

July 7, 1942.

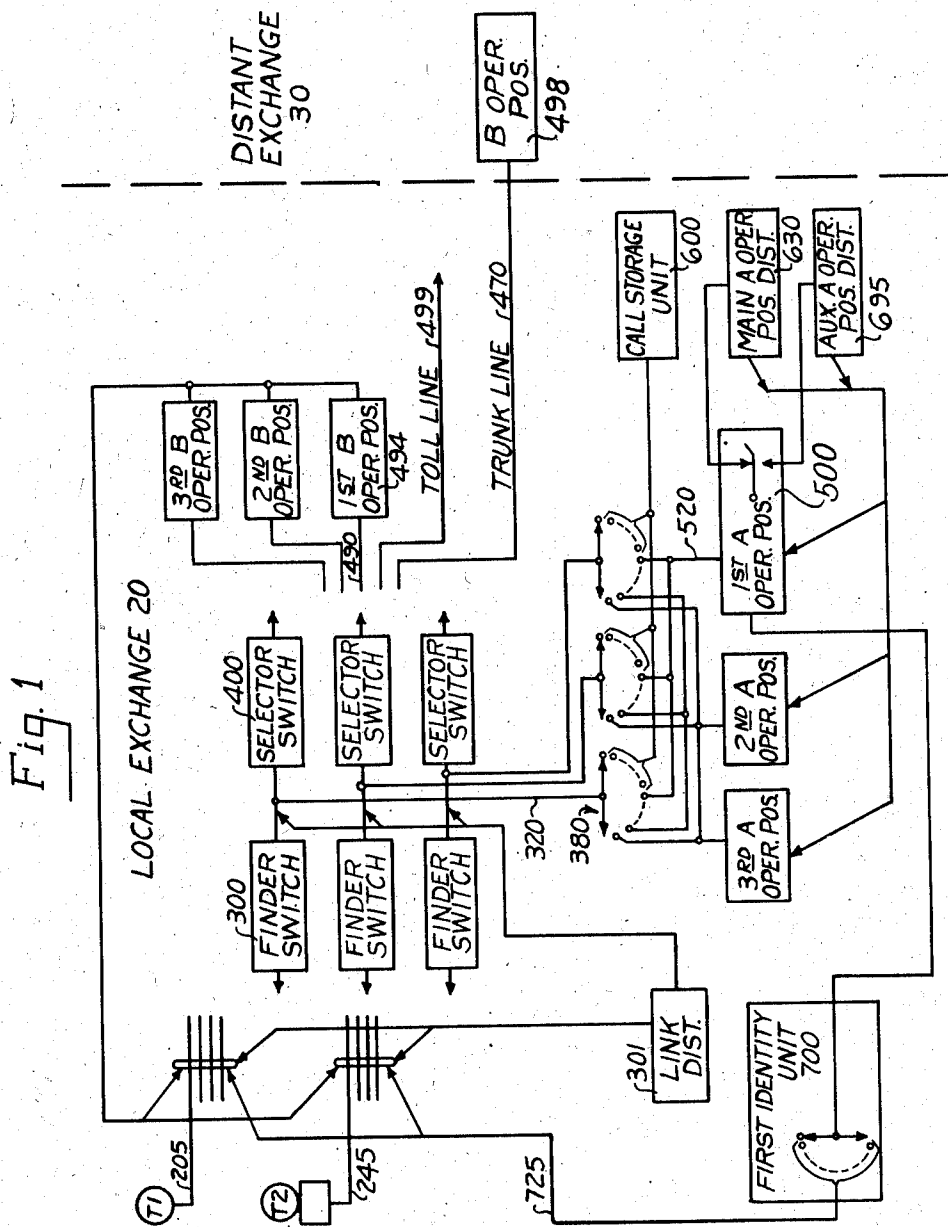
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2,288,789

TELEPHONE SYSTEM

Filed March 29, 1940

7 Sheets-Sheet 1



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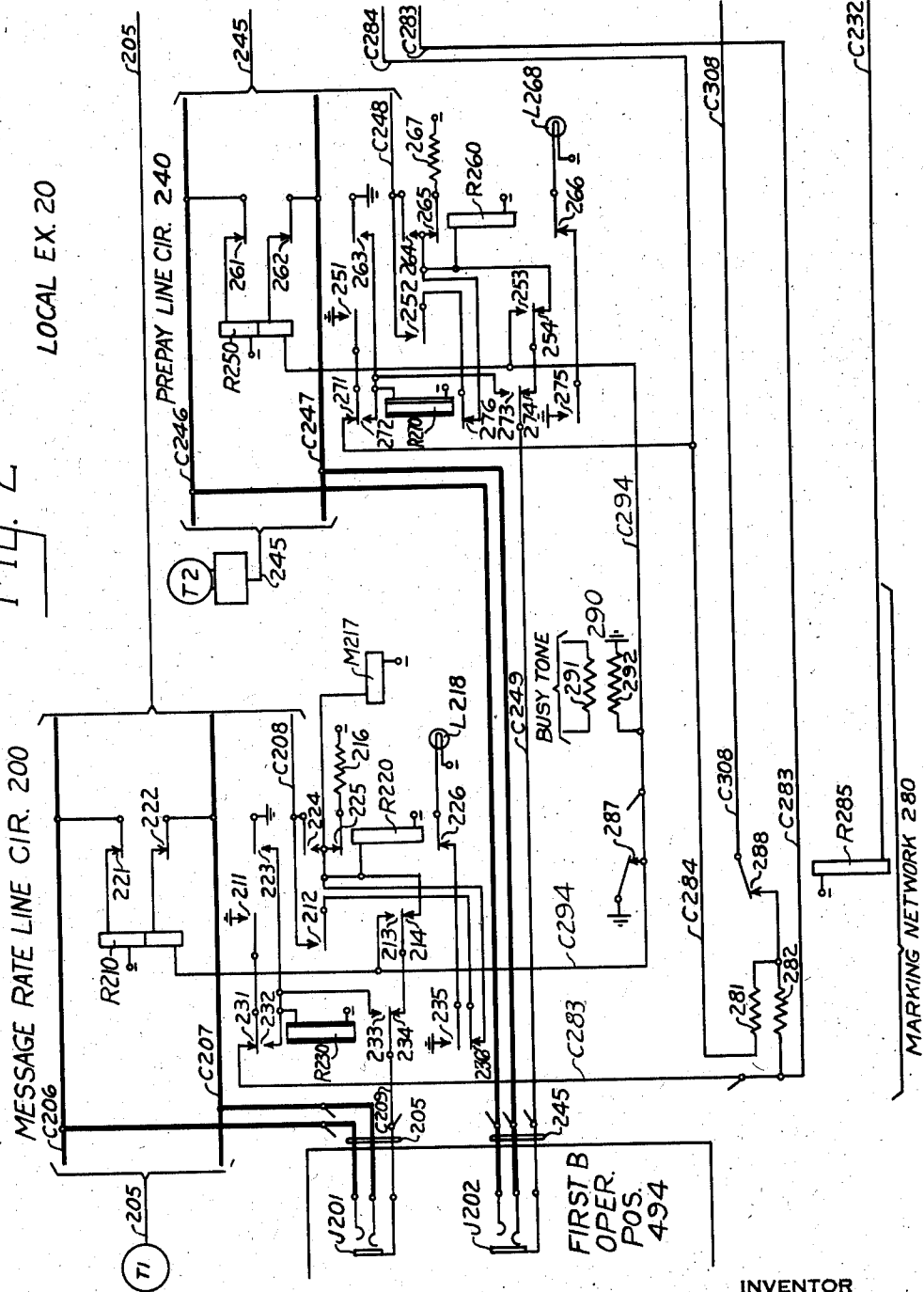
2,288,789

TELEPHONE SYSTEM

Filed March 29, 1940

7 Sheets-Sheet 2

Fig. 2



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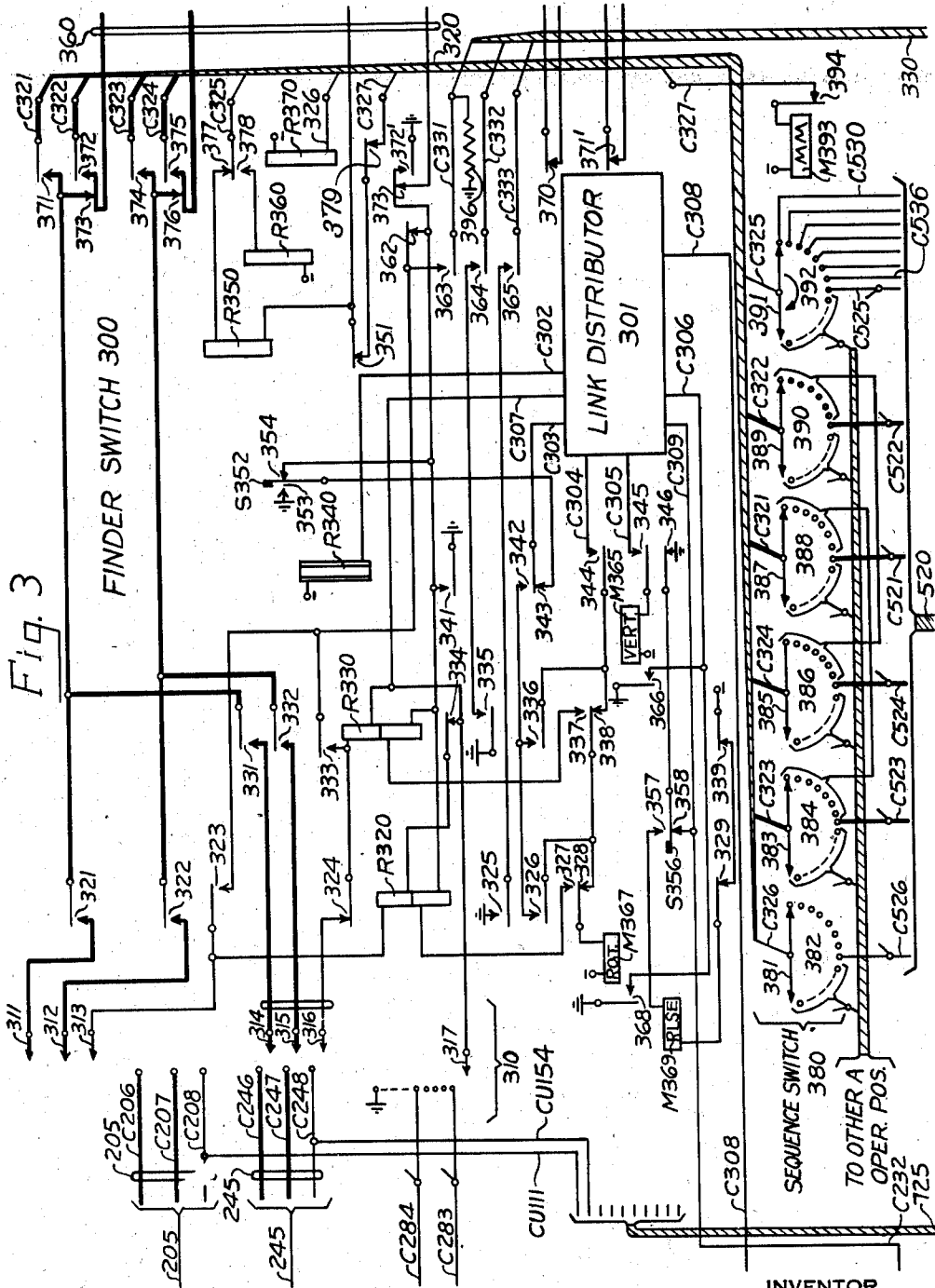
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TELEPHONE SYSTEM

