fully explained hereinafter. In order to facilitate communication between the dispatcher positions in the dispatcher exchange 30, order trunks are provided therebetween, the order trunk 660 extending between the first dispatcher position 600 and the second dispatcher position 800. Each dispatcher position in the dispatcher exchange 30 has a sender control circuit and a sending key set individually associated therewith, the sender control circuit 806 and the sending key set K805 being individually associated with the first dispatcher position 600.

The sender control circuit 806 comprises a finder switch S809 having access to each trunk line in the group of trunk lines extending from the first dispatcher position 600 in the dispatcher exchange 30 to the P. A. X 40 and a finder switch S810 having access to a group of digit registers, including the digit register 808, provided in the dispatcher exchange 30.

The operator position 835 in the P. B. X 20, shown in Fig. 8, comprises conventional apparatus including a telephone instrument and equipment for answering and for completing connections between the central office 10, the various telephone lines in the P. B. X 20 and the dispatcher exchange 30. Preferably, the switches included in the switch train in the P. A. X 40, shown in Fig. 3, and including the finder switch 826, the selector switch 827, the connector switch 821 and the selector switch 820, are of the usual Strowger type. Preferably, the apparatus in the two radio stations 50 and 60, shown in Fig. 8, are identical, these apparatus respectively comprising the radio broadcast transmitters 850 and 860 of conventional connection and arrangement.

Preferably, each of the line circuits terminating a telephone line in the dispatcher exchange 30 and each of the line circuits terminating a trunk line in the first group of trunk lines extending from the P. A. X 40 to the dispatcher exchange 30 is identical to the line circuit 200, shown in Fig. 2. The line circuit 200 comprises a finder switch S230 of the rotary type including six rotary wipers 231, 232, 233, 234, 235 and 236 provided with individually associated rotary contact banks 241, 242, 243, 244, 245 and 246. Also the rotary switch S230 is provided with a rotary magnet M237 for moving the wipers noted in the rotary direction. Further the line circuit 200 comprises a number of relays including a line relay R210, a cutoff relay R205 and a switching

relay R220 connected and arranged in a manner more fully described subsequently.

Preferably, each of the links in the groups of links individually associated with the dispatcher positions in the dispatcher exchange 30 is identical to the first link 300 in the group of links associated with the first dispatcher position 600, shown in Fig. 3. The first link 300 comprises a repeater 305 operatively interconnecting a first branch of the first link 300 including the trunk 750, and a second branch of the first link 300 including the cable 380. Further the first link 300 comprises a number of relays including a start relay R310, a stop relay R320, a control relay R330, a hold relay R325, a line relay R340, a supervisory relay R350 and a cut-in relay R360 connected and arranged in a manner more fully described subsequently.

The link distributor 400, shown in Fig. 4, comprises four cutoff relays R410, R420, R430 and R440 individually associated with the four dispatcher positions in the dispatcher exchange 30 and four hold relays R405, R415, R425 and R435 individually associated with the four dispatcher positions in the dispatcher exchange 30. The particular connection and arrangement of the cutoff and hold relays mentioned are described more fully subsequently.

The identity distributor unit 500, shown in Fig. 5, comprises four cutoff relays R520, R530, R540 and R550 individually associated with the four dispatcher positions in the dispatcher exchange 30 and four identity relays R510 and R516, the reference character R516 indicating three of the identity relays, individually associated with the four dispatcher positions in the dispatcher exchange 30. The particular connection and arrangement of the cutoff and identity relays mentioned are described more fully subsequently.

Preferably, the trunk circuit associated with each of the trunk lines extending between the P. B. X 20 and the various dispatcher positions in the dispatcher exchange 30 are identical to the trunk circuit 560, shown in Fig. 5, individually associated with the trunk line 575 extending between the P. B. X 20 and the first dispatcher position 600 in the dispatcher exchange 30. The trunk circuit 560 comprises a ring-up relay R565 and a cutoff relay R570 connected and arranged in a manner more fully described subsequently.

Preferably, each of the dispatcher positions in the dispatcher exchange 30 is identical to the first dispatcher position 600, shown in Figs. 6 and 7, which comprises a trunk circuit including a transmitter 601, a receiver 602, a repeater 610, an impedance element 1616 and a number of relays including the control relay R655, and two switching relays R650 and R660 connected and arranged in a manner more fully described subsequently. Also the trunk circuit at the first dispatcher position 600 comprises a number of line keys individually associated with the telephone lines in the dispatcher exchange 30, the line key K630 being individually associated with the telephone line 201 extending to the telephone station T1; a number of trunk keys, not shown, individually associated with the trunk lines in the first group of trunk lines extending from the P. A. X 40 to the dispatcher exchange 30; a number of link keys individually associated with the links in the associated group of links, the link key K750 being individually associated with the first link 300 in the associated group of links; and a number of link identity keys individually associated with the links in the associated group of links, the link identity key K760 being individually associated with the first link 300 in the associated group of links. Further the trunk circuit at the first dispatcher position 600 comprises a number of P. B. X keys individually associated with the trunk lines in the group of trunk lines extending between the first dispatcher position 600 and the P. B. X 20, the P. B. X key K710 being individually associated with the trunk line 575 included in the group of trunk lines extending between the first dispatcher position 600 and the P. B. X 20; a radio station key K720 commonly associated with the trunk lines 780 and 785 extending between the dispatcher exchange 30 and the radio stations 50 and 60, respectively; and a number of order keys individually associated with the order trunks extending between the first dispatcher position 600 and the other dispatcher positions, the order key K640 being individually associated with the order trunk 680 extending between the first dispatcher position 600 and the second dispatcher position 800. Finally the trunk circuit at the first dispatcher position 600 comprises a common ring key K625 which is operative to ring over a connection associated with the rear end of the trunk circuit, and a common split key K740 which is operative to split in either direction a connection associated with the front end of the trunk circuit.

Also associated with the first dispatcher position 600 are various groups of signal lamps which are provided in order to facilitate the supervision of the various connections. For example, the identity signal lamp L637, the busy signal lamp L638 and the line signal lamp L639 are individually associated with the cable 260 extending to the line circuit 200 individually associated with the telephone line 201 extending to the telephone station T1; the call signal lamp L773, the answer signal lamp L774 and the busy signal lamp L775 are individually associated with the cable 380 extending to the first link 300; the signal lamp L736 is individually associated with the trunk circuit 560 which is individually associated with the trunk line 575 extending between the first dispatcher position 600 in the dispatcher exchange 30 and the P. B. X 20; and the signal lamps L737 and L738 are individually associated with the respective trunks 780 and 785 extending from the first dispatcher position 600 in the dispatcher exchange 30 to the radio stations 50 and 60, respectively.

The sending key set K805, the sender control circuit 806 and the digit register 808 are connected and arranged in a conventional manner; and, in view of the fact that the particular connection and arrangement of this apparatus forms no part of the present invention, the details thereof have not been illustrated in the interest of brevity. However, for reference purpose, a sending key set, a sender control circuit and a digit register of the general character of the sending key set K805, the sender control circuit 806 and the digit register 808, respectively, are disclosed respectively in Fig. 16, Figs. 15 and 16, and Figs. 17 to 21, inclusive, of Thomas F. Crocker Patent No. 2,167,710, issued August 1, 1939.

A better understanding of the connection and arrangement of the apparatus incorporated in the signaling system will be facilitated from a consideration of the detailed operation of the various pieces of apparatus incorporated therein incident to the completion and the handling of the various connections at the first dispatcher

position 600 in the dispatcher exchanger 30 and at the operator position 635 in the P. B. X 20, as will appear hereinafter.

General operation of the signaling system

Considering now the general operation of the signaling system with reference to Fig. 1 of the drawings, it is noted that a call initiated at any one of the telephone stations in the dispatcher exchange 30, such, for example, as the telephone station T1, causes a signal to be transmitted to each of the dispatcher positions in the dispatcher exchange 30 and may be answered at any one of the dispatcher positions, such, for example, as the first dispatcher position 600. In order to answer the call from the telephone station T1 on the telephone line 201, the dispatcher at the first dispatcher position 600 operates the line key in his trunk circuit individually associated with the telephone line 201, thereby to cause the finder switch S230 in the line circuit 200 individually associated with the telephone line 201 to operate and find an idle one of the links in the group of links individually associated with the first dispatcher position 600, such, for example, as the first link 300. Immediately the dispatcher at the first dispatcher position 600 operates the line key in his trunk circuit corresponding to the telephone line 201 extending to the telephone station T1, a connection is completed between the first dispatcher position 600 and the telephone station T1; and immediately the finder switch S230 in the line circuit 200 individually associated with the telephone line 201 seizes the first link 300, operation of the sender control circuit 306 individually associated with the first dispatcher position 600 is initiated. More particularly, the finder switch S309 of the sender control circuit 306 finds the trunk 310 connected to the first link 300 and to the trunk line 770 extending from the first dispatcher position 600 in the dispatcher exchange 30 to the P. A. X 40. Also the finder switch S310 of the sender control circuit 306 finds an idle one of the digit registers, such, for example, as the digit register 308. Accordingly, at this time, the apparatus at the first dispatcher position 600 is automatically conditioned to extend the call therefrom by way of the trunk line 770 to any subscriber substation in the P. A. X 40, in the event this service is desired.

In the event the call is to be extended from the first dispatcher position 600 in the dispatcher exchange 30 to a subscriber substation, such, for example, as the subscriber substation T2 in the P. A. X 40, the dispatcher in the first dispatcher position 600 operates the sending key set K305, thereby to cause appropriate digits to be registered in the digit register 308, whereupon the digit register 308 governs the sender control circuit 306 in order to cause the digits to be transmitted over the trunk line 770 to the P. A. X 40. The digits transmitted over the trunk line 770 to the P. A. X 40 control the automatic switch train therein in order to cause the call to be extended to the subscriber substation T2 in a well-known manner, thereby to establish a connection between the telephone station T1 in the dispatcher exchange 30 and the subscriber substation T2 in the P. A. X 40. The dispatcher at the first dispatcher position 600 may then operate the link key in his trunk circuit individually associated with the first link 300 and then return the line key in his trunk circuit individually associated with the telephone line 201 to its normal position, thereby to cause a three-way communication connection to be completed including the telephone station T1, the trunk circuit at the first dispatcher position 600, and the subscriber substation T2. Further it is noted that, when the line key in the trunk circuit at the first dispatcher position 600 individually associated with the telephone line 201 is operated in order to answer the call on the telephone line 201, the link distributor 400 operates in order to lock out the other dispatcher positions, thereby to prevent the call on the telephone line 201 from being answered at the other dispatcher positions.

After the connection has been established between the telephone station T1 in the dispatcher exchange 30 and the subscriber substation T2 in the P. A. X 40, the dispatcher at the first dispatcher position 600 may free the trunk circuit at his position by returning the link key in his trunk circuit individually associated with the first link 300 to its normal position. Further it is noted that the dispatcher in the first dispatcher position 600 may monitor or split in either direction the established connection between the telephone station T1 in the dispatcher exchange 30 and the subscriber substation T2 in the P. A. X 40. Finally it is noted that the release of the established connection between the telephone station T1 in the dispatcher exchange 30 and the subscriber substation T2 in the P. A. X 40 is under the control of the dispatcher at the first dispatcher position 600; and that the dispatcher at the first dispatcher position 600 may control the identity distributor unit 500 by operating a link identity key in his trunk circuit individually associated with the first link 300, thereby to cause the particular telephone station included in the established connection, routed by way of the first link 300, to be identified. The identity distributor unit 500 is so connected and arranged that, when it is taken for use by the dispatcher at the first dispatcher position 600 to identify a telephone station, it is locked against use by the dispatchers at the other dispatcher positions.

Further it is noted that a call may be extended from any one of the dispatcher positions in the dispatcher exchange 30 to any one of the telephone stations in the dispatcher exchange 30 or to the operator position 635 in the P. B. X 20 and from the operator position 635 in the P. B. X 20 to any one of the dispatcher positions in the dispatcher exchange 30, in a manner more fully explained hereinafter. Further, calls may be set up in either direction between the central office 10 and the P. B. X 20 and then routed to any one of the dispatcher positions in the dispatcher exchange 30. The dispatcher at any one of the dispatcher positions in the dispatcher exchange 30 may route a call from his position to either one of the radio stations 50 or 60, thereby to broadcast directly from the dispatcher position in the dispatcher exchange 30 over the transmitter in the radio station. Further, calls may be extended between the dispatcher positions in the dispatcher exchange 30 by way of the order trunks extending therebetween.

Also a call may be extended from any subscriber substation in the P. A. X 40 to any other subscriber substation therein, to any telephone station in the dispatcher exchange 30 directly and to the dispatcher exchange 30 to be answered by a dispatcher at one of the dispatcher positions therein, in a manner more fully explained hereinafter.

Initiation of a call at a telephone station in the dispatcher exchange

A call may be initiated at a telephone station in the dispatcher exchange 30, such, for example, as the telephone station T1, by removing the receiver of the telephone instrument thereat from its associated switchhook. When the receiver of the telephone instrument at the telephone station T1 is removed from its associated switchhook, a bridge path is completed thereat between the line conductors C202 and C203 of the telephone line 201 extending to the telephone station T1. When this bridge path is completed between the line conductors of the telephone line 201 a circuit is completed for energizing the winding of the line relay R210. This circuit extends from ground by way of the contacts 206, C202, the bridge path between the line conductors C202 and C203 of the telephone line 201 at the telephone station T1, C203, the contacts 207 and the winding of R210 to battery. When thus energized the line relay R210 operates to complete, at the contacts 211, an obvious path for applying ground potential to the control conductor C204 of the telephone line 201. This application of ground potential to the control conductor C204 of the telephone line 201 completes a path extending by way of the control conductor C267 in the cable 260 for applying ground potential to the control conductor of the trunk line 470 extending from the P. A. X 40 to the dispatcher exchange 30 in order to mark the trunk line 470 and consequently the telephone line 201 as busy to the connector switches in the P. A. X 40. Further the line relay R210 completes, at the contacts 213, an obvious path for applying ground potential to the control conductor C264 in the cable 260, thereby to complete an obvious circuit for illuminating the line signal lamp L639 at the first dispatcher position 600 and the corresponding line signal lamps at the other dispatcher positions.

The illumination of the line signal lamps at the various dispatcher positions indicates to the dispatchers thereat that a call is waiting to be answered on the telephone line 201 extending to the telephone station T1. In order to answer the call on the telephone line 201 the dispatcher at one of the dispatcher positions operates the line key in his trunk circuit individually corresponding to the telephone line 201. Assuming that the call on the telephone line 201 is answered at the first dispatcher position 600, the dispatcher thereat operates the line key K630 in the trunk circuit at the first dispatcher position 600 away from its normal position, thereby to complete, at the contacts 633 and 636 thereof, obvious connections between the line conductors C670 and C671 of the trunk circuit at the first dispatcher position 600 and the respective line conductors C202 and C203 of the telephone line 201. Also when the line key K630 is thus operated there is completed, at the contacts 635 thereof, an obvious path for applying ground potential to the control conductor C672, thereby to complete an obvious circuit for energizing the upper winding of the control relay R655. When thus energized, the control relay R655 operates to complete, at the contacts 657, an obvious circuit, including the grounded control conductor C672, for energizing the winding of the switching relay R660. When thus energized, the switching relay R660 operates shortly thereafter, this relay being of the slow-to-operate type, to complete, at the contacts 664, an obvious holding circuit including the grounded control conductor C672 for energizing the winding thereof. Further the switching relay R660 interrupts, at the contacts 665, the previously mentioned circuit for energizing the upper winding of the control relay R655, thereby to cause the control relay R655 to restore shortly thereafter, the latter relay being of the slow-to-release type.

Also, upon operating, the switching relay R660 completes, at the contacts 661 and 663, a connection between the repeater 610 and the line conductors C202 and C203 of the telephone line 201, this connection extending from the line conductor C202 of the telephone line 201 by way of the contacts 633 of the line key K630, C670, the contacts 627 of the ring key K625, C673, the contacts 661, the condenser 614, the windings 611 and 612 of the repeater 610, the contacts 663, C674, the contacts 629 of the ring key K625, C671 and the contacts 636 of the line key K630 to the line conductor C203 of the telephone line 201. Accordingly, at this time, the telephone instrument at the telephone station T1 is operatively connected by way of the previously traced circuit to the repeater 610 at the first dispatcher position 600. Further the switching relay R660 completes, at the contacts 662, a circuit for supplying operating current to the transmitter 601, assuming that the plugs P603 and P605 occupy their inserted positions into the jacks J604 and J606, respectively, at this time. This circuit extends from ground by way of the winding 613 of the repeater 610, the jack J604, the plug P603, the transmitter 601, the plug P605, the jack J606, the contacts 662 and the retarder coil 607 to battery. Further it is noted that a signal current path is completed which extends from ground by way of the winding 613 of the repeater 610, the jack J604, the plug P603, the transmitter 601, the plug P605, the jack J606 and the condenser 608 to ground. The above-traced signal current path by-passes the previously traced circuit for supplying current to the transmitter 601. Also the receiver 602 is operatively associated with the winding 612 of the repeater 610 by way of a circuit extending from one terminal of the receiver 602 over the plug P603, the jack J604, the condenser 615, the winding 612 of the repeater 610, the jack J606 and the plug P605 to the other terminal of the receiver 602. Accordingly, at this time, the transmitter 601 and the receiver 602 are operatively connected to the repeater 610. Hence, a two-way communication connection is completed at this time between the telephone station T1 and the first dispatcher position 600.

At this point it is noted that, upon operating, the control relay R655 completes, at the contacts 656, a path for short-circuiting the receiver 602, which path is interrupted at the contacts 656 incident to the restoration of the control relay R655. This path is completed and subsequently interrupted in order to prevent disagreeable clicks from being produced in the receiver 602 incident to the operation of the switching relay R660. The path for short-circuiting the receiver 602 extends, when completed, from one terminal of the receiver 602 by way of the plug P603, the jack J604, the contacts 656, the jack J606 and the plug P605 to the other terminal of the receiver 602. Further it is noted that the impedance element I616 is connected across the line conductors C673 and C674 of the trunk circuit at the first dispatcher position 600, this connection

extending from ground by way of the upper winding of I616 to the line conductor C673 and from battery by way of the lower winding of I616 to the line conductor C674. Accordingly, battery is supplied by way of the impedance element I616 to the telephone instrument at the telephone station T1 at this time.

Also when the line key K630 is thus operated there is completed, at the contacts 631 thereof, an obvious path for applying ground potential to the control conductor C261 in the cable 260, thereby to complete an obvious circuit for energizing the winding of the cutoff relay R205. When thus energized the cutoff relay R205 operates to complete, at the contacts 206, an obvious path for applying ground potential to the control conductor C263 in the cable 260, thereby to complete an obvious circuit for illuminating the busy signal lamp L638 at the first dispatcher position 600 and the corresponding busy signal lamps at the other dispatcher positions. The illumination of the busy signal lamps at the various dispatcher positions indicates to the dispatchers thereat that the telephone line 201 is now busy. Further the cutoff relay R205 interrupts, at the contacts 209, a circuit traced hereinafter for energizing the rotary magnet M237 of the finder switch S230 and interrupts, at the contacts 206 and 207, the previously traced circuit for energizing the winding of the line relay R210, thereby to cause the latter relay to restore shortly thereafter, the latter relay being of the slow-to-release type, and to clear the telephone line 201 of impedance elements. Upon restoring, the line relay R210 interrupts, at the contacts 213, the previously mentioned circuit for illuminating the line signal lamp L639 at the first dispatcher position 600 and the corresponding line signal lamps at the other dispatcher positions, thereby to indicate to the dispatchers at the various dispatcher positions that the call on the telephone line 201 has been answered. Further the line relay R210 completes, at the contacts 212, an obvious connection between the control conductors C261 and C267 in the cable 260, thereby to retain the application of ground potential upon the control conductor of the trunk line 370 extending from the P. A. X 40 to the dispatcher exchange 30.

Further when the line key K630 is operated there is completed, at the contacts 632 thereof, a circuit for energizing in series the winding of the cutoff relay R410 in the link distributor 400 and the winding of the start relay included in one of the links in the group of links individually associated with the first dispatcher position 600, the particular one of the start relays, the winding of which is energized, depending upon the condition of the chain circuit included in the group of links mentioned for energizing the windings of these start relays. In the present example, assuming that the first link 300 in the group of links individually associated with the first dispatcher position 600 is idle, a circuit is completed for energizing in series the winding of the cutoff relay R410 in the link distributor 400 and the winding of the start relay R310 in the first link 300. This circuit extends from ground by way of the contacts 441, 431 and 421, the winding of R410, the contacts 407, the control conductor C453 in the cable 450, the contacts 632 of the line key K630, the control conductor C255 in the cable 260, the contacts 313 and 334 and the winding of R310 to battery. When thus energized the start relay R310 operates to prepare, at the contacts 311, a circuit traced hereinafter for energizing the winding of the stop relay R320, to complete, at the contacts 312, an obvious holding circuit for energizing the winding thereof by way of the grounded control conductor C255 in the cable 260 and to interrupt, at the contacts 313, a point in the previously traced circuit for energizing the winding thereof. Further the start relay R310 prepares, at the contacts 315, a circuit traced hereinafter for energizing the winding of the hold relay R405 in the link distributor 400. Finally, the start relay R310 completes, at the contacts 314, a circuit for energizing the rotary magnet M237 of the finder switch S230, this circuit extending from ground by way of the contacts 335, 322 and 314, the control conductor C257 in the cable 260, the contacts 634 of the line key K630, the control conductor C262 in the cable 260, the contacts 224 and 239 and the rotary magnet M237 to battery. When thus energized the rotary magnet M237 operates to interrupt, at the contacts 236, the previously traced circuit for energizing the rotary magnet M237 and to condition the wipers noted of the finder switch S230 to be driven one step in the clockwise direction. The rotary magnet M237 then restores in order to drive the wipers noted of the finder switch S230 one step in the clockwise direction and to recomplete, at the contacts 236, the previously traced circuit for energizing the rotary magnet M237. Accordingly, the rotary magnet M237 operates intermittently, thereby to drive the wipers noted of the finder switch S230 step by step in the clockwise direction until the trunk 250 extending to the first link 300 is seized, in a manner more fully described hereinafter.

When the previously traced series circuit for energizing the winding of the start relay R310 in the first link 300 and the cutoff relay R410 in the link distributor 400 is completed, the cutoff relay R410 also operates. Upon operating, the cutoff relay R410 interrupts, at the contacts 411, an obvious path for applying ground potential by way of the contacts 441 and the winding of the cutoff relay R420 to the control conductor C452 in the cable 450 and interrupts, at the contacts 412, obvious paths for applying ground potential by way of the contacts 412 and the windings of the cutoff relays R430 and R440, respectively, to the control conductors C457 and C456 in the cable 450. The control conductors C452, C457 and C456 in the cable 450 respectively extend to the second, third and fourth dispatcher positions. Accordingly, the operated cutoff relay R410 individually corresponding to the first dispatcher position 600 prevents operation of the cutoff relays R420, R430 and R440 individually corresponding to the second, third and fourth dispatcher positions, respectively. Further, it will be understood that the removal of ground potential from the control conductors C452, C456 and C457 in the cable 450 positively prevents operation of the start relays in the links included in the groups of links individually associated with the second, third and fourth dispatcher positions. Accordingly, it will be understood that, while the cutoff relay R410 in the link distributor 400 individually corresponding to the first dispatcher position 600 remains in its operated position, it is impossible for the dispatchers at the other dispatcher positions to answer incoming calls to the dispatcher exchange 30. This arrangement prevents interference between the dispatchers at the various dispatcher positions and causes a call on a telephone line to be answered at the particular dispatcher position at

which the line key individually associated with the telephone line is first operated.

Continuing now with the operation of the finder switch S230, when the finder switch S230 seizes the trunk 250 extending to the first link 300 the previously mentioned circuit for energizing the winding of the stop relay R320 in the first link 300 is completed, this circuit extending from ground by way of the wiper 234 and engaged contact in the associated contact bank 244 of the finder switch S230, the control conductor C254 of the trunk 250, the contacts 311 and the winding of R320 to battery. When thus energized the stop relay R320 operates to interrupt, at the contacts 322, the previously traced circuit for energizing the rotary magnet M237, thereby positively to arrest further operation of the rotary magnet M237 at this time. Further the stop relay R320 completes, at the contacts 321, an obvious circuit for energizing the winding of the control relay R330, thereby to cause the control relay R330 to operate shortly thereafter, the latter relay being of the slow-to-operate type. Upon operating, the control relay R330 completes, at the contacts 336, the previously mentioned circuit for energizing the winding of the hold relay R405 in the link distributor 400, this circuit extending from ground by way of the contacts 336 and 315, the control conductor C454 in the cable 450 and the winding of R405 to battery. When thus energized the hold relay R405 operates to complete, at the contacts 406, an alternative holding circuit substantially identical to that previously traced for energizing the winding of the start relay R310 and to interrupt, at the contacts 407, the previously traced circuit for energizing the winding of the cutoff relay R410. The cutoff relay R410 then restores, thereby to prepare, at the contacts 411 and 412, the previously traced paths for applying ground potential to the control conductors C452, C457 and C456 in the cable 450. The application of ground potential to the control conductors C452, C457 and C456 renders the apparatus at the respective second, third and fourth dispatcher positions again operative to answer incoming calls to the dispatcher exchange 30. Accordingly, it will be understood that the cutoff relay R410 remains in its operated position in order to disable the apparatus at the second, third and fourth dispatcher positions only during the brief time interval while the finder switch S230 is hunting for the trunk 250 extending to the first link 300.

Also, upon operating, the control relay R330 completes, at the contacts 331, a circuit for energizing the winding of the switching relay R220 in the line circuit 200, this circuit extending from ground by way of the contacts 331, the control conductor C252 of the trunk 250, the wiper 232 and engaged contact in the associated contact bank 242 of the finder switch S230 and the winding of R220 to battery. When thus energized the switching relay R220 operates shortly thereafter, this relay being of the slow-to-operate type, to interrupt, at the contacts 224, a further point in the previously traced circuit for energizing the rotary magnet M237, to complete, at the contacts 223, an obvious holding circuit for energizing the winding of the cutoff relay R205, and to complete, at the contacts 221 and 222, a connection between the telephone line 201 and the repeater 305. The connection between the telephone line 201 and the repeater 305 extends from ground by way of the upper winding of the line relay R340, the winding 306 of the repeater 305, the line conductor C251 of the trunk 250, the wiper 231 and engaged contact in the associated contact bank 241 of the finder switch S230 and the contacts 221 to the line conductor C202 of the telephone line 201; and from battery by way of the lower winding of the line relay R340, the winding 307 of the repeater 305, the line conductor C253 of the trunk 250, the wiper 233 and engaged contact in the associated contact bank 243 of the finder switch S230 and the contacts 222 to the line conductor C203 of the telephone line 201. When this connection between the telephone line 201 and the repeater 305 is completed the upper and lower windings of the line relay R340 are energized, thereby to cause the latter relay to operate.