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7 Sheets-Sheet 3



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TELEPHONE SYSTEM

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7 Sheets-Sheet 4

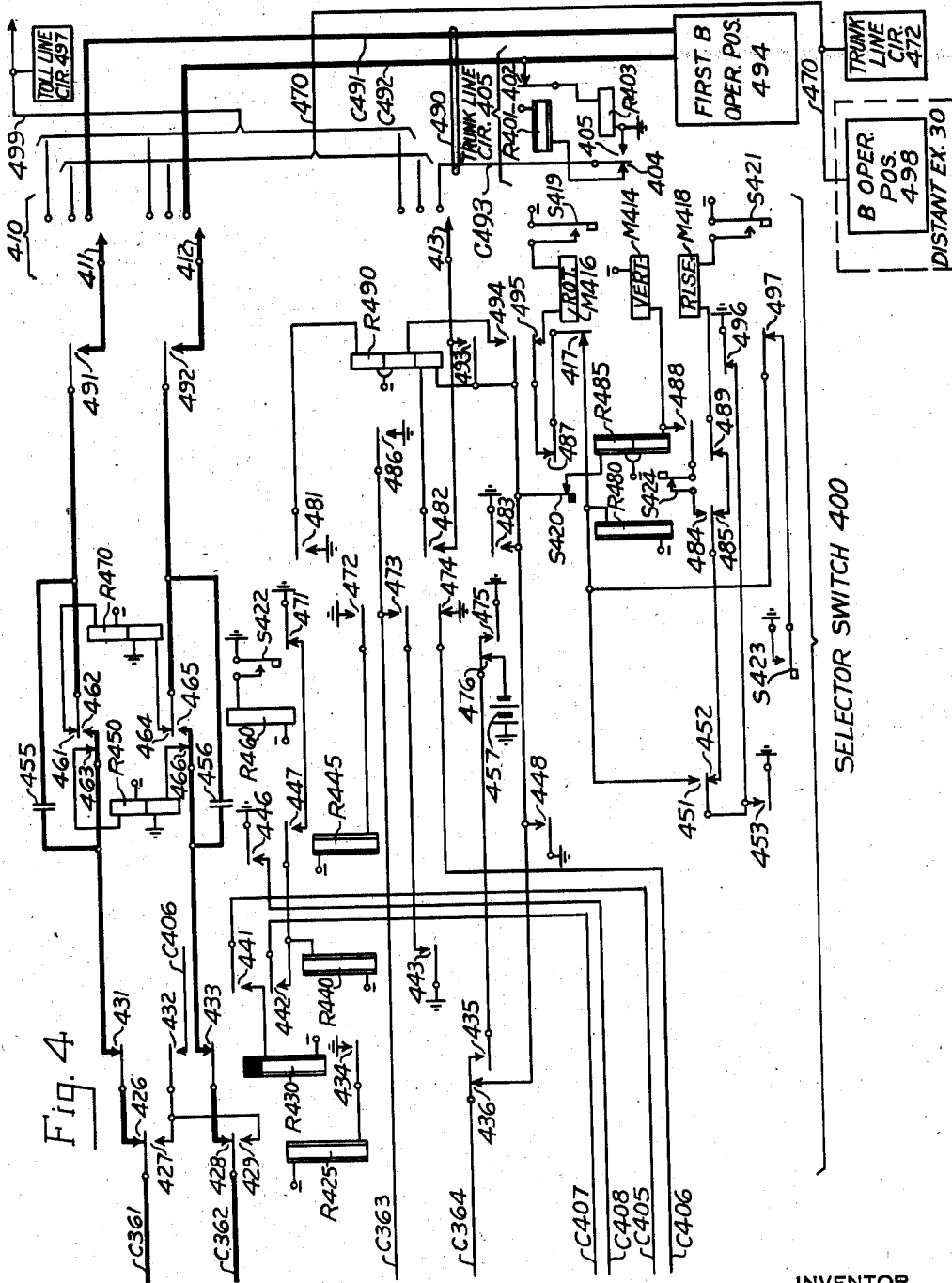


Fig. 4

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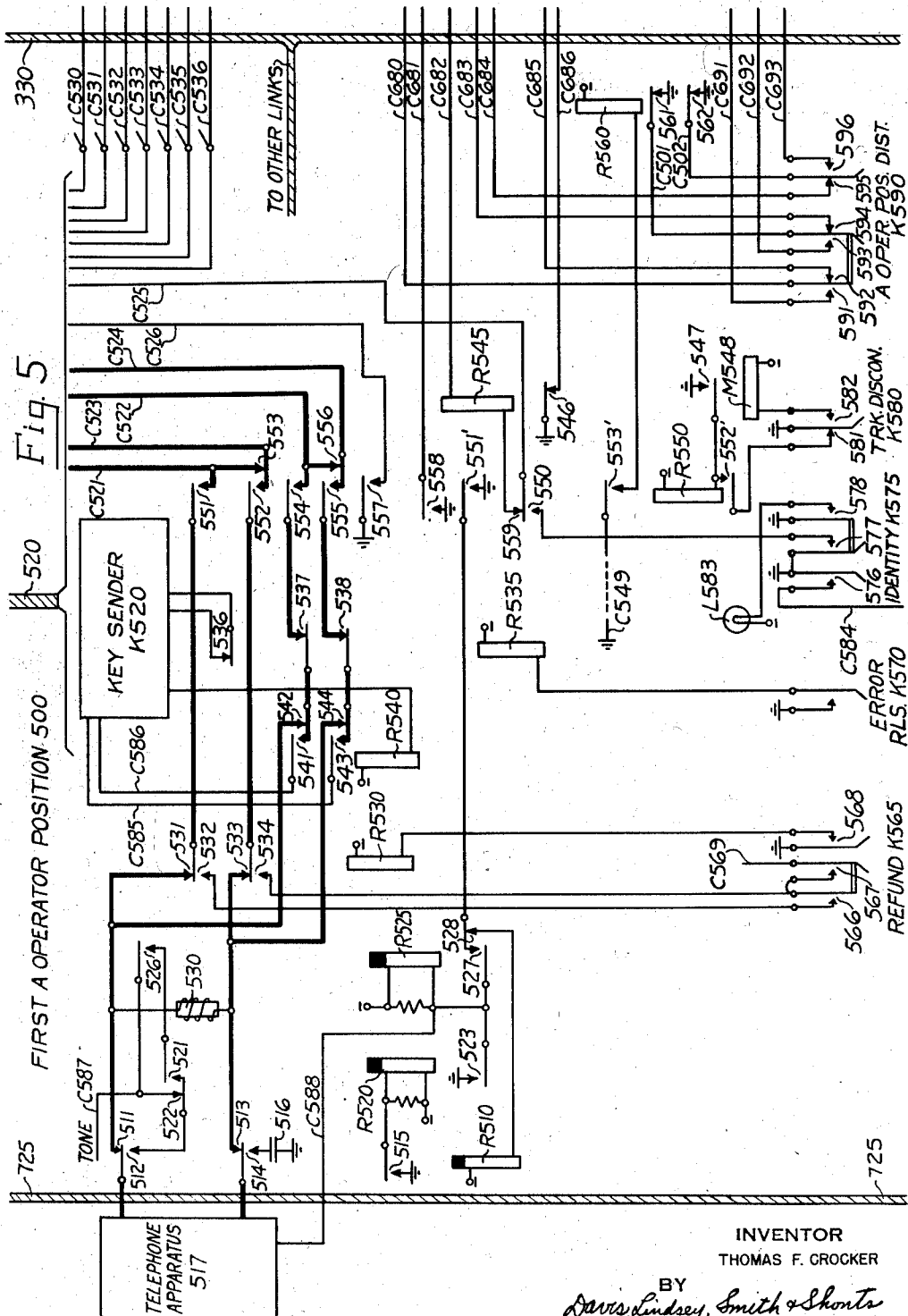
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2,288,789