Also, upon operating, the control relay R330 interrupts, at the contacts 334, a further point in the previously traced original circuit for energizing the winding of the start relay R310 and prepares, at the contacts 333, a point in a circuit traced hereinafter for energizing the winding of the start relay, not shown, included in the second link 375. Further the control relay R330 completes, at the contacts 332, an obvious path for applying ground potential to the control conductor C387 in the cable 380, thereby to complete an obvious circuit for illuminating the busy signal lamp L775 at the first dispatcher position 600. The illumination of the busy signal lamp L775 indicates to the dispatcher at the first dispatcher position 600 that the finder switch S230 in the line circuit 200 has seized the first link 300 in the group of links individually associated with the first dispatcher position 600 and, in the event the call on the telephone line 201 is to be extended to the P. A. X 40, that the first link 300 will be utilized. Finally, the control relay R330 interrupts, at the contacts 335, an obvious path for applying ground potential to the control conductor C388 in the cable 380. When ground potential is removed from the control conductor C388 in the cable 380, operation of the sender control circuit 806 is initiated. More particularly, the finder switch S810 of the sender control circuit 806 operates automatically to find a trunk extending to an idle one of the digit registers, such, for example, as the trunk 807 extending to the digit register 808. When the finder switch S810 seizes the trunk 807 extending to the digit register 808, further operation of the finder switch S810 is arrested and the digit register 808 is conditioned to register digits transmitted thereto. Also the finder switch S809 of the sender control circuit 806 is operated to search for the trunk 810 marked as a calling trunk by the absence of ground potential upon the control conductor C388 thereof. When the finder switch S809 seizes the trunk 810, further operation thereof is arrested and the sender control circuit 806 is conditioned to be operative further in accordance with the operation of the sending key set K805 in the event the call is to be extended from the first dispatcher position 600 to the P. A. X 40. At this time, a bridge path is completed in the sender control circuit 806 by way of the finder switch S809 between the line conductors C811 and C812 of the trunk 810 and, consequently, between the line conductors C771 and C772 of the trunk line 770 extending from the first dispatcher position 600 in the dispatcher exchange 30 to the P. A. X 40. When this bridge path is completed between the line conductors of the trunk line 770 the selector switch 820 in the P. A. X 40 is conditioned to be operative in response to impulses trans-

mitted thereto. Also at this time, the line conductors C771 and C772 of the trunk line 770 are respectively connected by way of the contacts 753 and 756 of the link key K750 to the line conductors C385 and C381 in the cable 380 extending to the first link 300, the link key K750 in the trunk circuit at the first dispatcher position 600 being individual to the first link 300. However, it is noted that the line conductors C381 and C385 in the cable 380 are not operatively connected to the repeater 305 in the first link 300 at this time, due to the restored position of the cut-in relay R360.

Upon operating, the line relay R340 completes, at the contacts 341, an obvious circuit for energizing the winding of the hold relay R325, thereby to cause the latter relay to operate. Also the line relay R340 interrupts, at the contacts 342, a point in a path traced hereinafter for applying ground potential to the control conductor C386 in the cable 380, for a purpose more fully explained subsequently. Upon operating, the hold relay R325 prepares, at the contacts 326, a further point in the previously mentioned path for applying ground potential to the control conductor C386 in the cable 380 and completes, at the contacts 327, an obvious holding circuit for energizing the winding of the control relay R330.

At this time, the call from the telephone station T1 on the telephone line 201 has been answered by the dispatcher at the first dispatcher position 600 and the apparatus in the trunk circuit at the first dispatcher position 600 is conditioned to extend the call on the telephone line 201 by way of the first link 300, the cable 380 and the trunk line 770 to the P. A. X 40 in the event this service is desired by the person at the telephone station T1. Also, at this time, the telephone instrument at the telephone station T1 is operatively connected by way of the telephone line 201 and the cable 260 to the transmitter 601 and the receiver 602 at the first dispatcher position 600. Accordingly, the person at the telephone station T1 and the dispatcher at the first dispatcher position 600 communicate with each other and the dispatcher at the first dispatcher position 600 is advised concerning the extension of the call in the event this service is desired.

Extension of a call from the dispatcher exchange to the P. A. X

In the event a call from a telephone station to a dispatcher position, such, for example, as the call from the telephone station T1 to the first dispatcher position 600 routed by way of the telephone line 201, the cable 260 and the first link 300 is to be extended to a subscriber substation in the P. A. X 40, such, for example, as the subscriber substation T2, the dispatcher at the first dispatcher position 600 initiates the extension of the call by operating the sending key set K605 in accordance with the appropriate series of digits. When the sending key set K605 is thus operated the digit register 608 previously selected by the finder switch S610 of the sender control circuit 606 is governed by way of the sender control circuit 606 to register the digits set up by the dispatcher at the first dispatcher position 600 on the sending key set K605. The digit register 608 then controls the sender control circuit 606, thereby to cause the digits registered in the digit register 608 to be transmitted by the sender control circuit 606 over the finder switch S609, the trunk 610 and the trunk line 770 to the P. A. X 40. The selector switch 620 in the P. A. X 40 responds to the first digit transmitted over the trunk line 770 and operates to select an idle connector switch in a corresponding group of connector switches, such, for example, as the connector switch 621. The connector switch 621 then responds to the following two digits to seize the telephone line 630 extending to the subscriber substation T2 in the usual manner. The subsequent operation of the connector switch 621 depends upon the idle or busy condition of the subscriber substation T2 in accordance with conventional practice.

After the sender control circuit 606 has transmitted the last digit registered, it operates to cause ground potential to be applied by way of the finder switch S609 to the control conductor C382 of the trunk 610. The application of ground potential to the control conductor C382 of the trunk 610 completes an obvious path, including the control conductor C382 in the cable 380, for energizing the winding of the cut-in relay R360, thereby to cause the cut-in relay R360 to operate shortly thereafter, the latter relay being of the slow-to-operate type. The sending key set 605, the sender control circuit 606 and the digit register 608 are then automatically released. Upon operating, the cut-in relay R360 completes, at the contacts 361, a holding circuit for energizing the winding thereof, this circuit extending from ground by way of the resistor 791, the contacts 751 of the link key K750 in the trunk circuit at the first dispatcher position 600, the control conductor C383 in the cable 380, the contacts 361 and the winding of R360 to battery. Also the cut-in relay R360 completes, at the contacts 363, a loop circuit between the upper winding of the supervisory relay R350 and the repeater 305 in the first link circuit 300 in the dispatcher exchange 30 and the connector switch 621 in the P. A. X 40, this circuit extending from the line conductor C771 of the trunk line 770 by way of the contacts 753 of the link key K750, the line conductor C385 in the cable 380, the contacts 363, the winding 309 of the repeater 305, the upper winding of R350, the resistor 302, the winding 308 of the repeater 305, the line conductor C381 in the cable 380 and the contacts 756 of the link key K750 to the line conductor C772 of the trunk line 770, the line conductors C771 and C772 being connected together in the connector switch 621 by way of the selector switch 620 in the P. A. X 40. When the upper winding of the supervisory relay R350 is thus energized this relay does not operate as it is of the differential type, an obvious circuit being completed at this time for energizing the lower winding thereof, at the contacts 362, incident to the operation of the cut-in relay R360.

Further the cut-in relay R360 prepares, at the contacts 364, an alternative path traced hereinafter for applying ground potential to the control conductor C386 in the cable 380, completes, at the contacts 365, an obvious alternative holding circuit for energizing the winding of the control relay R330, and completes, at the contacts 366, an obvious path for applying ground potential to the control conductor C388 in the cable 380 and consequently to the control conductor C388 of the trunk 610. The application of ground potential to the control conductor C388 marks the trunk 610 as busy to the finder switch S609 of the sender control circuit 606, thereby to prevent seizure of the trunk 610 by the finder switch S609 when operation of the sender control circuit 606 is again initiated incident to the extension of another call to the P. A. X 40.

Finally, the cut-in relay R360 completes, at the contacts 362, an obvious path for applying ground potential to the control conductor C384 in the cable 380, thereby to complete an obvious circuit for illuminating the call signal lamp L773 at the first dispatcher position 600. The illumination of the call signal lamp L773 indicates to the dispatcher at the first dispatcher position 600 that the sender control circuit 806 has completed its operation and that the connection has been extended from the first link 300 to the P. A. X 40.

At this time, the dispatcher at the first dispatcher position 600 may return the line key K630 in the trunk circuit at his position to its normal position in order to free the trunk circuit at the first dispatcher position 600; on the other hand, the dispatcher at the first dispatcher position 600 may retain the line key K630 in its operated position until after the subscriber at the called subscriber substation T2 has answered the call extending thereto or the call has been abandoned, as he desires. As previously noted, the connector switch 821 operates in accordance with conventional practice upon seizing the telephone line 830 extending to the subscriber substation T2 in the P. A. X 40. More particularly, in the event the subscriber substation T2 is busy at this time, busy tone current is returned over the previously traced loop circuit extending between the connector switch 821 in the P. A. X 40 and the repeater 305 in the first link 300 in the dispatcher exchange 30. On the other hand, in the event the subscriber substation T2 is idle at this time, ringing current is projected from the connector switch 821 over the telephone line 830 to the subscriber substation T2 in order to operate the ringer thereat; and ring-back tone current is conducted over the previously traced loop circuit extending between the connector switch 821 in the P. A. X 40 and the repeater 305 in the first link 300 in the dispatcher exchange 30. Tone current conducted over the previously traced loop circuit is by-passed around the upper winding of the supervisory relay R350 by way of the condenser 304 and energizes the windings 306 and 309 of the repeater 305, thereby to cause a similar tone current to be induced in the windings 306 and 307 of the repeater 305 which is by-passed around the windings of the line relay R350 by the condenser 303. The tone current induced in the windings 306 and 307 of the repeater 305 is returned over the previously traced loop circuit extending between the repeater 305 and the telephone station T1, and to the trunk circuit at the first dispatcher position 600 by way of the telephone line 201 and the cable 260 in the event the line key K630 occupies its operated position.

When the subscriber at the subscriber substation T2 answers the call by removing the receiver of the telephone instrument thereat from its associated switchhook, the connector switch 821 in the P. A. X 40 switches through, thereby to cause the current traversing the previously traced loop circuit extending between the connector switch 821 in the P. A. X 40 and the repeater 305 of the first link 300 in the dispatcher exchange 30 to be reversed, whereupon the upper winding of the supervisory relay R350 is energized in the reverse direction. When the upper winding of the supervisory relay R350 is thus energized this relay operates as it is of the differential type. Upon operating, the supervisory relay R350 interrupts, at the contacts 351, the previously mentioned path for applying ground potential to the control conductor C384 in the cable 380, thereby to interrupt the previously mentioned circuit for illuminating the call signal lamp L773 at the first dispatcher position 600. When the call signal lamp L773 is extinguished it indicates to the dispatcher at the first dispatcher position 600 that the call from the telephone station T1 in the dispatcher exchange 30 to the subscriber substation T2 in the P. A. X 40 has been answered.

At this time, the dispatcher at the first dispatcher position 600 returns the line key K630 in the trunk circuit at his position to its normal position in the event this has not previously been done. When the line key K630 is returned to its normal position the previously traced connection between the line conductors of the telephone line 201 and the trunk circuit at the first dispatcher position 600 is interrupted at the contacts 633 and 636 thereof. Also, at the contacts 635 of the line key K630, the previously mentioned holding circuit for energizing the winding of the switching relay R660 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the switching relay R660 interrupts, at the contacts 661 and 663, further points in the previously traced connection including the trunk circuit at the first dispatcher position 600 and interrupts, at the contacts 662, the previously traced circuit for supplying current to the transmitter 601. Further, when the line key K630 is returned to its normal position there is interrupted, at the contacts 634 thereof, a further point in the previously traced circuit for energizing the rotary magnet M237 of the finder switch S230 and, at the contacts 631 thereof, there is interrupted the previously traced original circuit for energizing the winding of the cut-off relay R205. Finally, at the contacts 632 of the line key K630, there is interrupted the previously traced holding circuit for energizing the winding of the start relay R310, thereby to cause the latter relay to restore. Upon restoring, the start relay R310 interrupts, at the contacts 311, the previously traced circuit for energizing the winding of the stop relay R320, thereby to cause the latter relay to restore. Further the start relay R310 interrupts, at the contacts 312, a further point in the previously traced holding circuit for energizing the winding thereof, interrupts, at the contacts 314, a further point in the previously traced path for applying ground potential to the control conductor C257 in the cable 260, and interrupts, at the contacts 315, the previously traced circuit for energizing the winding of the hold relay R405 in the link distributor 400, thereby to cause the latter relay to restore.

Finally, upon restoring, the start relay R310 prepares, at the contacts 313, the previously traced chain circuit between the first link 300 and the second link 375 for energizing the winding of the start relay, not shown, in the second link 375. This prepared circuit extends from the control conductor C255 in the cable 260 by way of the contacts 313 and 333 to the control conductor C343 extending to the second link 375, battery by way of the winding of the start relay in the second link 375 being connected to the control conductor C343. Upon restoring, the hold relay R405 prepares, at the contacts 407, the previously traced path for applying ground potential by way of the contacts 441 and the winding of the cutoff relay R410 to the control conductor C453 in the cable 450. Accordingly, at this time, it will be understood that the link distributor 400 is completely released and the

second link 375 in the group of links individually associated with the first dispatcher position 600 is selected for use by the next calling telephone line answered at the first dispatcher position 600. For example, in the event another of the line keys in the trunk circuit at the first dispatcher position 600 is operated at this time in order to answer a call on the corresponding telephone line, a circuit substantially identical to that previously traced is completed for energizing in series the windings of the cutoff relay R410 in the link distributor 400 and the winding of the start relay, not shown, in the second link 375, this circuit extending from ground by way of the contacts 441, 431 and 421, the winding of R410, the contacts 407, the control conductor C453 in the cable 450, the contacts of the link key mentioned in the trunk circuit at the first dispatcher position 600, the control conductor in the corresponding cable, the control conductor C301, the contacts 313 and 333 to the control conductor C343 extending to the second link 375, battery potential by way of the winding of the start relay, not shown, in the second link 375 being applied to the control conductor C343. Accordingly, at this time, the trunk circuit at the first dispatcher position 600 is completely released and the apparatus thereat is in readiness to answer another call on a telephone line in the dispatcher exchange 30.