TELEPHONE SYSTEM

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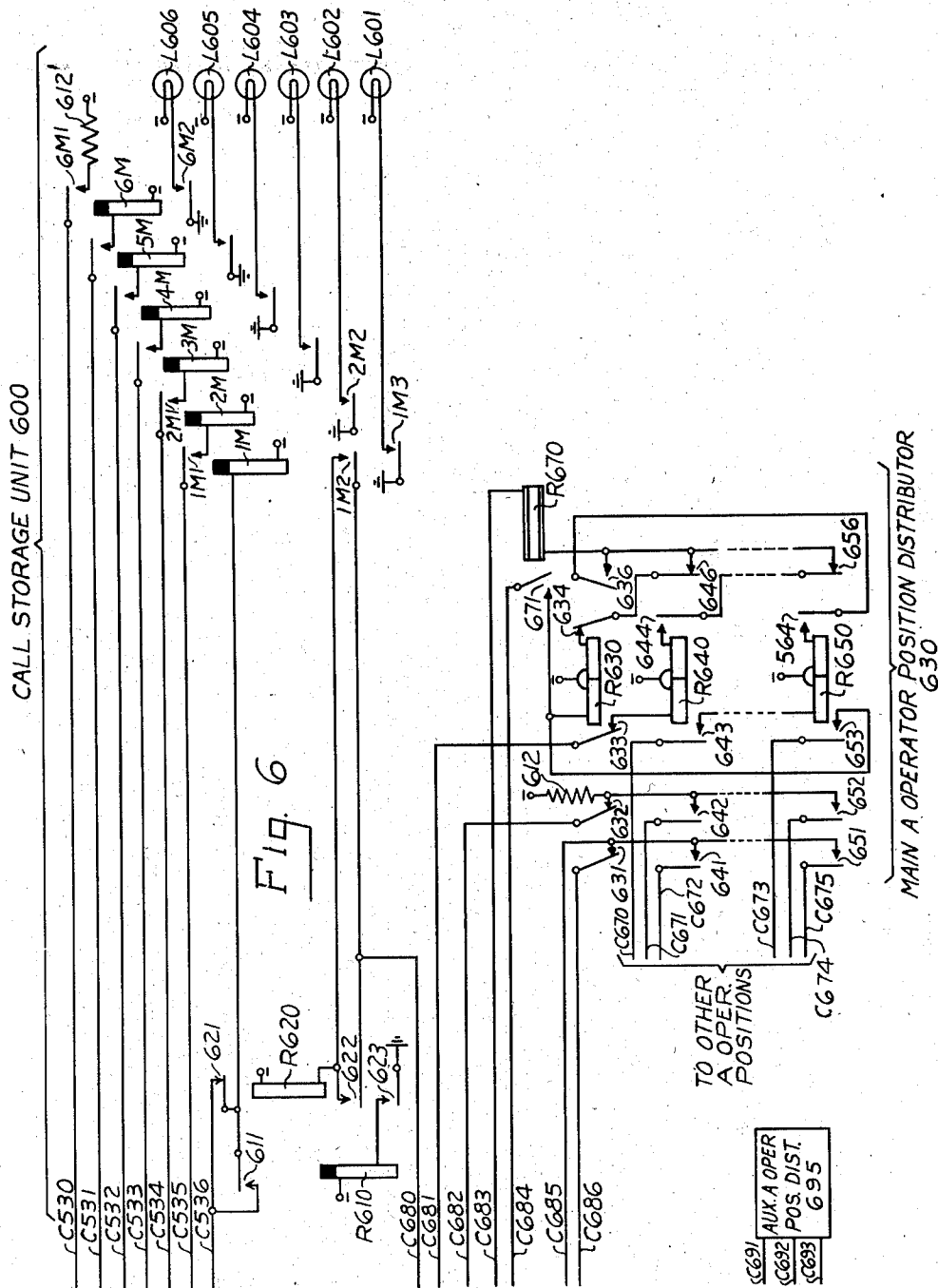
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7 Sheets-Sheet 6



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7 Sheets-Sheet 7

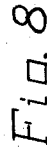
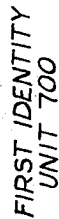
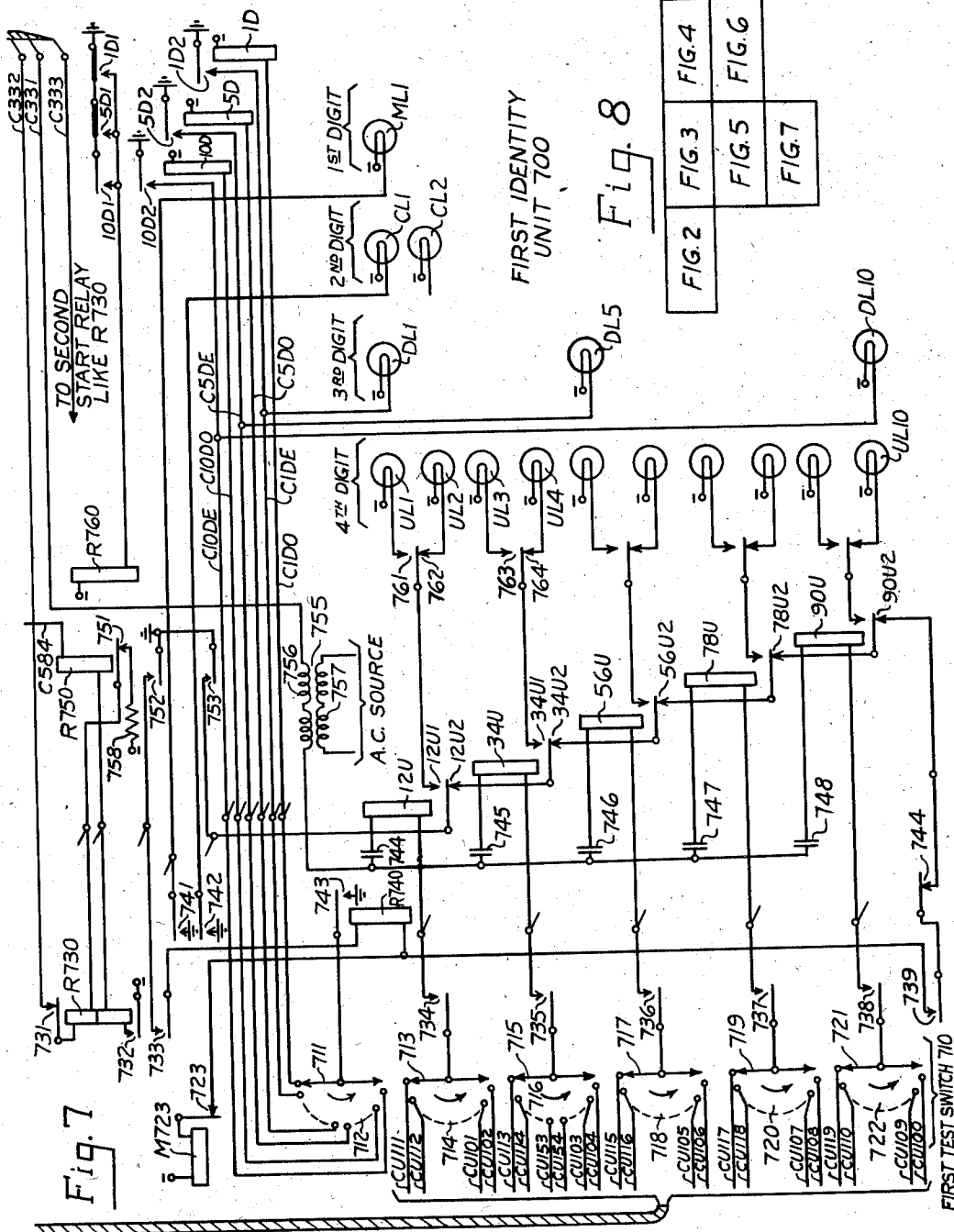


FIG. 2	FIG. 3	FIG. 4
	FIG. 5	FIG. 6
	FIG. 7	

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UNITED STATES PATENT OFFICE

2,288,789

TELEPHONE SYSTEM

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Application March 29, 1940, Serial No. 326,619

34 Claims. (Cl. 179-6.3)

The present invention relates to telephone systems and more particularly to improved semi-automatic telephone systems of the character of that disclosed and claimed in the copending application of Thomas F. Crocker, Serial No. 311,551, filed December 29, 1939.

In a conventional telephone system of the semi-automatic type, the various manual telephone lines terminate in jacks at the A and B operator positions; and an automatic switch train provided with a distributing system is interposed between the A operator positions and the B operator positions. In a telephone system of this type, calls on the telephone lines are answered directly by the operators at the A operator positions and routed by way of the switch train under the control of the distributing system to the B operator positions to be completed.

Hence, in a telephone system of this type, the traffic between the A operator positions and the B operator positions is governed by the distributing system. However, the traffic between the calling telephone lines of the various A operator positions is not governed but remains under the manual control of the operators at the A operator positions, rendering the number of calls on the telephone lines answered by an operator at a given A operator position and routed therefrom to the B operator positions to be completed entirely within the discretion of the operator at the given A operator position.

Accordingly, it is an object of the present invention to provide in a telephone system of the type described, improved apparatus for distributing calls on telephone lines to a number of A operator positions to be answered.

Another object of the invention is to provide in a telephone system including a number of A operator positions and a number of B operator positions, an improved arrangement for distributing incoming calls on telephone lines to the A operator positions to be answered and for distributing recalls on established connections to the A operator positions to be answered.

Another object of the invention is to provide in a telephone system including a number of A operator positions and a number of B operator positions and apparatus under the control of the operators at the A operator positions for answering incoming calls on the telephone lines and for completing connections to the B operator positions, improved apparatus selectively controllable from the B operator positions for routing recalls on the established connections to

the A operator positions to be answered and for governing coin collection and refund mechanism and message register mechanism associated with the telephone lines.

A further object of the invention is to provide in a telephone system including an operator position provided with facilities for answering a call-back upon an established connection, improved switching apparatus included in the established connection and embodying control apparatus selectively governable over the established connection for creating a call-back upon the established connection and for governing coin collection and refund mechanism or message register mechanism associated with a calling line included in the established connection.

The features of the present invention are illustrated as being incorporated in a telephone system comprising an exchange terminating a plurality of manual telephone lines and including a number of A operator positions, a number of B operator positions and a number of switching links. The switching links have access to the telephone lines, to the A operator positions and to the B operator positions; while the B operator positions have access to the telephone lines. The telephone lines comprise two classes which are rendered corresponding classes of service consisting of message register service and prepay service.

In accordance with one feature of the invention, the telephone system comprises a plurality of telephone lines, a plurality of A operator positions and a B operator position. Also the system comprises means for routing a call on any one of the telephone lines to an idle one of the A operator positions to be answered, means for routing a call from the one A operator position to the B operator position, and means for establishing a connection between the one telephone line and the B operator position independent of the one A operator position, thereby to route a call from the one telephone line to the B operator position. Further the system comprises means for routing a recall by the operator at the B operator position upon the established connection to an idle one of the A operator positions to be answered. More particularly, the system comprises a switching link including an answer switch having access to the telephone lines, a finder switch having access to the A operator positions and a call switch having access to the B operator positions; and means controlled by the presence of a call on one of the telephone lines for initiat-

ing operations of the answer switch and the finder switch of the switching link, the operation of the answer switch being arrested when it finds a calling one of the telephone lines and the operation of the finder switch being arrested when it finds an idle one of the A operator positions. Also, each one of the A operator positions has an identity unit individually associated therewith which is controllable from the one A operator position to indicate the particular character identifying a calling telephone line seized by the finder switch of the link, each of the telephone lines being identified by a particular multi-symbol character.

In accordance with a further feature of the invention, in the telephone system, each switching link comprises control apparatus which is operative in a first manner to create a call-back upon an established connection including a calling first line extending to a paystation or a called third line, and operative in a second manner to release the link. Also the arrangement comprises means controllable over the third line for selectively governing the manner of operation of the control apparatus, means for routing a call-back upon the established connection to an operator position to be answered, additional means operative under the control of an operator at the operator position for releasing the link, means operative under the control of an operator at the operator position for governing coin collection and refund control means to cause coins deposited in a coin receiving means at the paystation to be refunded in the event the first line is included in the established connection, and additional means controlled only in response to the release of the link by the control apparatus for governing the coin collection and refund control means to cause coins deposited in the coin receiving means to be collected in the event the first line is included in the established connection and for operating a message register associated with the second line in the event the second line is included in the established connection.