Supervision and release of an established connection between a telephone station in the dispatcher exchange and a subscriber substation in the P. A. X

An established connection between a telephone station in the dispatcher exchange 30 and a subscribed substation in the P. A. X 40 is supervised by the dispatcher at the particular dispatcher position in the dispatcher exchange at which the connection is set up. For example, the established connection between the calling telephone station T1 in the dispatcher exchange 30 and the called subscriber substation T2 in the P. A. X 40 and routed therebetween by way of the telephone line 201, the first link 300, the trunk line 770, the selector switch 620, the connector switch 821 and the telephone line 830 is supervised by the dispatcher at the first dispatcher position 600. More particularly, the person at the calling telephone station T1 in the dispatcher exchange 30 has switchhook supervision and may signal the dispatcher at the first dispatcher position 600 by repeatedly operating the switchhook at the telephone station T1, thereby intermittently to interrupt the previously traced loop circuit extending between the telephone station T1 and the line relay R340. The line relay R340 operates and restores intermittently, thereby intermittently to complete, at the contacts 342, the previously mentioned circuit for illuminating the answer signal lamp L774. This circuit extends from ground by way of the contacts 364 and from ground by way of the contacts 326 over the contacts 342, the control conductor C386 in the cable 380 and the answer signal lamp L774 to battery. The intermittent operation of the line relay R340 causes the answer signal lamp L774 to flash, thereby to indicate to the dispatcher at the first dispatcher position 600 that a person at a calling telephone station in the dispatcher exchange 30 desires the dispatcher's service.

Similarly, the subscriber at the called subscriber substation T2 in the P. A. X 40 has switchhook supervision and may signal the dispatcher at the first dispatcher position 600 by repeatedly operating the switchhook at the subscriber substation T2, thereby to cause the connector switch 821 to operate intermittently in order intermittently to cause current to be reversed over the previously traced loop circuit extending between the connector switch 821 in the P. A. X 40 and the repeater 305 in the first link 300 in the dispatcher exchange 30. The intermittent reversal of current over the previously traced loop circuit causes the supervisory relay R350 to operate and restore intermittently, thereby to complete intermittently, at the contacts 351, the previously traced circuit for illuminating the call signal lamp L773, whereupon the call signal lamp L773 is flashed. The flashing of the call signal lamp L773 indicates to the dispatcher at the first dispatcher position 600 that a subscriber at a subscriber substation in the P. A. X 40 desires the dispatcher's service.

Furthermore, the flashing of the call signal lamp L773 or the flashing of the answer signal lamp L774 indicates to the dispatcher at the first dispatcher position 600 that the established connection upon which his service is desired is routed by way of the first link 300, the signal lamps L773 and L774 being individual to the first link 300. The dispatcher at the first dispatcher position 600 then operates the link key K750 to its talk position, thereby to complete, at the contacts 758 thereof, an obvious path for applying ground potential to the control conductor C683, thereby to complete an obvious circuit for energizing the lower winding of the control relay R655. When thus energized, the control relay R655 operates to complete, at the contacts 658, an obvious circuit for energizing the winding of the switching relay R650, thereby to cause the switching relay R650 to operate shortly thereafter, the latter relay being of the slow-to-operate type. Upon operating, the switching relay R650 completes, at the contacts 653, an obvious holding circuit for energizing the winding thereof including the grounded control conductor C683 and interrupts, at the contacts 654, the previously mentioned circuit for energizing the lower winding of the control relay R655, thereby to cause the control relay R655 to restore shortly thereafter, the latter relay being of the slow-to-release type. Also, upon operating, the switching relay R650 completes, at the contacts 651, an obvious connection between the windings 611 and 612 of the repeater 610 and the line conductors C675 and C676 of the trunk circuit at the first dispatcher position 600, and completes, at the contacts 652, an obvious alternative circuit for supplying current to the transmitter 601.

Also when the link key K750 is operated to its talk position the previously traced direct connection between the line conductors C771 and C772 of the trunk line 770 and the line conductors C385 and C391, respectively, in the cable 380 are interrupted at the contacts 753 and 756, respectively, thereof. Further, at the contacts 754 and 757 of the link key K750, there is completed a connection between the line conductors C771 and C772 of the trunk line 770 and the repeater 610 in the trunk circuit at the first dispatcher position 600, this connection extending from the line conductor C771 of the trunk line 770 by way of the contacts 754 of the link key K750, the line conductor C764, the contacts 742 of the split key K740, the line conductor C675, the contact 651, the windings 611 and 612 of the repeater 610, the line conductor C676, the con-

denser 792, the line conductor C739, the contacts 745 of the split key K740, the line conductor C765 and the contacts 757 of the link key K750 to the line conductor C772 of the trunk line 770. Finally, at the contacts 752 and 755 of the link key K750, a connection is completed between the line conductors C385 and C381 in the cable 380 and the repeater 610, this connection extending from the line conductor C385 in the cable 380, the contacts 752 of the link key K750, the line conductor C763, the contacts 743 of the split key K740, the line conductor C675, the contacts 651, the windings 611 and 612 of the repeater 610, the line conductor C676, the condenser 792, the line conductor C739, the contacts 746 of the split key K740, the line conductor C766 and the contacts 755 of the link key K750 to the line conductor C381 in the cable 380. Accordingly, at this time, the apparatus in the trunk circuit at the first dispatcher position 600 is operatively connected to both the repeater 305 in the first link 300 in the dispatcher exchange 30 and the subscriber substation T2 in the P. A. X 40, the telephone station T1 in the dispatcher exchange 30 being operatively connected to the repeater 305, as previously noted. Hence, a three-way communication connection including the telephone station T1, the subscriber substation T2 and the first dispatcher position 600 is completed at this time.

With the link key K750 thus operated, the dispatcher at the first dispatcher position 600 may split the connection in either direction by selectively operating the split key K740 in the trunk circuit at his position. More particularly, in order to split the connection and talk to the person at the calling telephone station T1 in the dispatcher exchange 30 to the exclusion of the subscriber at the called subscriber substation T2, the dispatcher at the first dispatcher position 600 operates the split key K740 to its front position. When the split key K740 is operated to its front position the previously traced connection between the repeater 610 and the trunk line 770 extending to the P. A. X 40 is interrupted at the contacts 742 and 745 thereof; and, at the contacts 741 of the split key K740, there is completed a bridge path between the line conductors C771 and C772 of the trunk line 770, thereby to retain the connector switch 821 in the P. A. X 40 in its operated position. This bridge path extends from the line conductor C771 of the trunk line 770 by way of the contacts 754 of the link key K750, the line conductor C764, the resistor 790, the contacts 741 of the split key K740, the line conductor C765 and the contacts 757 of the link key K750 to the line conductor C772 of the trunk line 770. On the other hand, in order to split the connection and talk to the subscriber at the called subscriber substation T2 in the P. A. X 40 to the exclusion of the person at the calling telephone station T1 in the dispatcher exchange 30, the dispatcher at the first dispatcher position 600 operates the split key K740 to its rear position. When the split key K740 is operated to its rear position the previously traced connection between the repeater 610 and the cable 380 extending to the repeater 305 in the first link 300 is interrupted at the contacts 743 and 746 thereof; and, at the contacts 744 of the split key K740, there is completed a bridge path between the line conductors C771 and C772 of the trunk line 770, thereby to retain the connector switch 821 in its operated position. This bridge path extends from the line conductor C771 of the trunk line 770 by way of the contacts 754 of the link key K750, the line conductor C764, the resistor 790, the contacts 744 of the split key K740, the line conductor C765 and the contacts 757 of the link key K750 to the line conductor C772 of the trunk line 770.

After the dispatcher at the first dispatcher position 600 renders the desired service to the person at the calling telephone station T1 in the dispatcher exchange 30 or to the subscriber at the called subscriber substation T2 in the P. A. X 40, he returns the link key K750 to its normal position, thereby to recomplete the previously traced direct connection between the telephone station T1 and the subscriber substation T2 and to free the trunk circuit at the first dispatcher position 600. More particularly, when the link key K750 is returned to its normal position there is interrupted, at the contacts 758, the previously mentioned holding circuit for energizing the winding of the switching relay R650, thereby to cause the latter relay to restore. At this time, the apparatus at the first dispatcher position 600 is completely released.

At any time, the dispatcher at the first dispatcher position 600 may determine the particular telephone station in the dispatcher exchange 30, included in an established connection extending between the dispatcher exchange 30 and the P. A. X 40 by way of one of the links in the group of links individually associated with the first dispatcher position 600, by operating the corresponding link identity key in the trunk circuit at the first dispatcher position 600. For example, in order to verify the telephone station included in the established connection between the telephone station T1 in the dispatcher exchange 30 and the subscriber substation T2 in the P. A. X 40 routed by way of the first link 300 and the trunk line 770, the dispatcher at the first dispatcher position 600 operates the link identity key K760 in the trunk circuit at the first dispatcher position 600, the link identity key K760 being individual to the first link 300. When the link identity key K760 is thus operated there is completed, at the contacts 761 thereof, a circuit for energizing the winding of the cutoff relay R520 in the identity distributor unit 500 individually corresponding to the first dispatcher position 600, this circuit extending from ground by way of the contacts 551, 541 and 531, the winding of R520, C767, the contacts 761 of the link identity key K760 and the resistor 793 to battery. When thus energized the cutoff relay R520 operates to interrupt, at the contacts 521 and 523, a circuit substantially identical to that previously traced for energizing the windings of the cutoff relays R530, R540 and R550 respectively corresponding to the second, third and fourth dispatcher positions. Accordingly, the operated cutoff relay R520 individually corresponding to the first dispatcher position 600 prevents operation of the cutoff relays R530, R540 and R550 individually corresponding to the second, third and fourth dispatcher positions. Hence, it will be understood that, when the identity distributor unit 500 is being utilized by the dispatcher at the first dispatcher position 600 to identify a telephone station in the dispatcher exchange 30, the identity distributor unit 500 is locked against use by the dispatchers at the other dispatcher positions.

Also, upon operating, the cutoff relay R520 completes, at the contacts 524, an obvious cir-

cuit for energizing the identity relay R510, thereby to cause the latter relay to operate. Finally, the cutoff relay R520 prepares, at the contacts 522, a test circuit for identifying the particular telephone station in the dispatcher exchange 30 included in the established connection routed by way of the first link 300, which test circuit is completed at the contacts 511 incident to the operation of the identity relay R510. The test circuit mentioned extends from ground by way of the contacts 522, C760, the contacts 762 of the link identity key K760, the control conductor C256 in the cable 380, the wiper 236 and engaged contact in the associated contact bank 246 of the finder switch S230, the control conductor C265 in the cable 260, the identity lamp L637, C590, the contacts 511 and the resistor 514 to battery. When this test circuit is completed the identity lamp L637 is illuminated at the first dispatcher position 600, thereby to indicate to the dispatcher thereat that the telephone station in the dispatcher exchange 30 included in the established connection routed by way of the first link 300 is the telephone station T1.

After verifying the identification of the telephone station T1 the dispatcher at the first dispatcher position 600 returns the link identity key K760 to its normal position, thereby to interrupt, at the contacts 762 thereof, a point in the previously traced test circuit for illuminating the identity lamp L637, whereupon the identity lamp L637 is extinguished. Also, at the contacts 761 of the link identity key K760, there is interrupted the previously traced circuit for energizing the winding of the cutoff relay R520, thereby to cause the latter relay to restore. Upon restoring, the cutoff relay R520 interrupts, at the contacts 524, the previously mentioned circuit for energizing the winding of the identity relay R510, thereby to cause the latter relay to restore. Also, upon restoring, the cutoff relay R520 and the identity relay R510 respectively interrupt, at the contacts 522 and 511, further points in the previously traced test circuit for illuminating the identity lamp L637. Finally, the cutoff relay R520 prepares, at the contacts 521 and 523, the previously mentioned circuits for energizing the windings of the cutoff relays R530, R540 and R550 individually associated with the second, third and fourth dispatcher positions, thereby to render the identity distributor unit 500 operative under the control of the dispatcher at any one of the dispatcher positions.

The release of the established connection between the telephone station T1 in the dispatcher exchange 30 and the subscriber substation T2 in the P. A. X 40 is primarily under the control of the dispatcher at the first dispatcher position 600. More particularly, when the person at the telephone station T1 replaces the receiver of the telephone instrument thereat upon its associated switchhook, the previously traced loop circuit extending between the telephone station T1 and the line relay R340 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the line relay R340 interrupts, at the contacts 341, the previously mentioned circuit for energizing the winding of the hold relay R325, thereby to cause the hold relay R325 to restore shortly thereafter, the latter relay being the slow-to-release type. Further, the line relay R340 completes, at the contacts 342, the previously traced circuit for illuminating the answer signal lamp L774 at the first dispatcher position 600. Upon restoring, the hold relay R325 interrupts, at the contacts 327, the previously mentioned original holding circuit for energizing the winding of the control relay R330, this relay being retained in its operated position due to the previously mentioned completed auxiliary holding circuit for energizing the winding thereof. Further the hold relay R325 interrupts, at the contacts 326, a point in the multiple path for applying ground potential to the control conductor C366 in the cable 360, thereby to interrupt a point in the previously mentioned multiple circuit for illuminating the answer signal lamp L774.

When the subscriber at the subscriber substation T2 replaces the receiver of the telephone instrument thereat upon its associated switchhook the connector switch 821 is controlled, thereby to cause current to be reversed over the previously traced loop circuit extending between the connector switch 821 in the P. A. X 40 and the repeater 305 in the first link 300 in the dispatcher exchange 30, thereby to cause the supervisory relay R350 to restore. Upon restoring, the supervisory relay R350 completes, at the contacts 351, the previously traced circuit for illuminating the call signal lamp L773 at the first dispatcher position 600. When both the call signal lamp L773 and the answer signal lamp L774 are illuminated it indicates to the dispatcher at the first dispatcher position 600 that both the subscriber at the subscriber substation T2 in the P. A. X 40 and the party at the telephone station T1 in the dispatcher exchange 30 have replaced the receivers of the telephone instruments thereat upon their associated switchhooks.

The dispatcher at the first dispatcher position 600 then actually releases the established connection by operating the link key K750 momentarily to its released position, thereby to interrupt, at the contacts 751 thereof, the previously traced holding circuit for energizing the winding of the cut-in relay R360, whereupon the latter relay restores. Upon restoring, the cut-in relay R360 interrupts, at the contacts 361, a further point in the previously traced holding circuit for energizing the winding thereof and interrupts, at the contacts 363, the previously traced loop circuit extending between the repeater 305 in the first link 300 in the dispatcher exchange 30 and the connector switch 821 in the P. A. X 40, thereby to cause the connector switch 821 to restore and release the telephone line 830 extending to the subscriber substation T2. Also, the release of the connector switch 821 causes the release of the selector switch 820. Further the cut-in relay R360 interrupts, at the contacts 362 and 364, respectively, the previously traced circuits for illuminating the call signal lamp L773 and the answer signal lamp L774 at the first dispatcher position 600, thereby to indicate to the dispatcher thereat that the release of the established connection is in progress. Also the cut-in relay R360 interrupts, at the contacts 365, the previously mentioned alternative holding circuit for energizing the winding of the control relay R330, thereby to cause the latter relay to restore. Upon restoring, the control relay R330 interrupts, at the contacts 332, the previously traced circuit for illuminating the busy signal lamp L775 at the first dispatcher position 600, thereby to indicate to the dispatcher thereat that the first link has been released and is now idle. Further the control relay R330 recompletes, at the contacts 335, the previously mentioned path for applying ground potential to the control conductor C366

in the cable 380 and consequently to the control conductor C388 of the trunk 810, thereby to complete an alternative path for marking the trunk 810 as busy to the finder switch S809 of the sender control circuit 806 at the first dispatcher position 600. Also the control relay R330 interrupts, at the contacts 333, the previously traced prepared circuit for energizing the winding of the start relay, not shown, in the second link 375 and prepares, at the contacts 334, the previously traced circuit for energizing the winding of the start relay R310 in the first link 300. Accordingly, at this time, the first link 300 is selected for use in preference to the second link 375. Finally, the control relay R330 interrupts, at the contacts 331, the previously traced circuit for energizing the winding of the switching relay R220, thereby to cause the latter relay to restore. Upon restoring, the switching relay R220 interrupts, at the contacts 221 and 222, the previously traced connection between the telephone line 201 and the wipers 231 and 233 of the finder switch S230. Also the switching relay R220 interrupts, at the contacts 223, the previously mentioned holding circuit for energizing the winding of the cutoff relay R205, thereby to cause the latter relay to restore. Finally, the switching relay R220 prepares, at the contacts 224, the previously traced circuit for energizing the rotary magnet M237 of the finder switch S230.

Upon restoring, the cutoff relay R205 prepares, at the contacts 206 and 207, the previously traced circuit for energizing the winding of the line relay R210 and interrupts, at the contacts 208, the previously traced circuit for illuminating the busy signal lamp L638 at the first dispatcher position 600 and the corresponding busy signal lamps at the other dispatcher positions, thereby to indicate to the dispatchers at the various dispatcher positions that the telephone line 201 extending to the telephone station T1 is now idle.

Finally, the cutoff relay R205 completes, at the contacts 209, an alternative circuit for energizing the rotary magnet M237 of the finder switch S230, this circuit extending from ground by way of the contacts 209, the wiper 235 and engaged contact in the associated contact bank 245 of the finder switch S230, the contacts 238 and the rotary magnet M237 to battery. When thus energized the rotary magnet M237 operates intermittently in order to drive the wipers noted of the finder switch S230 step by step in the clockwise direction, in the manner previously explained, until the wiper 235 disengages the last contact in the associated contact bank 245 of the finder switch S230, thereby to interrupt the previously traced alternative circuit for energizing the rotary magnet M237, whereupon further operation of the rotary magnet M237 is positively arrested. At this time, the apparatus included in the line circuit 200 and in the first link 300 and the apparatus at the first dispatcher position 600 are completely released.

Extension of a call from a dispatcher position in the dispacher exchange to a telephone station in the dispatcher exchange or to a subscriber substation in the P. A. X

In order to extend a call from a dispatcher position in the dispatcher exchange 30, such, for example, as the first dispatcher position 600, to a telephone station in the dispatcher exchange 30, such, for example, as the telephone station T1, it is only necessary for the dispatcher at the first dispatcher position 600 to operate the line key K630 away from its normal position, thereby to complete, at the contacts 633 and 636 thereof, the previously traced connection between the repeater 610 and the line conductors C202 and C203 of the telephone line 201. Also, when the line key K630 is operated, there is completed, at the contacts 635 thereof, the previously traced circuit for energizing the winding of the control relay R655, thereby to cause the latter relay to operate, whereupon the switching relay R660 operates in order to cause the control relay R655 to restore. At this time, a connection identical to that previously traced is established between the first dispatcher position 600 and the telephone line 201 extending to the telephone station T1. Also, at the contacts 631 of the line key K630, there is completed the previously traced circuit for energizing the winding of the cutoff relay R205, thereby to cause the latter relay to operate, as previously explained. Also, at the contacts 632 of the line key K630, there is completed the previously traced series circuit for energizing the winding of the cutoff relay R410 in the link distributor 400 and the start relay R310 in the first link 300, assuming that the first link 300 is assigned for use at this time, thereby to cause the cutoff relay R410 and the start relay R350 to operate, as previously explained. Finally, at the contacts 634 of the line key K630, there is completed the previously traced circuit for energizing the rotary magnet M237 of the finder switch S230. Accordingly, the rotary magnet M237 of the finder switch S230 operates intermittently, thereby to drive the wipers noted of the finder switch S230 step by step in the clockwise direction until the finder switch S230 seizes the trunk 250 extending to the first link 300, whereupon the stop relay R320, the control relay R330 and the switching relay R220 operate, in the manner previously explained. The operation of the control relay R330 initiates operation of the sender control circuit 806, thereby to cause the finder switch S809 thereof to seize the trunk 810 connected to the trunk line 770 extending from the first dispatcher position 600 to the selector switch 820 in the P. A. X 40, in the manner previously explained. Further, the finder switch S810 of the sender control circuit 806 seizes the idle digit register 808 in the manner previously explained.

The dispatcher at the first dispatcher position 600 then operates the ring key K625 away from its normal position for a short time interval and then back to its normal position. When the ring key K625 is operated away from its normal position there is interrupted, at the contacts 627 and 629 thereof, the previously traced connection between the repeater 610 and the telephone line 201 and there is completed, at the contacts 626 and 628 thereof, a circuit substantially identical to that previously traced for projecting ringing current from a suitable source of ringing current, not shown, over the line conductors C202 and C203 of the telephone line 201 to the telephone station T1 in order to cause the ringer thereat to be operated. When a person at the telephone station T1 answers the call by removing the receiver of the telephone instrument thereat from its associated switchhook, the previously mentioned bridge path is completed between the line conductors C202 and C203 of the telephone line 201, thereby to complete the previously traced connection between the telephone station T1 and the trunk circuit at the first dispatcher position 600 and the previously traced loop circuit be-

tween the telephone station T1 and the line relay R340. The line relay R340 then operates, thereby to cause operation of the hold relay R325, as previously explained.

At this time, the dispatcher at the first dispatcher position 600 communicates with the person at the telephone station T1 in the dispatcher exchange 30 and may extend the connection to a subscriber substation, such, for example, as the subscriber substation T2 in the P. A. X 40 by controlling the sending key set K805, in the manner previously explained.

On the other hand, in the event the connection is to be extended only between the first dispatcher position 600 and the telephone station T1, the sending key set K805 is not controlled. The release of the established connection between the first dispatcher position 600 and the telephone station T1 is under the joint control of the dispatcher at the first dispatcher position 600 and the person at the telephone station T1 and is effected when the receiver of the telephone instrument at the telephone station T1 is replaced upon its associated switchhook and the line key K630 is return to its normal position; whereupon the line relay R340 and the cutoff relay R205 restore in the manner previously explained. When the line relay R340 and the cutoff relay R205 restore, the first link 300 and the line circuit 200 are released in the manner previously described. Also, when the line key K630 is returned to its normal position the previously traced holding circuit for energizing the winding of the switching relay R660 is interrupted, thereby to cause the latter relay to restore. When the switching relay R660 restores, the apparatus at the first dispatcher position 600 is released in the manner previously explained.

On the other hand, in the event a call is to be extended from a dispatcher position in the dispatcher exchange 30, such, for example, as the first dispatcher position 600, directly to a subscriber substation in the P. A. X 40, such, for example, as the subscriber substation T2, the dispatcher at the first dispatcher position 600 first selects an idle one of the telephone lines in the dispatcher exchange 30, such, for example, as the telephone line 201 extending to the telephone station T1 and then operates the line key K630 thereof away from its normal position, thereby to cause the apparatus in the line circuit 200, the apparatus in the link distributor 400 and the apparatus in one of the links in the group of links individually associated with the first dispatcher position 600, such, for example, as the first link 300, to operate in the manner previously explained. More particularly, the finder switch S230 of the link 200 seizes the trunk 250 extending to the first link 300, thereby to cause the sender control circuit 806 to be associated with the digit register 808 and with the trunk line 770 extending from the first dispatcher position 600 to the selector switch 820 in the P. A. X 40, in the manner previously explained. Also, at this time, the stop relay R320 and the control relay R330 in the first link 300 occupy their operated positions.

The dispatcher at the first dispatcher position 600 then operates the sending key set at K805, thereby to cause the digit register 808 and the sender control circuit 806 to operate in the manner previously explained, whereupon digits are transmitted over the trunk line 770 to the P. A. X 40, thereby to cause the selector switch 820 and the connector switch 821 to operate in the manner previously explained. More particularly, the connector switch 821 seizes the telephone line 830 extending to the subscriber substation T2 and then operates in accordance with conventional practice, depending upon the idle or busy condition of the subscriber substation T2. Also, the sender control circuit 806 causes operation of the cut-in relay R360 in the manner previously explained. Accordingly, at this time, a connection is completed between the repeater 610 in the trunk circuit at the first dispatcher position 600 and the repeater 305 in the first link 300 by way of the line key K630, the cable 260 and the finder switch S230 in the manner previously explained. Furthermore, the repeater 305 in the first link 300 is connected by way of the cable 380, the trunk line 770 and the selector switch 820 to the connector switch 821, as previously explained.

At this time, the dispatcher at the first dispatcher position 600 operates the link key K750 to its talk position, thereby to complete the previously traced connection between the repeater 610 in the trunk circuit at the first dispatcher position 600 and the trunk line 770 extending to the P. A. X 40 by way of the link key K750. The dispatcher at the first dispatcher position 600 then returns the line key K630 to its normal position.

The connector switch 821 operates to cause busy tone current to be returned over the previously traced connection extending between the repeater 610 and the connector switch 821 in the event the subscriber substation T2 is busy at this time. On the other hand, the connector switch 821 operates to cause ringing current to be projected over the telephone line 830 extending to the subscriber substation T2 and the ring-back tone current to be returned over the previously traced connection extending between the connector switch 821 and the repeater 610 in the event the subscriber substation T2 is idle at this time. When the call is answered at the subscriber substation T2 the connector switch 821 switches through, thereby to cause the current returned over the previously traced loop circuit extending between the connector switch 821 and the repeater 305 to be reversed in order to cause operation of the supervisory relay R350, the cut-in relay R360 being operated at this time as previously explained. The dispatcher at the first dispatcher position 600 then communicates with the subscriber at the subscriber substation T2 over the previously traced connection extending therebetween, in the manner previously explained.

In order to release the established connection between the first dispatcher position 600 in the dispatcher exchange 30 and the subscriber substation T2 in the P. A. X 40, it is only necessary for the dispatcher at the first dispatcher position 600 to operate the link key K750 momentarily to its released position, thereby to cause the line circuit 200, the first link 300 and the apparatus at the first dispatcher position 600 in the dispatcher exchange 30 to be released, in the manner previously explained, and to cause the selector switch 820 and the connector switch 821 in the P. A. X 40 to be released, in the manner previously explained.

Extension of special connections from and to a dispatcher position in the dispatcher exchange

The dispatcher at any one of the dispatcher positions in the dispatcher exchange 30, such, for example, as the first dispatcher position 600,

may extend a number of special connections from the first dispatcher position 600.

For example, the dispatcher at the first dispatcher position 600 in the dispatcher exchange 30 may extend a connection or call therefrom to the operator position 835 in the P. B. X 20 by operating the P. B. X key in the trunk circuit at the first dispatcher position 600 corresponding to an idle trunk line in the group of trunk lines extending between the first dispatcher position 600 and the operator position 835, such, for example, as the P. B. X key K710 corresponding to the trunk line 575 extending between the first dispatcher position 600 and the operator position 835. When the P. B. X key K710 is operated away from its normal position there is completed, at the contacts 713 thereof, an obvious circuit for energizing the lower winding of the control relay R655, thereby to cause the latter relay to operate. Upon operating, the control relay R655 completes, at the contacts 658, the previously mentioned circuit for energizing the winding of the switching relay R650, thereby to cause the switching relay R650 to operate shortly thereafter, the latter relay being of the slow-to-operate type. Upon operating, the switching relay R650 completes, at the contacts 653, the previously mentioned holding circuit for energizing the winding thereof and interrupts, at the contacts 654, the previously mentioned circuit for energizing the lower winding of the control relay R655, thereby to cause the control relay R655 to restore shortly thereafter, the latter relay being of the slow-to-release type. Also, upon operating, the switching relay R650 completes, at the contacts 651, the previously traced connection between the line conductors C675 and C676 in the trunk circuit and the repeater 610, thereby operatively to connect the apparatus at the first dispatcher position 600 to the line conductors mentioned of the trunk circuit thereat.