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, 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 telephone system including a local exchange and a distant exchange embodying the present invention; and Figs. 2 to 7, inclusive, when combined in the manner shown in Fig. 8, illustrate the details of a system having incorporated therein the features of the invention, as briefly outlined above.

Description of the apparatus incorporated in the telephone system

Referring now more particularly to Fig. 1 of the drawings the telephone system there illustrated comprises a local exchange 20, a distant exchange 30 and a plurality of one-way trunk lines, including the trunk line 470, extending therebetween. The local exchange 20 and the distant exchange 30 are of the manual type, each serving a number of groups of telephone stations

to which different classes of service are rendered. For example, the local exchange 20 serves a group of subscriber substations, including the subscriber substation T1, which is rendered message rate register service; and a group of paystations, including the paystation T2, which is rendered prepay service. A telephone line having a line circuit individually associated therewith extends to each telephone station in the local exchange; the telephone lines 205 and 245, respectively, extend to the subscriber substation T1 and to the paystation T2. Also, it is noted that each telephone line in the local exchange 20 is identified by a particular multi-symbol character constituting a directory number in a manner more fully explained subsequently. The message rate line circuit 200 is individually associated with the telephone line 205; and the prepay line circuit 240 is individually associated with the telephone line 245. Each of the subscriber substations and paystations in the local exchange 20 is provided with station equipment including a telephone instrument and a ringer.

Further each of the paystations is provided with mechanism for receiving coins or the like and apparatus for controlling collection and refund of coins deposited in the coin receiving mechanism, which may be constructed and arranged in the manner shown and described in Oscar F. Forsberg Patent No. 1,043,219, issued November 5, 1912.

Also the local exchange 20 comprises a number of A operator positions, including the first A operator position 500, and a number of B operator positions, including the first B operator position 494. Also a group of toll lines, including the toll line 499, terminates at the local exchange 20 and extends to a remote exchange, not shown. Each A operator position has a trunk individually extending thereto, the trunk 520 individually extending to the first A operator position 500; and each B operator position has a group of trunks individually extending thereto, the trunk 490 being included in the group of trunks individually extending to the first B operator position 494. Each trunk extending to each B operator position is provided with a trunk line circuit individual thereto, the trunk line circuit 405 being individual to the trunk line 490 extending to the first B operator position 494. Each toll line terminated at the local exchange 20 is provided with a toll line circuit individual thereto, the toll line circuit 497 being individual to the toll line 499. Also each trunk line extending between the local exchange 20 and the B operator position 498 in the distant exchange 30 is provided with a trunk line circuit individual thereto, the trunk line circuit 472 being individual to the trunk line 470 extending between the local exchange 20 and the B operator position 498 in the distant exchange 30.

Further the local exchange 20 comprises a number of finder-selector links, including the finder-selector link illustrated, and a link distributor 301 for assigning idle ones of the links to the use of the telephone stations. For example, the link illustrated includes a finder switch 300 and a selector switch 400. Also a sequence switch is individually associated with each of the links, the sequence switch 380 being individually associated with the link illustrated. Further the local exchange 20 comprises a main A operator position distributor 630 and an auxiliary A operator position distributor 695, each of the A

operator position distributors being operative to assign idle ones of the A operator positions to receive incoming calls or recalls to the local exchange 20 in a predetermined order. Finally the local exchange 20 comprises a call storage unit 600 and a number of identity units individually associated with the A operator positions, the first identity unit 700 being individually associated with the first A operator position 500.

Each of the finder switches, such, for example, as the finder switch 300, constitutes an answer switch having access to each of the telephone lines in the local exchange; each of the selector switches, such, for example, as the selector switch 400, constitutes a call switch having access to each of the trunks extending to the B operator positions and to the toll lines and to each of the trunk lines extending to the distant exchange 30; and each of the sequence switches, such, for example, as the sequence switch 300, constitutes a position and storage finder switch having access to each of the trunks individually extending to the A operator positions and to the call storage unit 600. Also it is noted that each B operator position in the local exchange 20 has access to each telephone line therein.

The distant exchange 30 comprises a number of A operator positions, not shown, and a number of B operator positions including the B operator position 400, previously mentioned. It is noted that the trunk line 470 extending between the local exchange 20 and the distant exchange 30 is terminated at the B operator position 400 in the distant exchange 30.

Preferably, each of the finder-selector links is identical to the link illustrated which comprises a finder switch 300 and a selector switch 400, as previously noted. The finder switch 300, as best shown in Fig. 3, comprises a switching mechanism 310 of the 200-point Strowger type including a carriage provided with a first wiper set, including the wipers 314, 315 and 316, a second wiper set including the wipers 311, 312 and 313 and a control wiper 317. It is noted that the wipers 314, 315 and 316 of the first wiper set and the wipers 311, 312 and 313 of the second wiper set are capable of both vertical and rotary movements; while the control wiper 317 is capable of vertical movement. Further the mechanism 310 comprises a circumferentially disposed main contact bank provided with two sections respectively associated with the first and second wiper sets and a vertical control contact bank associated with the control wiper 317. Accordingly, in the mechanism 310, the first and second wiper sets respectively have access to the first and second groups of one hundred lines each, respectively terminated by the first and second sections of the main contact bank. Also the mechanism 310 is provided with a vertical magnet M365 for moving the first and second wiper sets thereof in the vertical direction, a rotary magnet M367 for moving the first and second wiper sets thereof in the rotary direction and a release magnet M369 for releasing the first and second wiper sets thereof and for causing these wiper sets to be returned to their normal positions. Finally, the mechanism 310 has two sets of switch springs S352 and S356 operatively associated therewith, which are controlled in accordance with the movements of the first and second wiper sets thereof, in a manner more fully described subsequently.

Also the finder switch 300 comprises a number of relays including two switching relays R320 and R330, a start relay R340, a stop relay R350, an

identity relay R360 and a cut-in relay R370 connected and arranged in a manner more fully described hereinafter.

The selector switch 400, as best shown in Fig. 4, comprises a switching mechanism 410 of the 100-point Strowger type including a carriage provided with a wiper set including the wipers 411, 412 and 413. It is noted that the wipers 411, 412 and 413 of the wiper set are capable of both vertical and rotary movements. Further the mechanism 410 comprises a circumferentially disposed main contact bank associated with the wiper set. Accordingly, the wiper set has access to a group of one hundred lines terminated by the contact bank. Also the mechanism 410 is provided with a vertical magnet M414 for moving the wiper set thereof in the vertical direction, a rotary magnet M416 for moving the wiper set thereof in the rotary direction, and a release magnet M418 for releasing the wiper set thereof and for causing the wiper set to be returned to its normal position. Finally the mechanism 410 has a number of switch springs S419, S420, S421, S422, S423 and S424 operatively associated therewith, which are controlled in accordance with the movements of the wiper set thereof, in a manner more fully described subsequently.

Also the selector switch 400 comprises a number of relays including a control relay R425, a coin and register relay R430, a call pack relay R440, two hold relays R445 and R480, a line relay R450, a switch-through relay R460, a battery supply relay R470, a transfer relay R485 and a switching relay R490 connected and arranged in a manner more fully described subsequently.

Preferably, each of the sequence switches is identical to the sequence switch 300 individually associated with the link illustrated. The sequence switch 300 is of the rotary type and comprises, as best shown in Fig. 3, six rotary wipers 301, 303, 305, 307, 309 and 301 provided with individually associated rotary contact banks 302, 304, 306, 308, 310 and 312. Also the sequence switch 300 is provided with a rotary magnet M393 for moving the wipers noted in the rotary direction.

The link distributor 301 illustrated in Fig. 3 has access to each of the links in the local exchange 20 and is operative to assign an idle one of the links to the use of any one of the telephone stations in the local exchange 20. The details of the connection and arrangement of the link distributor 301 are not disclosed as they form no part of the present invention. However, for reference purpose, it is noted that the connection and arrangement of a link distributor of the type of the link distributor 301 is shown in the copending application of Edward S. Peterson, Serial No. 233,021, filed October 3, 1938. Also a marking network 280, shown in Fig. 2, is associated with the link distributor 301 in order to initiate operation thereof when a call is initiated on one of the telephone lines extending to a telephone station in the local exchange 20. Also the marking network 280 comprises a busy relay R285 associated with the link distributor 301 and a tone transformer 290 commonly associated with the various line circuits, in a manner more fully described hereinafter.

Preferably, each of the message rate line circuits is identical to the message rate line circuit 200 individually associated with the telephone line 205 extending to the subscriber substation T1, shown in Fig. 2, which comprises a line relay R210, a cutoff relay R220 and a lockout relay

R230 connected and arranged in a manner more fully described subsequently. Also, a signal lamp L213 and a message register provided with an operating magnet M217 is individually associated with the message rate line circuit 200.

Preferably, each of the prepay line circuits is identical to the prepay line circuit 240 individually associated with the telephone line 245 extending to the paystation T2, shown in Fig. 2. The prepay line circuit 240 comprises a line relay R250, a cutoff relay R260 and a lockout relay R270 connected and arranged in a manner more fully described subsequently. Also a signal lamp L268 is individually associated with the prepay line circuit 240.

Preferably, each of the trunk line circuits is identical to the trunk line circuit 405 individually associated with the trunk line 490 extending to the first B operator position 494, shown in Fig. 4, which comprises a line relay R401 and a busy relay R403 connected and arranged in a manner more fully described subsequently.

Preferably, each of the B operator positions in the local exchange 20 is identical to the first B operator position 494, shown in Figs. 4 and 2. The first B operator position 494 comprises conventional answering equipment, not shown; conventional calling equipment including a number of call jacks J201 and J202 respectively terminating the telephone lines 205 and 245; and a number of conventional cord circuits, not shown.

Preferably, each of the A operator positions is substantially identical to the first A operator position 500, shown in Fig. 5, which comprises a trunk circuit provided with a set of position keys including a refund key K565, an error release key K570, an identity key K575, a trunk disconnect key K580 and an A operator position distributor key K590. Also the trunk circuit at the first A operator position 500 comprises telephone apparatus 517 including the usual telephone instrument and repeater, not shown, a retarder coil 530, a key sender K520, and a number of relays including three tone relays R510, R520 and R525, a refund relay R530, a send relay R540, an error relay R535, a disconnect relay R550, an answer relay R545 and a busy relay R560. Also associated with the first A operator position 500 are a peg count meter provided with a register magnet M548 and an identity lamp L553. The key sender K520 is of a well-known type; accordingly, the details of the connection and arrangement thereof are not disclosed as they form no part of the present invention.