Also, at the contacts 712 and 714 of the P. B. X key K710, there is completed an obvious connection between the line conductors C675 and C739 of the trunk circuit at the first dispatcher position 600 and the respective line conductors C576 and C577 of the trunk line 575, the line conductor C739 being operatively connected to the line conductor C676 by way of the condenser 792. Finally, at the contacts 711 of the P. B. X key K710, there is completed an obvious circuit for energizing the winding of the cutoff relay R570 in the trunk circuit 560 individually associated with the trunk line 575, thereby to cause the latter relay to operate. Upon operating, the cutoff relay R570 interrupts, at the contacts 571, a point in an obvious holding circuit for energizing the left-hand winding of the ring-up relay R565, interrupts, at the contacts 572, a point in a circuit traced hereinafter for energizing the right-hand winding of the ring-up relay R565, and interrupts, at the contacts 574, a point in an obvious circuit for illuminating the signal lamp L736 at the first dispatcher position 600. Finally, the cutoff relay R570 completes, at the contacts 573, an obvious path for connecting the resistor 562 across the line conductors C576 and C577 of the trunk line 575. When the resistor 562 is thus connected across the line conductors of the trunk line 575, a signal is transmitted to the operator position 835 in the P. B. X 20, thereby to indicate to the operator thereat that there is a call waiting to be answered on the trunk line 575. The operator at the operator position 835 then answers the call, thereby to complete an operative connection between the telephone instrument at the operator position 835 in the P. B. X 20 and the trunk circuit at the first dispatcher position 600 in the dispatcher exchange 30, including the trunk line 575.

At this point, it is noted that the operator at the operator position 835 in the P. B. X 20 may extend the call from the first dispatcher position 600 in the dispatcher exchange 30 to any subscriber substation, not shown, in the P. B. X 20 or to the central office 10 by way of an idle one of the trunk lines extending between the operator position 835 in the P. B. X 20 and the central office 10, such, for example, as the trunk line 840. The actual extension of the call from the operator position 835 in the P. B. X 20 over the trunk line 840 to the central office 10 is accomplished in accordance with conventional practice.

The release of the established connection is under the joint control of the dispatcher at the first dispatcher position 600 in the dispatcher exchange 30 and the operator at the operator position 835 in the P. B. X 20. More particularly, the operator at the operator position 835 in the P. B. X 20 releases the connection between her position and the first dispatcher position 600 in the dispatcher exchange 30 in accordance with conventional practice. Further, the operator at the operator position 835 in the P. B. X 20 releases the connection to the central office 10, in the event this connection is completed in accordance with conventional practice. The dispatcher at the first dispatcher position 600 in the dispatcher exchange 30 effects the complete release of the established connection by returning the P. B. X key K710 to its normal position, thereby to interrupt, at the contacts 713 thereof, the previously mentioned holding circuit for energizing the winding of the switching relay R650 in order to cause the latter relay to restore. Also, at the contacts 711 of the P. B. X key K710, there is interrupted the previously mentioned circuit for energizing the winding of the cutoff relay R570, thereby to cause the latter relay to restore. Upon restoring, the cutoff relay R570 interrupts, at the contacts 573, the previously mentioned bridge path including the resistor 562 across the line conductors C576 and C577 of the trunk line 575, thereby to mark the trunk line 575 extending between the first dispatcher position 600 in the dispatcher exchange 30 and the operator position 835 in the P. B. X 20 as idle. At this time, the previously mentioned established connection between the first dispatcher position 600 in the dispatcher exchange 30 and the operator position 835 in the P. B. X 20 is completely released.

Further it is noted that a connection or call may be extended from the operator position 835 in the P. B. X 20 to any one of the dispatcher positions in the dispatcher exchange 30, such, for example, as the first dispatcher position 600. More particularly, the operator at the operator position 835 in the P. B. X 20 selects an idle one of the trunk lines in the group of trunk lines extending between the operator position 835 and the first dispatcher position 600, such, for example, as the trunk line 575, and then operates the apparatus at her position, thereby to cause ringing current to be projected over the line conductors C576 and C577 of the trunk line 575. The projection of ringing current over the line conductors

C576 and C577 of the trunk line 575 completes a circuit for energizing the right-hand winding of the ring-up relay R565 in the trunk circuit 560 individually associated with the trunk line 575, this circuit extending from the line conductor C576 of the trunk line 575 by way of the contacts 572, the condenser 561, the right-hand winding of the ring-up relay R565 and the contacts 567 to the line conductor C577 of the trunk line 575. When thus energized, the ring-up relay R565 operates to complete, at the contacts 566, the previously mentioned holding circuit for energizing the left-hand winding thereof and to interrupt, at the contacts 567, the previously traced circuit for energizing the right-hand winding thereof. Further, the ring-up relay R565 completes, at the contacts 568, an obvious circuit for illuminating the signal lamp L736 at the first dispatcher position 600. The illumination of the signal lamp L736 indicates to the dispatcher at the first dispatcher position 600 that a call on the trunk line 575 is waiting to be answered.

In order to answer the call on the trunk line 575, the dispatcher at the first dispatcher position 600 operates the P. B. X key K710 away from its normal position, thereby to complete, at the contacts 713, the previously mentioned circuit for energizing the lower winding of the control relay R655, thereby to cause the control relay R655 to operate and cause operation of the switching relay R650, whereupon the control relay R655 restores, as previously explained. Also, at the contacts 711 of the P. B. X key K710, there is completed the previously mentioned circuit for energizing the winding of the cutoff relay R570, thereby to cause the latter relay to operate. Upon operating, the cutoff relay R570 interrupts, at the contacts 571, the previously mentioned holding circuit for energizing the left-hand winding of the ring-up relay R565, thereby to cause the latter relay to restore and interrupt, at the contacts 568, the previously mentioned circuit for illuminating the signal lamp L736. Further, the cutoff relay R570 completes, at the contacts 573, the previously mentioned bridge path including the resistor 562 between the line conductors C576 and C577 of the trunk line 575. At this time, a connection is established between the first dispatcher position 600 in the dispatcher exchange 30 and the operator position 835 in the P. B. X 20 including the trunk line 575. This connection might have originated in the central office 10 or in the P. B. X 20. In the event the connection originated in the central office 10, the call is first extended from the central office 10 to the P. B. X 20 by way of an idle one of the trunk lines extending therebetween, such, for example, as the trunk line 840. After the operator at the operator position 835 answers the call on the trunk line 840 the call is extended by way of the trunk line 575 to the first dispatcher position 600, in the manner previously explained. The release of the established connection between the first dispatcher position 600 in the dispatcher exchange 30 and the operator position 835 in the P. B. X 20 and between the operator position 835 in the P. P. X 20 and the central office 10 is the same as that previously explained.

The dispatcher at any one of the dispatcher positions in the dispatcher exchange 30, such, for example, as the first dispatcher position 600, may extend a connection to either one of the radio stations 50 or 60. In order to extend a connection from the first dispatcher position 600 in the dispatcher exchange 30 to the radio station 50, the dispatcher at the first dispatcher position 600 operates the radio station key K720 to its left-hand position, thereby to complete, at the contacts 721 and 723 thereof, an obvious connection between the trunk circuit at the first dispatcher position 600 and the line conductors C781 and C782 of the trunk line 780 extending to the transmitter 850 in the radio station 50. Also, at the contacts 722 of the radio station key K720, there is completed the previously mentioned circuit for energizing the lower winding of the control relay R655, thereby to cause the control relay R655 to operate and effect the operation of the switching relay R650, whereupon the control relay R655 restores, as previously explained. Also, at the contacts 723 of the radio station key K720, there is completed an obvious circuit for illuminating the signal lamp L737 at the first dispatcher position 600, and the corresponding signal lamps at the other dispatcher positions. The illumination of the signal lamps mentioned at the various dispatcher positions in the dispatcher exchange 30 indicates to the dispatchers thereat that the radio station 50 is busy at this time. Finally, at the contacts 724 of the radio station key K720, there is completed an obvious path for applying battery potential to the control conductor C783 of the trunk line 780 extending to the transmitter 850 in the radio station 50. The application of battery potential to the control conductor C783 of the trunk line 780 renders the transmitter 850 operative for broadcast purposes. Accordingly, at this time, an operative connection is completed between the trunk circuit at the first dispatcher position 600 and the transmitter 850 in the radio station 50 for broadcast purposes.

In view of the foregoing explanation of the mode of operation of the apparatus at the first dispatcher position 600 to answer an incoming call extended thereto from one of the telephone stations in the dispatcher exchange 30 or from the operator position 835 in the P. B. X 20, it will be understood that, after the dispatcher at the first dispatcher position 600 has answered a call from a telephone station in the dispatcher exchange 30, such, for example, as the telephone station T1 routed thereto by way of an idle one of the links in the group of links individually associated with the first dispatcher position 600, such, for example, as the first link 300, or a call from the operator position 835 in the P. B. X 20 routed thereto by way of an idle one of the trunk lines extending between the P. B. X 20 and the first dispatcher position 600 in the dispatcher exchange 30, such, for example, as the trunk line 575, he may hold the incoming call and broadcast the message received by way of the radio station 50. For example, the dispatcher at the first dispatcher position 600 may selectively communicate with the person at the telephone station T1 in the dispatcher exchange 30 and broadcast by way of the radio station 50 by controlling the link key K750 and the radio station key K720. More particularly, when the dispatcher at the first dispatcher position 600 is communicating with the person at the telephone station T1, the radio station key K720 is returned to its normal position and the link key K750 is operated to its talk position; on the other hand, when the dispatcher at the first dispatcher position 600 is broadcasting by way of the radio station 50, the radio station key K720 is operated

to its left-hand position and the link key K750 is returned to its normal position.

Similarly, the dispatcher at the first dispatcher position 600 may selectively communicate with the operator at the operator position 835 in the P. B. X 20 and broadcast by way of the radio station 50 by controlling the P. B. X key K710 and the radio station key K720. More particularly, when the dispatcher at the first dispatcher position 600 is communicating with the operator at the operator position 835 in the P. B. X 20, the radio station key K720 is returned to its normal position and the P. B. X key K710 is operated away from its normal position; on the other hand, when the dispatcher at the first dispatcher position 600 is broadcasting by way of the radio station 50, the radio station key K720 is operated to its left-hand position and the P. B. X key K710 is returned to its normal position.

In order to release the transmitter 850 in the radio station 50, it is only necessary for the dispatcher at the first dispatcher position 600 in the dispatcher exchange 30 to return the radio station key K720 to its normal position. When the radio station key K720 is returned to its normal position there is interrupted, at the contacts 721 and 723 thereof, the previously mentioned connection between the trunk circuit at the first dispatcher position 600 and the trunk line 780 extending to the transmitter 850 in the radio station 50. Also, at the contacts 724 of the radio station key K720, there is interrupted the previously mentioned path for applying battery potential to the control conductor C783 of the trunk line 780, thereby to render the transmitter 850 and the radio station 50 ineffective for broadcast purposes. Further, at the contacts 722 of the radio station key K720, there is interrupted the previously mentioned holding circuit for energizing the winding of the switching relay R650, thereby to cause the latter relay to restore, as previously explained. Finally, at the contacts 725 of the radio station key K720, there is interrupted the previously mentioned circuit for illuminating the signal lamp L737 at the first dispatcher position 600 and the corresponding signal lamps at the other dispatcher positions, thereby to indicate to the dispatchers at the various dispatcher positions that the radio station 50 is idle at this time.

In view of the foregoing explanation of the mode of operation of the apparatus at the first dispatcher position 600 in order to complete a connection between the trunk circuit thereat and the transmitter 850 in the radio station 50, it will be understood that an operative connection may be completed between the first dispatcher position 600 and the transmitter 860 in the radio station 60, in a similar manner, by operating the radio station key K720 to its right-hand position. Accordingly, the dispatcher at the first dispatcher position 600 may broadcast by way of the radio stations 50 and 60 selectively by appropriately operating the radio station key K720 in the trunk circuit at the first dispatcher position 600.

Connections between the various dispatcher positions in the dispatcher exchange 30 may be completed over the various order trunks extending therebetween. For example, in order to extend a connection from the first dispatcher position 600 to the second dispatcher position 800, it is only necessary for the dispatcher at the first dispatcher position 600 to operate the order key K640 in the trunk circuit at the first dispatcher position 600 individually associated with the order trunk 680 extending between the first dispatcher position 600 and the second dispatcher position 800 away from its normal position. When the order key K640 is thus operated, there is completed, at the contacts 642 thereof, the previously mentioned circuit for energizing the lower winding of the control relay R655, thereby to cause the latter relay to operate and cause operation of the switching relay R650, whereupon the control relay R655 is restored, as previously explained. Also, at the contacts 641 and 643 of the order key K640, there is completed an obvious connection between the trunk circuit at the first dispatcher position 600 and the line conductors C681 and C682 of the order trunk 680, thereby to cause a signal to be transmitted to the dispatcher at the second dispatcher position 800, in order to indicate to the dispatcher at the second dispatcher position 800 that there is a call on the order trunk 680 waiting to be answered. The dispatcher at the second dispatcher position 800 answers the call on the order trunk 680 by operating the key in the trunk circuit at his position individually associated with the order trunk 680 and corresponding to the order key K640 in the trunk circuit at the first dispatcher position 600, thereby to complete an obvious communication connection between the first dispatcher position 600 and the second dispatcher position 800 including the order trunk 680. The release of this connection is under the joint control of the dispatchers at the first dispatcher position 600 and at the second dispatcher position 800, and is effected when the order key K640 in the trunk circuit at the first dispatcher position 600 and the order key, not shown, in the trunk circuit at the second dispatcher position 800 are returned to their normal positions. When the order key K640 is returned to its normal position there is interrupted, at the contacts 641 and 643 thereof, the previously mentioned connection between the trunk circuit at the first dispatcher position 600 and the order trunk 680. Also, at the contacts 642 of the order key K640, there is interrupted the previously mentioned path for applying ground potential to the control conductor C683 in the order trunk 680 and the previously mentioned holding circuit for energizing the winding of the switching relay R650, thereby to cause the latter relay to restore. At this time, the apparatus at both the first dispatcher position 600 and the second dispatcher position 800 are completely released.

Local connections between subscriber substations in the P. A. X 40 are completed automatically under the control of the subscriber at a calling subscriber substation therein in accordance with conventional practice. In establishing a local connection in the P. A. X 40, one of the links, such, for example, as the link 825, and one of the connector switches, such, for example, as the connector switch 821, is utilized in a well-known manner. Also, the release of this local connection is under the control of subscribers at the subscriber substations in the P. A. X 40.