As previously noted, the other A operator positions are substantially identical to the first A operator position 500, and the other A operator positions being different from the first A operator position 500 in that they do not include an A operator position distributor key and a busy relay, as only the first A operator position 500 includes this apparatus.

The call storage unit 600, shown in Fig. 6, comprises six marking relays 1M to 6M, inclusive, a control relay R610 and a release relay R620 connected and arranged in a manner more fully described subsequently. Also, six storage lamps L601 to L606, inclusive, are associated with the call storage unit 600 and commonly associated with each of the A operator positions.

Preferably, both the main A operator position distributor 630 and the auxiliary A operator position distributor 695 are identical; the main A operator position distributor 630 comprising,

as shown in Fig. 6, a hold relay R670 and a number of position relays R630, R640, R650, etc., respectively corresponding to the various A operator positions, connected and arranged in a manner more fully described subsequently.

Preferably, each of the identity units is identical to the first identity unit 700 individually associated with the first A operator position 500 which comprises, as shown in Fig. 7, a first test switch 710 individually associated with the first group of one hundred lines accessible to the finder-selector links associated with the first A operator position 500; and a second test switch, not shown, individually associated with the second group of one hundred lines accessible to the finder-selector links associated with the first A operator position 500. The test switch 710 is of the rotary type and comprises six rotary wipers 711, 713, 715, 717, 719 and 721 provided with individually associated rotary contact banks 712, 714, 716, 718, 720 and 722. Also the test switch 710 is provided with a rotary magnet M723 for moving the wipers noted in the rotary direction.

Further, the first identity unit 700 comprises a first start relay R736 and a first stop relay R740 individually associated with the first test switch 710, and a second start relay and a second stop relay, not shown, individually associated with the second test switch. Also the first identity unit 700 includes a test transformer 755, a lockout relay R759, a switching relay R760, five testing relays 12U, 34U, 56U, 78U and 90U and ten marking relays 1D to 10D, inclusive. Finally, the first identity unit 700 comprises a group of identity lamps including a thousand-digit lamp ML1, two hundred-digit lamps CL1 and CL2, ten ten-digit lamps DL1 to DL10, inclusive, and ten unit-digit lamps UL1 to UL10, inclusive. The first identity unit 700 is so connected and arranged that, when the identity key K575 at the first A operator position 500 is operated, the first identity unit 700 operates in a manner more fully described hereinafter, thereby to cause the four of the identity lamps to be illuminated which correspond to the directory number of the line seized by the finder switch of the finder-selector link associated with the first A operator position 500.

A better understanding of the connection and arrangement of the apparatus incorporated in the telephone system will be facilitated from a consideration of the detailed operation of the various pieces of apparatus incorporated therein incident to the completion and handling of the various calls at the first A operator position 500, as will appear hereinafter.

General operation of the system

Considering now the general operation of the system with reference to Fig. 1 of the drawings, it is noted that, when a call is initiated at any one of the subscriber substations or at any one of the paystations in the local exchange 20, the line circuit individually associated with the telephone line extending thereto is controlled, thereby to initiate operation of the link distributor 301. The link distributor 301 is of the preselective type and operates to select an idle one of the links when a previously selected link is assigned to the use of a calling telephone station. Accordingly, the link distributor 301 operates at this time in order to assign a previously selected one of the links, such, for example, as the link illustrated, to the use of the calling tele-

phone station; whereupon the finder switch 300 thereof operates to seize the telephone line extending to the calling telephone station, and operation of the sequence switch 300 individually associated with the link illustrated is initiated. When the finder switch 300 seizes the telephone line extending to the calling telephone station, such, for example, as the telephone line 205 extending to the subscriber substation T1, the link distributor 301 is released and operates to preselect another idle link, as previously noted.

The A operator position distributor 330 preselects one of the idle A operator positions for use; and when a preselected one of the A operator positions is taken for use the A operator position distributor 630 operates to preselect another idle one of the A operator positions for use. Upon operating, the sequence switch 300 seizes the trunk extending to the previously selected A operator position, such, for example, as the trunk 520 extending to the first A operator position 500, thereby to extend the call from the calling subscriber substation T1 to the selected first A operator position 500. The operator at the first A operator position 500 answers the call and then operates the key sender at her position, thereby to control the operation of the selector switch 400 in order to extend the call to its destination. In this connection it is noted that the selector switch 400 may be selectively controlled to extend the call to any idle B operator position in the local exchange 20, to the B operator position 493 in the distant exchange 30 or over a toll line, such, for example, as the toll line 499.

In the event the call is to be routed to a telephone station in the local exchange 20, the selector switch 400 is controlled in order to route the call to an idle B operator position in the local exchange 20. The operator at the idle B operator position in the local exchange 20 answers the call and then extends the call to the called telephone station in the local exchange 20, in the usual manner. In the event the call is to be routed to a telephone station in the distant exchange 30, the selector switch 400 is controlled in order to route the call to the B operator position 493 in the distant exchange 30. The operator at the B operator position 493 in the distant exchange 30 answers the call and then extends the call to the called telephone station in the distant exchange 30, in the usual manner. In the event the call is to be routed toll, the selector switch 400 is controlled in order to route the call to an idle one of the toll lines, such, for example, as the toll line 499. Thereafter the call is further extended over the toll line to its destination in the usual manner.

After the call has been routed from the first A operator position 500 in the local exchange 20 to an idle one of the B operator positions in the local exchange 20, to the B operator position 493 in the distant exchange 30 or over one of the toll lines, and the information concerning the extension of the call has been conveyed to the called operator, the operator at the first A operator position 500 releases the connection between her position and the finder-selector link, whereupon a direct connection is completed between the finder switch and the selector switch of the link excluding the first A operator position 500.

It is not that the called operator at a B operator position in the local exchange 20 or at the B operator position 493 in the distant exchange 30, to which the call is routed by the selector switch

400, may recall the operator at an idle one of the A operator positions in the local exchange 20 by causing the sequence switch 300 individually associated with the link illustrated to seize the trunk extending to the idle A operator position under the control of the A operator position distributor 630, in the manner previously explained.

It is noted that the selector switch 400 comprises apparatus which is so connected and arranged that, when the connection is released, the charge for the call is made automatically. More particularly, in the event the connection includes a telephone line in the local exchange 20 rendered message register service, the message register in the line circuit associated with the telephone line is operated in order to register a call; on the other hand, in the event the connection includes a telephone line in the local exchange 20 rendered prepay service, the coin collect and refund mechanism at the paystation associated with the telephone line is automatically controlled to collect the coin deposited therein. Also the coin collect and refund mechanism at a paystation associated with a line included in a connection may be controlled from the first A operator position 500, thereby to cause it to refund the coin deposited therein.

Also it is noted that, when a connection is routed to the first A operator position 500, the operator thereat may initiate operation of the first identity unit 700, thereby to cause the first identity unit 700 to operate and identify the directory number of the calling telephone line in the local exchange 20 included in the connection, as determined by the operation of the finder switch 300 of the link illustrated to seize the calling telephone line in the local exchange 20.

In the event all of the A operator positions in the local exchange 20 are busy when operation of the sequence switch 300 is initiated, the sequence switch 300 seizes the call storage unit 600. More particularly, the sequence switches individually associated with the links in the local exchange 20 seize the respective positions of the call storage unit 600 in a predetermined order, thereby to cause the calls and recalls to be stored in the call storage unit 600 in a predetermined order when all of the A operator positions in the local exchange 20 are busy. At this time, when a number of calls and recalls on a number of the links are stored in the call storage unit 600 and one of the A operator positions in the local exchange 20 becomes idle, the A operator position distributor 630 operates to assign the idle A operator position for use and causes the call storage unit 600 to initiate operation of the sequence switch corresponding to the first stored call or recall in the call storage unit 600. The sequence switch corresponding to the first stored call or recall in the call storage unit 600 then operates to find the assigned A operator position. The call storage unit 600 then operates to cause each of the remainder of the sequence switches to be advanced one position, thereby to advance, by one position, the calls and recalls stored in the call storage unit 600. Accordingly, the call storage unit 600 operates to cause incoming calls and recalls to be stored in a predetermined order when all of the A operator positions in the local exchange 20 are busy; and causes the stored calls and recalls to be released to be answered at the A operator positions in the same predetermined order as the A operator positions in the local exchange 20 become idle.

After a call from a calling telephone station

has been extended from one of the A operator positions to one of the B operator positions in either the local exchange 20 or the distant exchange 30, the release of the established connection is primarily under the control of the operator at the called operator position. On the other hand, after a call from a calling telephone station has been extended from one of the A operator positions to a toll line, the release of the established connection is under the joint control of the calling telephone station and a toll operator position associated with the toll line.

Message rate subscriber substation call

A call from a message rate subscriber substation, such, for example, as the subscriber substation T1, is initiated by removing the receiver of the telephone instrument thereat from its associated switchhook. When the receiver of the telephone instrument at the subscriber substation T1 is removed from its associated switchhook, a bridge path is completed between the line conductors C206 and C207 of the telephone line 205 extending to the subscriber substation T1. When this bridge path is completed between the line conductors of the telephone line 205, a circuit is completed for energizing in series the upper and lower windings of the line relay R210. This circuit extends from ground by way of the contacts 237, C294, the lower winding of R210, the contacts 222, C207, the bridge path between the line conductors C207 and C206 at the subscriber substation T1, C206, the contacts 221 and the upper winding of R210 to battery. When energized over the above-traced circuit the line relay R210 operates to complete, at the contacts 213, an obvious path for applying ground potential to the control conductor C209 of the telephone line 205 terminating in the jack J201 at the first B operator position 494, thereby to mark the telephone line 205 as busy to the first B operator position 494. Also this application of ground potential to the control conductor C209 of the telephone line 205 marks the telephone line 205 as busy to the other B operator positions in the local exchange 20. Also the line relay R210 completes, at the contacts 212, obvious multiple paths for applying battery potential by way of the resistor 216 and the winding of the cutoff relay R220 to the control conductor C208 of the telephone line 205, thereby to mark the telephone line 205 as a calling line to the finder switches having access thereto. Further the line relay R210 completes, at the contacts 211, a path for applying resistance ground potential to the start conductor C308 extending to the link distributor 301, this path extending from ground by way of the contacts 211 and 231, C283, the resistor 282 and the contacts 288 to the start conductor C308. Also the line relay R210 completes, at the contacts 211, an obvious path for applying direct ground potential by way of the marking conductor C283 to the first contacts in the vertical control contact banks of the finder switches. The application of resistance ground potential to the start conductor C308 initiates operation of the link distributor 301; and the application of direct ground potential to the first contacts in the vertical control contact banks of the finder switches marks the telephone line 205 as terminating in the first level of the main contact banks of the finder switches.