A call may be extended from any one of the subscriber substations in the P. A. X 40 to the dispatcher exchange 30 to be answered at one of the dispatcher positions therein. For example, in order to extend a call from the subscriber substation T2 in the P. A. X 40 to the dispatcher exchange 30 to be answered at one of the dispatcher positions therein, the subscriber at the

subscriber substation T2 first initiates the call in the usual manner, thereby to cause the finder switch of an idle one of the links, such, for example, as the finder switch 826 of the link 825, to seize the telephone line 830 extending to the subscriber substation T2. The subscriber at the subscriber substation T2 then controls the selector switch 827 of the link 825, thereby to cause it to seize an idle one of the trunk lines in the first group of trunk lines extending from the P. A. X 40 to the dispatcher exchange 30, such, for example, as the trunk line 270. When the selector switch 827 seizes the trunk line 270 the line circuit 275 individually associated with the trunk line 270 operates in a manner similar to that of the line circuit 200 individually associated with the telephone line 201 in the dispatcher exchange 30, as previously explained. More particularly, the line circuit 275 operates in order to cause the line signal lamps, not shown, at the various dispatcher positions in the dispatcher exchange 30 to be illuminated, thereby to indicate to the dispatchers at the various dispatcher positions that a call on the trunk line 270 is waiting to be answered.

The call on the trunk line 270 is answered by the dispatcher at one of the dispatcher positions, such, for example, as the first dispatcher position 600, by operating the trunk key, not shown, at the first dispatcher position 600 individually corresponding to the trunk line 270, whereupon the line circuit 275 operates to seize an idle one of the links in the group of links individually associated with the first dispatcher position 600, such, for example, as the first link 300, in the manner previously explained. The dispatcher at the first dispatcher position 600 then operates the link key K750 to its talk position and returns the trunk key, not shown, individually associated with the trunk line 270 to its normal position, thereby to complete a connection substantially identical to that previously traced between the subscriber substation T2 in the P. A. X 40 and the trunk circuit at the first dispatcher position 600 in the dispatcher exchange 30, including the link 825 in the P. A. X 40, the trunk line 270, and the line circuit 275, the first link 300 and the cable 380 in the dispatcher exchange 30. Accordingly, a two-way communication connection is established at this time between the subscriber substation T2 in the P. A. X 40 and the first dispatcher position 600 in the dispatcher exchange 30. The release of this established connection is primarily under the control of the dispatcher at the first dispatcher position 600 and is effective when the link key K750 is operated momentarily to its released position. When the link key K750 is momentarily operated to its released position, the first link 300 and the line circuit 275 in the dispatcher exchange 30 are released in the manner previously explained. Also, when the subscriber at the subscriber substation T2 replaces the receiver of the telephone instrument thereat upon its associated switchhook, the link 825 in the P. A. X 40 is released in a well-known manner.

Further, the subscriber at any subscriber substation in the P. A. X 40 may extend a call directly to any one of the telephone stations in the dispatcher exchange 30. For example, in order to extend a connection from the subscriber substation T2 in the P. A. X 40 to the telephone station T1 in the dispatcher exchange 30, the subscriber at the subscriber substation T2 first initiates the call and controls the switch train, thereby to cause a connection to be routed from the subscriber substation T2 by way of a link, such, for example, as the link 825, and a connector switch, such, for example, as the connector switch 821, to the trunk line 870 extending from the P. A. X 40 to the dispatcher exchange 30 and directly connected to the telephone line 201 extending to the telephone station T1.

When the connector switch 821 seizes the trunk line 870 the idle or busy condition of the trunk line 870 and consequently the telephone line 201 in the telephone station T1 is tested thereby, in the usual manner. More particularly, in the event the telephone line 201 extending to the telephone station T1 is busy at this time, ground potential appears upon the control conductor C204 thereof due to the operated position of the line relay R210 or the operated position of switching relay R220 and the restored position of the line relay R210, depending upon the progress of the call on the telephone line 201. In this event, the presence of ground potential upon the control conductor C204 causes ground potential to be applied by way of the control conductor C267 in the cable 260 to the control conductor of the trunk line 870, whereupon the connector switch 821 causes busy tone current to be returned to the subscriber substation T2 in the usual manner.

On the other hand, in the event the telephone line 201 and the telephone station T1 are idle at this time, battery potential appears upon the control conductor C204 of the telephone line 201 and is connected by way of the control conductor C267 in the cable 260 to the control conductor of the trunk line 870, thereby to cause the connector switch 821 to project ringing current by way of the trunk line 870 and the cable 260 over the telephone line 201 to the telephone station T1. The path for applying battery potential to the control conductor C204 of the telephone line 201 extends from battery by way of the winding of the cutoff relay R205 and the contacts 212 to the control conductor C204 of the telephone line 201. After the connector switch 821 in the P. A. X 40 seizes the trunk line 870, it operates to cause ground potential to be applied to the control conductor thereof, thereby to complete a circuit including the control conductor C267 in the cable 260, the control conductor C204 of the telephone line 201 and the contacts 212 for energizing the winding of the cutoff relay R205. Accordingly, the cutoff relay R205 operates to interrupt, at the contacts 206 and 207, the previously traced circuit for energizing the winding of the line relay R210 and to complete, at the contacts 206, the previously mentioned circuit for illuminating the busy signal lamp L638 at the first dispatcher position 600 and the corresponding busy lamps, not shown, at the other dispatcher positions. The illumination of the busy signal lamps mentioned indicates to the dispatchers at the various dispatcher positions that the telephone station T1 is busy at this time.

The ringing current projected over the telephone line 201 to the telephone station T1 causes the ringer thereat to be operated. When the call is answered at the telephone station T1 a communication connection is established between the telephone station T1 in the dispatcher exchange 30 and the subscriber substation T2 in the P. A. X 40 including the telephone line 201, the cable 260, the trunk line 870, the connector switch 821, the link 825 and the telephone line 830. The release of this established connection is under the control of the subscriber at the subscriber

substation T2 in the P. A. X 40 and is effected in the usual manner, thereby to cause the link 625 and the connector switch 621 in the P. A. X 40 to be released. When the connector switch 621 is released the previously traced circuit for energizing the winding of the cutoff relay R205 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the cutoff relay R205 interrupts, at the contacts 208, the previously mentioned circuit for illuminating the busy signal lamp L638 at the first dispatcher position 600 and the corresponding busy signal lamps, not shown, at the other dispatcher positions, thereby to indicate to the dispatchers at the various dispatcher positions that the telephone station T1 is idle at this time.

Conclusions

From the foregoing it is apparent that a signaling system is provided, which comprises a central office, a private branch exchange, a dispatcher exchange, a private automatic exchange and a number of radio stations, which dispatcher exchange is provided with improved signaling apparatus and telephone equipment for establishing various signaling and telephone connections between the various exchanges and radio stations in an exceedingly fast and efficient manner.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a telephone system, a plurality of lines, a plurality of links, a plurality of trunks individually associated with said links, an operator position, means selectively controllable from said operator position for connecting said operator position to any one of said lines, means controlled when said operator position is connected to one of said lines for connecting said one line to an idle one of said links, an impulse sender controllable from said operator position, means controlled when said one line is connected to said one link for connecting said impulse sender to the one of said trunks associated with said one link, impulse responsive switching apparatus associated with said one trunk, and means for connecting said one link to said one trunk.

2. In a telephone system, a plurality of lines, a plurality of links, a plurality of trunks individually associated with said links, an operator position, means selectively controllable from said operator position for connecting said operator position to any one of said lines, means controlled when said operator position is connected to one of said lines for connecting said one line to an idle one of said links, an impulse sender controllable from said operator position, means controlled when said one line is connected to said one link for connecting said impulse sender to the one of said trunks associated with said one link, impulse responsive switching apparatus associated with said one trunk, means controlled by said impulse sender for connecting said one link to said one trunk, and means controllable from said operator position for connecting said operator position to said one link and to said one trunk.

3. In a telephone system, a plurality of lines, a plurality of links, a plurality of trunks individually associated with said links, an operator position, means selectively controllable from said operator position for connecting said operator position to any one of said lines, means controlled when said operator position is connected to one of said lines for connecting said one line to an idle one of said links, an impulse sender controllable from said operator position, means controlled when said one line is connected to said one link for connecting said impulse sender to the one of said trunks associated with said one link, impulse responsive switching apparatus associated with said one trunk, means for connecting said one link to said one trunk, and additional means controllable from said operator position for disconnecting said one link from said one trunk and for selectively connecting said operator position to said one link and to said one trunk.

4. In a telephone system, a plurality of lines, a plurality of links, a plurality of trunks individually associated with said links, an operator position, a plurality of devices at said operator position individually associated with said lines, means controlled by a first predetermined operation of one of said devices for connecting said operator position to the one of said lines associated with said one device, means including a link distributor for assigning an idle one of said links in a predetermined order, means controlled when said operator position is connected to said one line for connecting said one line to an assigned one of said links, an impulse sender controllable from said operator position, means controlled when said one line is connected to said one link for connecting said impulse sender to the one of said trunks associated with said one link, impulse responsive switching apparatus associated with said one trunk, means for connecting said one link to said one trunk, means controllable from said operator position for connecting said operator position to said one link and to said one trunk, and means controlled by a second predetermined operation of said one device for disconnecting said operator position from said one line and for causing said link distributor to assign another idle one of said links.

5. In a telephone system, a plurality of lines, a plurality of links, a plurality of trunks individually associated with said links, an operator position, a plurality of line keys at said operator position individually associated with said lines, each of the line keys being operable to connect said operator position to the associated line, means controlled when said operator is connected to one of said lines for connecting said one line to an idle one of said links, an impulse sender controllable from said operator position, means controlled when said one line is connected to said one link for connecting said impulse sender to the one of said trunks associated with said one link, impulse responsive switching apparatus associated with said one trunk, means for connecting said one link to said one trunk, and a plurality of link-trunk keys at said operator position individually associated with said links and said trunks, each of the link-trunk keys being operable to connect said operator position to the associated link and trunk.

6. In a telephone system, a first exchange, a plurality of telephone lines extending to said first exchange, a plurality of links in said first exchange, a second exchange, a plurality of trunks individually associated with said links and extending between said first exchange and said second exchange, impulse responsive switching apparatus in said second exchange associ-

ated with said trunks, an operator position in said first exchange, means selectively controllable from said operator position for connecting said operator position to any one of said telephone lines, thereby to answer a call on one of said telephone lines, means controlled when said operator position is connected to one of said telephone lines for connecting said one telephone line to an idle one of said links, an impulse sender in said first exchange controllable from said operator position, means controlled when said one telephone line is connected to said one link for connecting said impulse sender to the one of said trunks associated with said one telephone line, and means for connecting said one link to said one trunk.

7. In a telephone system, a first exchange, a plurality of telephone lines extending to said first exchange, a second exchange, a plurality of trunks extending between said first exchange and said second exchange, impulse responsive switching apparatus in said second exchange associated with said trunks, an operator position in said first exchange, means selectively controllable from said operator position for connecting said operator position to any one of said telephone lines, thereby to answer a call on one of said telephone lines, an impulse sender in said first exchange controllable from said operator position, means controlled when said operator position is connected to one of said telephone lines for selecting an idle one of said trunks and for connecting said impulse sender to said one trunk, and means for connecting said one telephone line to said one trunk.

8. In a telephone system, a first exchange, a plurality of telephone lines extending to said first exchange, a second exchange, a plurality of trunks extending between said first exchange and said second exchange, an operator position in said first exchange, means selectively controllable from said operator position for answering a call on any one of said telephone lines, automatic means controlled when a call on one of said telephone lines is answered at said operator position for selecting an idle one of said trunks, and means controllable from said operator position for extending a call from said first exchange over said one trunk to said second exchange and for completing a connection between said one telephone line and said one trunk.

9. In a telephone system, a first exchange, a plurality of telephone lines extending to said first exchange, a second exchange, a plurality of trunks extending between said first exchange and said second exchange, an operator position in said first exchange, means selectively controllable from said operator position for answering a call on any one of said telephone lines, automatic means controlled when a call on one of said telephone lines is answered at said operator position for selecting an idle one of said trunks, means selectively controllable from said operator position for extending a call over any other of said telephone lines and for completing a connection between said one telephone line and said other telephone line, and additional means controllable from said operator position for extending a call from said first exchange over said one trunk to said second exchange and for completing a connection between said one telephone line and said one trunk.

10. In a telephone system, a plurality of police telephone stations, a dispatcher exchange, a plurality of telephone lines individually extending between said police telephone stations and said dispatcher exchange, a private exchange, a plurality of trunks extending between said dispatcher exchange and said private exchange, means at each of said police telephone stations for initiating a call on the associated telephone line, a dispatcher position in said dispatcher exchange, means selectively controllable from said dispatcher position for answering a call on any one of said telephone lines, automatic means controlled when a call on one of said telephone lines is answered at said dispatcher position for selecting an idle one of said trunks, and means controllable from said dispatcher position for extending a call from said dispatcher exchange over said one trunk to said private exchange and for completing a connection between said one telephone line and said one trunk.

11. In a signaling system, a plurality of police telephone stations, a dispatcher exchange, a plurality of telephone lines individually extending between said police telephone stations and said dispatcher exchange, a radio broadcasting station including a radio transmitter, a trunk extending between said dispatcher exchange and said radio transmitter, means at each of said police telephone stations for initiating a call on the associated telephone line, a dispatcher position in said dispatcher exchange comprising position equipment including a telephone instrument, means selectively controllable from said dispatcher position for connecting said position equipment to any one of said telephone lines, thereby to answer a call on one of said telephone lines, additional means controllable from said dispatcher position for connecting said position equipment to said trunk, and means controlled when said position equipment is connected to said trunk for rendering operative said radio transmitter.

12. In a signaling system, a plurality of police telephone stations, a dispatcher exchange, a plurality of telephone lines individually extending between said police telephone stations and said dispatcher exchange, a private exchange, a plurality of first trunks extending between said dispatcher exchange and said private exchange, means at each of said police telephone stations for initiating a call on the associated telephone line, a dispatcher position in said dispatcher exchange comprising position equipment including a telephone instrument, means selectively controllable from said dispatcher position for connecting said position equipment to any one of said telephone lines, thereby to answer a call on one of said telephone lines, automatic means controlled when said position equipment is connected to one of said telephone lines for selecting an idle one of said first trunks, means controllable from said dispatcher position for extending a call from said dispatcher exchange over said one first trunk to said private exchange and for completing a connection between said one telephone line and said one first trunk, a radio broadcasting station including a radio transmitter, a second trunk extending between said dispatcher exchange and said radio transmitter, additional means controllable from said dispatcher position for connecting said position equipment to said trunk, and means controlled when said position equipment is connected to said trunk for rendering operative said radio transmitter.

13. In a telephone system, a plurality of lines, a plurality of operator positions, a plurality of

groups of links individually associated with said operator positions, a plurality of groups of trunks individually associated with said groups of links, whereby the individual trunks in a given group of trunks are individually associated with the links in the corresponding group of links, means selectively controllable from any one of said operator positions for connecting the operator position to any one of said lines, means controlled when one of said operator positions is connected to one of said lines for connecting said one line to an idle one of the links in the associated one of said groups of links, an impulse sender controllable from said one operator position, means controlled when said one line is connected to said one link in said one group of links for connecting said impulse sender to the associated one of the trunks in the associated one of said groups of trunks, impulse responsive switching apparatus associated with said one trunk in said one group of trunks, and means for connecting said one link in said one group of links to said one trunk in said one group of trunks.

14. In a telephone system, a plurality of lines, a plurality of operator positions, a plurality of groups of links individually associated with said operator positions, a plurality of groups of trunks individually associated with said groups of links, whereby the individual trunks in a given group of trunks are individually associated with the links in the corresponding group of links, means selectively controllable from any one of said operator positions for connecting the operator position to any one of said lines, means controlled when one of said operator positions is connected to one of said lines for connecting said one line to an idle one of the links in the associated one of said groups of links, an impulse sender controllable from said one operator position, means controlled when said one line is connected to said one link in said one group of links for connecting said impulse sender to the associated one of the trunks in the associated one of said groups of trunks, impulse responsive switching apparatus associated with said one trunk in said one group of trunks, means controlled by said impulse sender for connecting said one link in said one group of links to said one trunk in said one group of trunks, and means controllable from said one operator position for connecting said one operator position to said one link in said one group of links and to said one trunk in said one group of trunks.

15. In a telephone system, a first exchange, a plurality of telephone lines extending to said first exchange, a plurality of operator positions in said first exchange, a second exchange, a plurality of groups of trunks individually associated with said operator positions and extending between said first exchange and said second exchange, means selectively controllable from any one of said operator positions for answering a call on any one of said telephone lines, automatic means controlled when a call on one of said telephone lines is answered at one of said operator positions for selecting an idle one of the trunks in the associated one of said groups of trunks, and means controllable from said one operator position for extending a call from said first exchange over said one trunk in said one group of trunks to said second exchange and for completing a connection between said one telephone line and said one trunk in said one group of trunks.

16. In a telephone system, a first exchange, a plurality of telephone lines extending to said first exchange, a plurality of operator positions in said first exchange, a second exchange, a plurality of groups of trunks individually associated with said operator positions and extending between said first exchange and said second exchange, means selectively controllable from any one of said operator positions for answering a call on any one of said telephone lines, means including a distributor for assigning idle ones of said trunks in said groups of trunks in a predetermined order, automatic means controlled when a call on one of said telephone lines is answered at one of said operator positions for selecting an assigned one of the trunks in the associated one of said groups of trunks, means controllable from said one operator position for extending a call from said first exchange over said one trunk in said one group of trunks to said second exchange and for completing a connection between said one telephone line and said one trunk in said one group of trunks, and means controlled when the call is extended over said one trunk in said one group of trunks for causing said distributor to assign another idle trunk in said one group of trunks.

17. In a telephone system, a plurality of lines, a plurality of operator positions, a plurality of groups of links individually associated with said operator positions, means selectively controllable from any one of said operator positions for answering a call on any one of said lines, automatic means controlled when a call on one of said lines is answered at one of said operator positions for completing a connection between said one line and an idle one of the links in the associated one of said groups of links, and means controllable from said one operator position for extending the call on said one line over said one link in said one group of links.

18. In a telephone system, a plurality of lines, a plurality of operator positions, a plurality of groups of links individually associated with said operator positions, means selectively controllable from any one of said operator positions for answering a call on any one of said lines, means including a link distributor for assigning idle ones of the links in said groups of links in a predetermined order, automatic means controlled when a call on one of said telephone lines is answered at one of said operator positions for completing a connection between said one line and an assigned one of the links in the associated one of said groups of links, means controllable from said one operator position for extending the call on said one line over said one link in said one group of links, and means controlled when the call is extended over said one link in said one group of links for causing said link distributor to assign another idle link in said one group of links.

19. In a telephone system, a plurality of lines, a plurality of operator positions, a plurality of groups of links individually associated with said operator positions, means selectively controllable from any one of said operator positions for answering a call on any one of said lines, connect means associated with said lines operative to complete connections between the different ones of said lines and the different idle ones of the links in said groups of links, automatic means controlled when a call on one of said lines is answered at one of said operator positions for seizing said connect means to the use of said one line and for causing said connect means to

complete a connection between said one line and an idle one of the links in the associated one of said groups of links, means controlled when said one line is connected to said one link in said one group of links for releasing said connect means to the use of the other of said lines, and means controllable from said one operator position for extending the call on said one line over said one link in said one group of links.

20. In a telephone system, a plurality of lines, a plurality of automatic switches individually associated with said lines, a plurality of operator positions, a plurality of groups of links individually associated with said operator positions and accessible to said switches, means selectively controllable from any one of said operator positions for answering a call on any one of said lines, automatic means controlled when a call on one of said lines is answered at one of said operator positions for marking an idle one of the links in the associated one of said group of links and for initiating operation of the associated one of said switches, means controlled when said one switch seizes said marked link for arresting operation of said one switch, thereby to complete a connection between said one line and said one link in said one group of links, and means controllable from said one operator position for extending the call on said one line over said one link in said one group of links.

21. In a telephone system, a plurality of lines, a plurality of automatic switches individually associated with said lines, a plurality of operator positions, a plurality of groups of links individually associated with said operator positions and accessible to said switches, means selectively controllable from any one of said operator positions for answering a call on any one of said lines, automatic means controlled when a call on one of said lines is answered at one of said operator positions for marking an idle one of the links in the associated one of said groups of links and for initiating operation of the associated one of said switches, means controlled when said one switch seizes said marked link for arresting operation of said one switch, thereby to complete a connection between said one line and said one link in said one group of links, means controlled when one of said switches is operating for preventing operation of the other of said switches, and means controllable from said one operator position for extending the call on said one line over said one link in said one group of links.

22. In a telephone system, a plurality of lines, a plurality of automatic switches individually associated with said lines, a plurality of operator positions, a plurality of groups of links individually associated with said operator positions and accessible to said switches, means selectively controllable from any one of said operator positions for answering a call on any one of said lines, means including a link distributor for assigning idle ones of the links in said groups of links in a predetermined order, automatic means controlled when a call on one of said lines is answered at one of said operator positions for marking an assigned one of the links in the associated one of said groups of links and for initiating operation of the associated one of said switches, means controlled when said one switch seizes said marked link for arresting operation of said one switch, thereby to complete a connection between said one line and said one link in said one group of links, means controllable from said one operator position for extending the call on said one line over said one link in said one group of links, and means controlled when the call is extended over said one link in said one group of links for causing said link distributor to assign another idle link in said one group of links.

23. In a telephone system, a plurality of lines, a plurality of automatic switches individually associated with said lines, a plurality of operator positions, a plurality of groups of links individually associated with said operator positions and accessible to said switches, means selectively controllable from any one of said operator positions for answering a call on any one of said lines, automatic means controlled when a call on one of said lines is answered at one of said operator positions for marking an idle one of the links in the associated one of said groups of links and for initiating operation of the associated one of said switches, means controlled when said one switch seizes said marked link for removing the marking from said last-mentioned link and for arresting operation of said one switch, thereby to complete a connection between said one line and said one link in said one group of links, means controlled when a link in one of said groups of links is marked for preventing marking of a link in any other of said groups of links, and means controllable from said one operator position for extending the call on said one line over said one link in said one group of links.

24. In a telephone system, a plurality of lines, a plurality of automatic switches individually associated with said lines, a plurality of operator positions, a plurality of groups of links individually associated with said operator positions and accessible to said switches, means selectively controllable from any one of said operator positions for answering a call on any one of said lines, automatic means controlled when a call on one of said lines is answered at one of said operator positions for marking an idle one of the links in the associated one of said groups of links and for initiating operation of the associated one of said switches, means controlled when said one switch seizes said marked link for removing the marking from said last-mentioned link and for arresting operation of said one switch, thereby to complete a connection between said one line and said one link in said one group of links, means controlled when one of said switches is operating for preventing operation of the other of said switches, means controlled when a link in one of said groups of links is marked for preventing marking of a link in any other of said groups of links, and means controllable from said one operator position for extending the call on said one line over said one link in said one group of links.

25. In a telephone system, a plurality of lines, a plurality of operator positions, answer means at each of said operator positions selectively operable to answer at the operator position a call on any one of said lines, a plurality of groups of links individually associated with said operator positions, automatic means controlled upon substantially simultaneous operations of the answer means at a number of said operator positions to answer at the operator positions a call on one of said lines for completing a connection between said one line and an idle one of the links in the one of said groups of links associated with the one of said operator positions at which the answer means is first operated, and means controllable from said one operator position for extending the call on said

one line over said one link in said one group of links.

26. In a telephone system, a plurality of lines, a plurality of operator positions, a plurality of answer devices at each of said operator positions individually associated with said lines, a given answer device at a given operator position being operable to answer at said given operator position a call on a given line associated with said given answer device, a plurality of groups of links individually associated with said operator positions, automatic means controlled upon substantially simultaneous operations of answer devices at a number of said operator positions to answer calls on one or more of said lines at said operator positions for completing a connection between the one of said lines associated with the operated one of said answer devices at the one of said operator positions at which an answer device is first operated and an idle one of the links in the one of said groups of links associated with said one operator position, and means controllable from said one operator position for extending the call on said one line over said one link in said one group of links.

27. In a telephone system, a plurality of lines, a plurality of operator positions, a plurality of groups of links individually associated with said operator positions, means at each operator position for extending a number of different connections from said lines over the different links in the associated group of links, a plurality of identity apparatus individually corresponding to said operator positions, each identity apparatus being operative selectively to identify the particular lines included in connections extended over the links in the group of links associated with the corresponding operator position, normally effective means at each operator position for selectively operating the corresponding identity apparatus, and means including an identity distributor controlled by the operation of one of said identity apparatus for preventing operation of the other of said identity apparatus.

28. In a telephone system, a plurality of lines, a plurality of operator positions, a plurality of groups of links individually associated with said operator positions, means at each operator position for extending a number of different connections from said lines over the different links in the associated group of links, a plurality of groups of identity devices individually disposed at said operator positions, the identity devices in the group of identity devices disposed at each operator position individually corresponding to the links in the group of links associated with the operator position, a plurality of identity apparatus individually corresponding to said operator positions, each identity apparatus being normally operative selectively in response to the operation of the identity devices at the corresponding operator position to identify the particular lines included in connections extended over corresponding ones of the links in the group of links associated with the corresponding operator position, and means including an identity distributor controlled by the operation of one of said identity apparatus for preventing operation of the other of said identity apparatus.

29. In a telephone system, a plurality of lines, a plurality of operator positions, a plurality of groups of links individually associated with said operator positions, means at each operator position for extending a number of different connections from said lines over the different links in the associated group of links, a plurality of identity signals at each of said operator positions and individually corresponding to said lines, operating circuits for said identity signals, a plurality of identity apparatus individually corresponding to said operator positions, each identity apparatus being operative selectively to complete the operating circuits of the identity signals at the corresponding operator position corresponding to the particular lines included in connections extended over the links in the group of links associated with the corresponding operator position, normally effective means at each operator position for selectively operating the corresponding identity apparatus, and means including an identity distributor controlled by the operation of one of said identity apparatus for preventing operation of the other of said identity apparatus.

30. In a telephone system, a plurality of lines, a plurality of operator positions, a plurality of groups of links individually associated with said operator positions, means selectively controllable from any one of said operator positions for answering a call on any one of said lines, automatic means controlled when a call on one of said lines is answered at one of said operator positions for completing a connection between said one line and an idle one of the links in the associated one of said groups of links, means controllable from said one operator position for extending the call on said one line over said one link in said one group of links, a plurality of identity apparatus individually corresponding to said operator positions, each identity apparatus being operative selectively to identify the particular lines included in connections extended over the links in the group of links associated with the corresponding operator position, normally effective means at each operator position for selectively operating the corresponding identity apparatus, and means including an identity distributor controlled by the operation of one of said identity apparatus for preventing operation of the other of said identity apparatus.

31. In a telephone system, a plurality of lines, a plurality of operator positions, a plurality of groups of links individually associated with said operator positions, means at each operator position for extending a number of different connections from said lines over the different links in the associated group of links, a plurality of identity apparatus individually corresponding to said operator positions, each identity apparatus being operative selectively to identify the particular lines included in connections extended over the links in the group of links associated with the corresponding operator position, a normally effective and selectively operable control device at each operator position for selectively operating the corresponding identity apparatus, and means including an identity distributor controlled upon substantially simultaneous operations of the control devices at a number of said operator positions for preventing operation of each of said identity apparatus except the identity apparatus corresponding to the particular operator position at which a control device is first operated.

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