The link distributor 301 is of the preselective type and operates to select another idle link

as soon as the finder switch of a previously selected link operates to find a calling telephone line after it has been taken for use. Assuming that the link distributor 301 has previously selected the link illustrated to be taken for use at this time, the link distributor 301 operates to cause ground potential to be applied to the start conductor C302, thereby to complete an obvious circuit for energizing the winding of the start relay R340 in the finder switch 300 of the link illustrated. The start relay R340 then operates to interrupt, at the contacts 346, a point in a multiple path for applying ground potential to the all-link-busy conductor C309 and to complete, at the contacts 341, an obvious path for applying ground potential to the control conductor C364 of the trunk 360. The previously mentioned path for applying ground potential to the all-link-busy conductor C309 in the finder switch 300 extends, when completed, from ground by way of the contacts 346 and the contacts 358 of the set of switch springs S356 to the all-link-busy conductor C309. Also the start relay R340 prepares, at the contacts 341, obvious multiple circuits for energizing the lower windings of the switching relays R320 and R330, prepares, at the contacts 345, a circuit traced hereinafter for energizing the vertical magnet M365, and prepares, at the contacts 344, a circuit traced hereinafter for energizing the rotary magnet M367.

The link distributor 301 then operates to cause ground potential to be applied to the vertical conductor C305, thereby to complete the previously mentioned circuit for energizing the vertical magnet M365, this circuit extending from the grounded vertical conductor C305 by way of the contacts 345 and the vertical magnet M365 to battery. When energized over the above-traced circuit the vertical magnet M365 operates to drive the first and second wiper sets of the mechanism 310 one step in the vertical direction and to complete, at the contacts 366, an obvious path for applying ground potential to the interrupter conductor C306. The application of ground potential to the interrupter conductor C306 causes the link distributor 301 to interrupt the application of ground potential to the vertical conductor C305; whereupon the vertical magnet M365 restores to interrupt, at the contacts 366, the previously mentioned path for applying ground potential to the interrupter conductor C306. Accordingly, the vertical magnet M365 operates intermittently, thereby to drive the first and second wiper sets of the mechanism 310 step by step in the vertical direction until the control wiper 317 engages a contact in the associated vertical control contact bank having direct ground potential thereon; whereupon an obvious path is completed for applying ground potential to the test conductor C307 extending to the link distributor 301. In the present instance, the first and second wiper sets of the mechanism 310 are driven only one step in the vertical direction; whereupon the vertical control wiper 317 engages the first contact in the associated vertical control contact bank having ground potential thereon. The application of ground potential to the test conductor C307 causes the link distributor 301 to operate, thereby to interrupt the application of ground potential to the vertical conductor C305 and to apply ground potential to the rotary conductor C304.

The application of ground potential to the rotary conductor C304 completes the previously

mentioned circuit for energizing the rotary magnet M367, this circuit extending from the grounded rotary conductor C304 by way of the contacts 344, 338 and 328 and the rotary magnet M367 to battery. When energized over the above-traced circuit the rotary magnet M367 operates to drive the first and second wiper sets of the mechanism 310 one step in the rotary direction and to complete, at the contacts 368, an obvious path for applying ground potential to the interrupter conductor C306. This application of ground potential to the interrupter conductor C306 causes the link distributor 301 to operate and remove the application of ground potential to the rotary conductor C304; whereupon the rotary magnet M367 restores to interrupt, at the contacts 368, the previously mentioned path for applying ground potential to the interrupter conductor C306. Accordingly, the rotary magnet M367 operates intermittently, thereby to drive the first and second wiper sets of the mechanism 310 step by step in the rotary direction until either the control wiper 316 or the control wiper 313 of the respective first and second wiper sets engages a contact terminating the control conductor of a calling telephone line having battery potential thereon.

In the present example, the telephone line 205 is included in the first section of the main contact bank of the mechanism 310. Accordingly, when the control wiper 316 of the first wiper set of the mechanism 310 engages the contact of the contact set in the first section of the main contact bank of the mechanism 310 terminating the control conductor C208 of the telephone line 205, a circuit is completed for energizing the upper winding of the switching relay R330. This circuit extends from the grounded marking conductor C283 by way of the vertical control wiper 317 of the mechanism 310, the upper winding of R330, the contacts 324 and the control wiper 316 of the first wiper set of the mechanism 310 to the control conductor C208 of the telephone line 205, the control conductor C208 of the telephone line 205 having battery potential thereon. When the upper winding of the switching relay R330 is energized this relay operates exceedingly fast to interrupt, at the contacts 338, the previously traced circuit for energizing the rotary magnet M367 and to complete, at the contacts 337, a holding circuit for energizing in series the rotary magnet M367 and the lower winding of the switching relay R330. This holding circuit extends from ground by way of the contacts 341, the lower winding of R330, the contacts 337 and 328 and the rotary magnet M367 to battery. When this holding circuit is completed the rotary magnet M367 remains in its restored position due to the high series resistance of this holding circuit. Accordingly, further operation of the mechanism 310 is arrested. Also the switching relay R330 interrupts, at the contacts 334, a point in an obvious circuit for energizing the upper winding of the switching relay R320, thereby positively to prevent operation of the latter relay at this time. Further the switching relay R330 interrupts, at the contacts 339, a point in a circuit traced hereinafter for energizing the release magnet M369 and completes, at the contacts 336, a connection between the rotary conductor C304 and the guard conductor C303, this connection extending from the rotary conductor C304 by way of the contacts 344, 336 and 342 to the guard conductor C303. When the rotary conductor C304 is connected to the guard conductor C303, 75

operation of the link distributor 301 to control the finder switch 300 is arrested, whereupon the link distributor 301 operates automatically to select for use another idle one of the links.

Also it is noted that, when the carriage of the mechanism 310 is driven one step in the vertical direction, the sets of switch springs S352 and C356 are actuated. More particularly, the contacts 357 and 358 of the set of switch springs S356 are actuated respectively into engagement and disengagement, thereby to prepare a further point in the previously mentioned circuit for energizing the release magnet M369 and to interrupt a further point in the previously traced path for applying ground potential in the finder switch 300 to the all-link-busy conductor C309. Finally, the contacts 354 and 353 of the set of switch springs S352 are actuated respectively into disengagement and engagement, thereby to interrupt the connection between the control conductor C364 of the trunk 360 and the guard conductor C303 and to prepare a path traced hereinafter for applying ground potential to the guard conductor C303. Finally, upon operating, the switching relay R330 completes, at the contacts 331, 332 and 333, connections between the conductors of the trunk 360 extending between the finder switch 300 and the selector switch 400 and the first wiper set of the mechanism 310. More particularly, a circuit is completed, at the contacts 333, for energizing the winding of the cutoff relay R220, this circuit extending from the grounded control conductor C364 of the trunk 360 by way of the contacts 373, 362, 333 and 324, the wiper 316, the control conductor C208 of the telephone line 205, the contacts 212 and 236 and the winding of R220 to battery. When the winding of the cutoff relay R220 is thus energized this relay operates to interrupt, at the contacts 225, the previously mentioned path for applying battery potential by way of the resistor 216 to the control conductor C208 of the telephone line 205 and to complete, at the contacts 224, a holding circuit for energizing the winding of the cutoff relay R220, this holding circuit extending from the grounded control conductor C208 of the telephone line 205 by way of the contacts 224 and the winding of R220 to battery. Also the cutoff relay R220 interrupts, at the contacts 226, a point in an obvious circuit for illuminating the signal lamp L218 and completes, at the contacts 223, an obvious circuit for energizing the winding of the lockout relay R230, thereby to cause the latter relay to operate. Finally, the cutoff relay R220 interrupts, at the contacts 221 and 222, the previously traced circuit for energizing the winding of the line relay R210, thereby to clear the telephone line 205 of impedance elements and to cause the latter relay to restore.

Upon operating, the lockout relay R230 prepares, at the contacts 232, a point in a holding circuit traced hereinafter for energizing the winding thereof, completes, at the contacts 233, an obvious alternative path for applying ground potential to the control conductor C208 of the telephone line 205, thereby to mark the telephone line 205 as busy to the B operator positions in the local exchange 20 having access thereto, and prepares, at the contacts 235, a further point in the previously mentioned circuit for illuminating the signal lamp L218. Upon restoring, the line relay R210 interrupts, at the contacts 211, the previously traced paths for applying direct ground potential to the marking conductor C263 and

resistance ground potential to the start conductor C303 extending to the link distributor 301.

Further it is noted that the link distributor 301 operates in order to select another idle link for use only in the event ground potential appears upon the all-link-busy conductor C309 in the finder switch of at least one of the links, ground potential being removed from the all-link-busy conductor C309 in the finder switch 300 of the link illustrated at this time, due to the operated condition of the set of switch springs S356, as previously noted. Also, at this time, ground potential is applied to the guard conductor C303 in the finder switch 300, thereby to prevent the link distributor 301 from preselecting the link illustrated due to the busy condition of this link. The path for applying ground potential in the finder switch 300 to the guard conductor C303 extends from ground by way of the contacts 353 of the set of switch springs S352 and the contacts 343 to the guard conductor C303, the start relay R340 being restored at this time. Further it is noted that the start relay R340 is of the slow-to-release type and restores shortly after the link distributor 301 is released. Upon restoring, the start relay R340 interrupts, at the contacts 341, the previously traced path for applying ground potential to the control conductor C364 of the trunk 360, ground potential being applied to the control conductor C364 of the trunk 360 in the selector switch 400 at this time. Further the start relay R340 interrupts, at the contacts 344 and 345, additional points in the previously traced circuits for respectively energizing the rotary magnet M367 and the vertical magnet M355. However, the previously traced holding circuit for energizing the rotary magnet M367 and the lower winding of the switching relay R330 in series is retained completed, due to the presence of ground potential upon the control conductor C364 of the trunk 360 in the selector switch 400 at this time.

When the trunk 360 is connected to the telephone line 205 due to the operation of the switching relay R330 in the finder switch 300, a loop circuit is completed for energizing in series the upper and lower windings of the line relay R450 in the selector switch 400. This circuit extends from ground by way of the lower winding of R450, the contacts 466, 433 and 423, C362, the contacts 376 and 332, and the wiper 315 to the line conductor C207 of the telephone line 205, and from battery by way of the upper winding of R450, the contacts 463, 431 and 426, C361, the contacts 373 and 331 and the wiper 314 to the line conductor C206 of the telephone line 205, the line conductors C206 and C207 of the telephone line 205 being connected together by way of the bridge path at the subscriber substation T1. When the upper and lower windings of the line relay R450 are thus energized this relay operates to complete, at the contacts 453 and 451, an obvious circuit for energizing the winding of the hold relay R480, thereby to cause the latter relay to operate. Upon operating, the hold relay R480 completes, at the contacts 483, the previously mentioned path for applying ground potential to the control conductor C364 of the trunk 360, as previously noted. Also the hold relay R480 completes, at the contacts 481, an obvious circuit for energizing the upper winding of the switching relay R490, thereby to render the latter relay exceedingly fast to operate when the lower winding thereof is subsequently energized. Further the hold relay R480 prepares, at the contacts 432, a point in a circuit traced hereinafter for energiz-

ing the lower winding of the switching relay R490 and prepares, at the contacts 484, a circuit traced hereinafter for energizing in multiple the lower winding of the transfer relay R485 and the vertical magnet M414.

When ground potential is applied to the control conductor C364 of the trunk 360 an obvious circuit is completed for energizing the upper winding of the transfer relay R485, thereby to cause the latter relay to operate. Upon operating, the transfer relay R485 prepares, at the contacts 483, a further point in the previously mentioned circuit for energizing in multiple the lower winding of the transfer relay R485 and the vertical magnet M414 and completes, at the contacts 486, an obvious path for applying ground potential to the control conductor C363 of the trunk 360. This application of ground potential to the control conductor C363 of the trunk 360 prepares a circuit traced hereinafter for energizing the winding of the stop relay R350 in the finder switch 300 and completes a circuit for energizing the winding of the rotary magnet M393 of the sequence switch 380. The circuit for energizing the rotary magnet M393 of the sequence switch 380 extends from the grounded control conductor C363 of the trunk 360 by way of the contacts 351 and 379, the conductor C327 in the cable 320, the contacts 394 and the rotary magnet M393 to battery. When thus energized the rotary magnet M393 operates to condition the wipers noted of the sequence switch 380 to be driven one step in the clockwise direction and to interrupt, at the contacts 394, the previously traced circuit for energizing the rotary magnet M393; whereupon the rotary magnet M393 restores to drive the wipers noted of the sequence switch 380 one step in the clockwise direction and to recomplete, at the contacts 394, the previously traced circuit for energizing the rotary magnet M393. Accordingly, the rotary magnet M393 operates intermittently, thereby to drive the wipers noted of the sequence switch 380 step by step in the clockwise direction until the stop relay R350 is operated in a manner more fully described hereinafter to interrupt, at the contacts 351, the previously traced circuit for energizing the rotary magnet M393.

At this point it is noted that, immediately the link distributor 301 assigns the link illustrated to the use of the calling subscriber substation T1, operations of the finder switch 300 and the selector switch 400, previously described, are initiated, and that the operation of the selector switch 400 initiates operation of the sequence switch 380 individually associated with the link illustrated. Accordingly, operation of the sequence switch 380 to find an assigned one of the A operator positions or to find a storage position in the call storage unit 600 is initiated prior to the seizure of the telephone line 205 extending to the calling subscriber substation T1 by the finder switch 300.

Prior to continuing with the operation of the sequence switch 380, it is noted that the A operator position distributor in use, the main A operator position distributor 630 in the present example, is operative to preselect an idle one of the A operator positions to be seized by the sequence switch 380. Assuming that the first A operator position 500 has been preselected by the main A operator position distributor 630 to be seized by the sequence switch 380 at this time, a holding circuit is completed for energizing in series the winding of the hold relay R670 and

the right-hand winding of the position relay R630, the position relay R630 corresponding to the first A operator position 500. This holding circuit extends from ground by way of the contacts 551, C501, the contacts 594 of the A operator position distributor key K590, C633, the winding of R670, the contacts 646 and 634 and the right-hand winding of R630 to battery. The operated position relay R630 retains interrupted, at the contacts 636, a holding circuit traced hereinafter for energizing the winding of the hold relay R670 in series with the right-hand winding of the position relay R650. Also the position relay R630 prepares, at the contacts 633, an operating circuit traced hereinafter for energizing the left-hand winding of the position relay R640, completes, at the contacts 632, a path for applying battery potential by way of the resistor 612, C682, the winding of the answer relay R545 and the contacts 559 to the control conductor C525 of the trunk 520 extending to the first A operator position 500 and completes, at the contacts 631, a path for applying ground potential to the control conductor C680, for a purpose more fully described hereinafter. The path for applying ground potential to the control conductor C680 extends from ground by way of the contacts 546, C686, the contacts 631, C685 and the contacts 592 of the A operator position distributor key K590 to the control conductor C680. Further it is noted that no potential whatever appears upon the marking conductor C530 to C535, inclusive; while battery potential appears upon the marking conductor C536. The path for applying battery potential to the marking conductor C536 extends from battery by way of the winding of the first marking relay 1M and the contacts 621 to the marking conductor C536.

Continuing now with the operation of the sequence switch 380, the rotary magnet M393 continues to operate intermittently in order to drive the wipers noted of the sequence switch 380 step by step in the clockwise direction until the wiper 391 engages the seventh contact in the associated contact bank 392 terminating the marking conductor C536; whereupon a circuit is completed for energizing in series the winding of the stop relay R350 and the winding of the marking relay 1M. This circuit extends from the grounded control conductor C363 of the trunk 360 by way of the winding of R350, the contacts 377, the control conductor C325 in the cable 320, the wiper 391 and engaged seventh contact in the associated contact bank 392 of the sequence switch 380, the marking conductor C536, the contacts 621 and the winding of 1M to battery. When the winding of the stop relay R350 is thus energized this relay operates to interrupt, at the contacts 351, the previously traced circuit for energizing the rotary magnet M393, thereby positively to arrest further operation of the sequence switch 380.

When the winding of the marking relay 1M is thus energized this relay operates shortly thereafter, this relay being of the slow-to-operate type, to complete, at the contacts 1M2, a circuit for energizing the winding of the release relay R620, this circuit extending from the grounded control conductor C680 by way of the contacts 1M2 and the winding of R620 to battery. When thus energized the release relay R620 operates to complete, at the contacts 622, an obvious holding circuit for energizing the winding thereof by way of the grounded control conductor C680.

Also the release relay R620 completes, at the contacts 623, an obvious circuit for energizing the winding of the control relay R610, thereby to cause the latter relay to operate shortly thereafter, the latter relay being of the slow-to-operate type. Further the release relay R620 interrupts, at the contacts 621, the previously traced circuit for energizing in series the winding of the stop relay R350 and the winding of the marking relay 1M. Upon operating, the control relay R610 completes, at the contacts 611, an obvious path for applying battery potential by way of the winding of the marking relay 1M to the marking conductor C536.

Accordingly, the marking relay 1M and the stop relay R350 restore when the previously traced circuit for energizing in series the windings thereof is interrupted incident to the operation of the release relay R620. Upon restoring, the stop relay R350 completes, at the contacts 351, the previously traced circuit for energizing the rotary magnet M393 of the sequence switch 380, thereby to cause the rotary magnet M393 again to operate intermittently. In the present instance, the rotary magnet M393 operates and restores only once; whereupon the wiper 391 thereof engages the eighth contact in the associated contact bank 392 of the sequence switch 380 terminating the control conductor C525 of the trunk 520, thereby to complete a series circuit for energizing the winding of the answer relay R545 and the winding of the stop relay R350. This circuit extends from the grounded control conductor C363 of the trunk 360 by way of the winding of R350, the contacts 377, the control conductor C325 in the cable 320, the wiper 391 and engaged eighth contact in the associated contact bank 392 of the sequence switch 380, the control conductor C525 of the trunk 520, the contacts 559, the winding of R545, C682, the contacts 632 and the resistor 612 to battery. When this series circuit is completed the windings of the stop relay R350 and the answer relay R545 are energized, thereby to cause these relays to operate. Upon operating, the stop relay R350 again interrupts, at the contacts 351, the previously traced circuit for energizing the rotary magnet M393 of the sequence switch 380, thereby again to arrest operation of the sequence switch 380. Upon operating, the answer relay R545 interrupts, at the contacts 546, the previously traced holding circuit for energizing the winding of the release relay R620, thereby to cause the latter relay to restore and interrupt, at the contacts 623, the previously mentioned circuit for energizing the winding of the control relay R610, thereby to cause the latter relay to restore. Also the answer relay R545 completes, at the contacts 547, an obvious circuit for energizing the winding of the disconnect relay R550, thereby to cause the latter relay to operate.

Upon operating, the disconnect relay R550 completes, at the contacts 552', a holding circuit for energizing the winding thereof, this circuit extending from ground by way of the contacts 551 of the trunk disconnect key K590, the contacts 552' and the winding of R550 to battery. Also the disconnect relay R550 interrupts, at the contacts 559, the previously traced circuit for energizing in series the winding of the stop relay R350 and the winding of the answer relay R545 and completes, at the contacts 557, a circuit for energizing the winding of the cut-in relay R370, this circuit extending from ground by way of the contacts 557, the control conductor C526 of the

trunk 520, the wiper 381 and engaged contact in the associated contact bank 382 of the sequence switch 380, the control conductor C326 in the cable 320 and the winding of R370 to battery. When thus energized the cut-in relay R370 operates to interrupt, at the contacts 377, a further point in the previously traced series circuit for energizing the winding of the stop relay R350 and the winding of the answer relay R545, to prepare, at the contacts 378, a circuit traced hereinafter for energizing the winding of the identity relay R360 and to interrupt, at the contacts 379, a further point in the previously traced circuit for energizing the rotary magnet M393 of the sequence switch 380. The stop relay R350 and the answer relay R545 then restore. Accordingly, at this time, the wipers noted of the sequence switch 380 engage the contacts in the associated contact banks thereof terminating the conductors of the trunk 520 extending to the first A operator position 500.

Further, the disconnect relay R550 interrupts, at the contacts 553, an obvious connection between the line conductors C521 and C523 of the trunk 520, interrupts, at the contacts 555, an obvious connection between the line conductors C522 and C524 of the trunk 520, completes, at the contacts 551 and 552, a connection between the conductors C521 and C523 of the trunk 520 and the retarder coil 530 and the telephone apparatus 517 at the first A operator position 500, and completes, at the contacts 554 and 555, a connection between the line conductors C522 and C524 of the trunk 520 and the retarder coil 530 and the telephone apparatus 517 at the first A operator position 500. Accordingly, at this time, one terminal of the retarder coil 530 is connected by way of the contacts 531 and 551 and by way of the contacts 542, 537 and 554 to the line conductors C521 and C522, respectively, of the trunk 520; and the other terminal of the retarder coil 530 is connected by way of the contacts 533 and 552 and by way of the contacts 544, 538 and 555 to the line conductors C523 and C524, respectively, of the trunk 520. Also the telephone apparatus 517 at the first A operator position 500 is connected by way of the contacts 511 and 513 across the terminals of the retarder coil 530.

Upon operating, the cut-in relay R370 completes, at the contacts 372 and 375, an alternative loop circuit extending between the retarder coil 530 at the first A operator position 500 and the line relay R450 in the selector switch 400, this circuit extending from ground by way of the lower winding of R450, the contacts 466, 433 and 428, C362, the contacts 375, the line conductor C324 in the cable 320 and the wiper 385 and engaged contact in the associated contact bank 386 of the sequence switch 380 to the line conductor C524 of the trunk 520, and from battery by way of the upper winding of R450, the contacts 463, 431 and 426, C361, the contacts 372, the line conductor C322 in the cable 320 and the wiper 389 and engaged contact in the associated contact bank 390 of the sequence switch 380 to the line conductor C522 of the trunk 520, the line conductors C522 and C524 of the trunk 520 being connected together by way of the previously traced path including the retarder coil 530. Also the cut-in relay R570 completes, at the contacts 371 and 374, a connection between the subscriber substation T1 and the line conductors C521 and C523 of the trunk 520. More particularly, the line conductor C206 of the telephone line 205 is connected by way of the wiper 314, the contacts

331 and 371, the line conductor C321 in the cable 320, and the wiper 387 and engaged contact in the associated contact bank 388 of the sequence switch 380 to the line conductor C521 of the trunk 520; while the line conductor C207 of the telephone line 205 is connected by way of the wiper 315, the contacts 332 and 374, the line conductor C323 in the cable 320 and the wiper 383 and engaged contact in the associated contact bank 384 of the sequence switch 380 to the line conductor C523 of the trunk 520. Finally, it is noted that a bridge at the subscriber substation T1 is connected across the line conductors C206 and C207 of the telephone line 205; while the line conductors C521 and C523 of the trunk 520 are connected to the retarder coil 530. Accordingly, at this time, a direct loop circuit is completed between the retarder coil 530 at the first A operator position 500 and the line relay R450 in the selector switch 400; while an alternative loop circuit is completed between the subscriber substation T1 and the line relay R450 in the selector switch 400 which includes the trunk circuit at the first A operator position 500. Also when the telephone apparatus 517 at the first A operator position 500 is bridged across the retarder coil 530 a connection is completed between the calling subscriber substation T1 and the telephone apparatus 517.

Further the cut-in relay R370 interrupts, at the contacts 373 and 376, the previously traced direct loop circuit between the subscriber substation T1 and the line relay R450 in the selector switch 400, interrupts, at the contacts 370, a point in a holding circuit traced hereinafter for energizing the winding of the call back relay R440 in the selector switch 400, and interrupts, at the contacts 371', a point in a circuit traced hereinafter for energizing the winding of the coin and register relay R430 in the selector switch 400. Finally the cut-in relay R370 completes, at the contacts 372', an obvious alternative holding circuit for energizing in series the lower winding of the switching relay R330 and the rotary magnet M367, and interrupts, at the contacts 373', the previously traced original holding circuit for energizing in series the lower winding of the switching relay R330 and the rotary magnet M367. Accordingly, the operated cut-in relay R370 retains the switching relay R330 in its operated position independent of the selector switch 400, thereby to retain the finder switch 300 in its operated position independent of the selector switch 400.

Also, upon operating, the disconnect relay R550 completes, at the contacts 551', a circuit for energizing the winding of the tone relay R510, this circuit extending from ground by way of the contacts 551' and 528 and the winding of R510 to battery. When the winding of the tone relay R510 is thus energized this relay operates shortly thereafter, this relay being of the slow-to-operate type, to complete, at the contacts 515, an obvious circuit for energizing the winding of the tone relay R520. When thus energized the tone relay R520 operates shortly thereafter, this relay being of the slow-to-operate type, to complete, at the contacts 523, an obvious circuit for energizing the winding of the tone relay R525. When thus energized the tone relay R525 operates shortly thereafter, this relay being of the slow-to-operate type, to complete, at the contacts 527, an obvious holding circuit for energizing the winding thereof and to interrupt, at the contacts 528, the previously traced circuit for

energizing the winding of the tone relay R510. The tone relay R510 then restores to interrupt, at the contacts 515, the previously mentioned circuit for energizing the winding of the tone relay R520, thereby to cause the latter relay to restore.

Upon operating, the tone relay R510 interrupts, at the contacts 511 and 513, the previously traced connection between the telephone apparatus 517 and the retarder coil 530 and completes, at the contacts 512 and 514, a circuit for conducting tone current over the telephone apparatus 517. The last-mentioned circuit extends from the ungrounded terminal of a grounded source of tone current, not shown, by way of the tone conductor C587, the contacts 522 and 512, the telephone apparatus 517, the contacts 514 and the condenser 516 to ground. Upon operating, the tone relay R520 interrupts, at the contacts 522, the previously traced circuit for conducting tone current over the telephone apparatus 517 and prepares, at the contacts 521, an alternative circuit for conducting tone current over the telephone apparatus 517. Upon operating, the tone relay R525 completes, at the contacts 526, the previously mentioned alternative circuit for conducting tone current over the telephone apparatus 517, this alternative circuit extending from tone potential appearing upon the tone conductor C587 by way of the contacts 526, 521 and 512, the telephone apparatus 517, the contacts 514 and the condenser 516 to ground. Upon restoring, the tone relay R510 interrupts, at the contacts 512 and 514, the previously traced alternative circuit for conducting tone current over the telephone apparatus 517 and re-completes, at the contacts 511 and 513, the previously traced connection between the telephone apparatus 517 and the retarder coil 530. Finally, upon restoring, the tone relay R520 interrupts, at the contacts 521, a further point in the previously traced alternative circuit for conducting tone current over the telephone apparatus 517 and prepares, at the contacts 522, the previously traced original circuit for conducting tone current over the telephone apparatus 517. The operation of the tone relays R510, R520 and R525 and the subsequent restoration of the tone relays R510 and R520 is effective to cause the receiver of the telephone instrument included in the telephone apparatus 517 to be operated alternately, whereupon a distinct zip-zip tone is produced thereby. The production of the zip-zip tone by the receiver of the telephone instrument included in the telephone apparatus 517 at the first A operator position 500 indicates to the operator thereat that an incoming call has been extended to her position by one of the sequence switches.

Further, upon operating, the disconnect relay R550 prepares, at the contacts 553', a point in chain circuit traced hereinafter for energizing the winding of the busy relay R560, which chain circuit is completed in the event all of the A operator positions are busy at this time, in a manner more fully explained hereinafter. Finally, the disconnect relay R550 completes, at the contacts 558, the previously mentioned circuit for energizing the left-hand winding of the position relay R640 corresponding to the second A operator position, this circuit extending from ground by way of the contacts 558, C631, the contacts 633 and the left-hand winding of R640 to battery. When thus energized, the position

relay R640 operates to complete, at the contacts 644, a holding circuit for energizing in series the winding of the hold relay R670 and the right-hand winding of the position relay R640, this circuit extending from ground by way of the contacts 561, C501, the contacts 594 of the A operator position distributor key K590, C683, the winding of R670, the contacts 656 and 644 and the right-hand winding of R640 to battery. Also the position relay R640 interrupts, at the contacts 646, the previously traced holding circuit for energizing in series the winding of the hold relay R670 and the right-hand winding of the position relay R630, thereby to cause the latter relay to restore. Further the position relay R640 prepares, at the contacts 643, an obvious circuit for energizing the left-hand winding of the position relay R650 corresponding to the last A operator position, completes, at the contacts 642, an obvious path for applying battery potential to the control conductor C671 extending to the second A operator position and corresponding to the control conductor C682 extending to the first A operator position 500 and completes, at the contacts 641, an obvious path for applying ground potential at the second A operator position to the control conductor C680, in a manner similar to that previously explained.

Accordingly, the operation of the position relay R640 in the main A operator position distributor 630 is effective to prepare the second A operator position to receive the next incoming call in the event the second A operator position is idle at this time. On the other hand, in the event the second A operator position is busy at this time, the previously mentioned circuit for energizing the left-hand winding of the position relay R650 is completed at the contacts 643 incident to the operation of the position relay R640, the disconnect relay at the second A operator position being operated at this time. Further it is noted that, upon restoring, the position relay R630 interrupts, at the contacts 634, a further point in the previously traced holding circuit for energizing in series the winding of the hold relay R670 and the right-hand winding of the position relay R630. Also the position relay R630 interrupts, at the contacts 633, the previously traced circuit for energizing the left-hand winding of the position relay R640, interrupts, at the contacts 632, a further point in the previously traced circuit for energizing the winding of the answer relay R545 and interrupts, at the contacts 631, the previously traced original circuit for applying ground potential at the first A operator position 500 to the control conductor C680.

At this point it is noted that the main A operator position distributor 630 is operated, thereby to cause one of the position relays to operate and condition a corresponding one of the A operator positions to receive the next incoming call, such, for example, as the second A operator position, only in the event one of the A operator positions is idle at this time. More particularly, in the event all of the A operator positions are busy when the disconnect relay R550 is operated, the previously mentioned chain circuit for energizing the winding of the busy relay R560 is completed at the contacts 553' incident to the operation of the disconnect relay R550. This circuit extends from ground by way of the chain conductor C549, the contacts of the disconnect relays at the other A operator positions, the contacts 553' of the disconnect relay R550 at

the first A operator position 500 and the winding of R560 to battery. When thus energized the busy relay R560 operates to interrupt, at the contacts 561, the previously traced holding circuit for energizing the winding of the hold relay R670 in series with the right-hand winding of one of the position relays R630, R640, R650, etc., thereby to cause the hold relay R670 to restore and all of the position relays R630, R640, R650, etc., to remain in their restored positions. Also, upon operating, the busy relay R560 interrupts, at the contacts 562, a point in an alternative circuit for energizing the left-hand winding of the position relay R630. Upon restoring, the hold relay R670 prepares, at the contacts 671, a point in the previously mentioned alternative circuit for energizing the left-hand winding of the position relay R630. Accordingly, the operation of the busy relay R560 is effective to prevent further operation of the main A operator position distributor 630 until one of the A operator positions becomes idle.

When one of the A operator positions becomes idle the disconnect relay thereat is restored, thereby to interrupt the previously traced circuit for energizing the winding of the busy relay R560, whereupon the latter relay restores. Upon restoring, the busy relay R560 prepares, at the contacts 561, the previously traced holding circuit for energizing the winding of the hold relay R670 in series with one of the position relays R630, R640, R650, etc., and completes, at the contacts 562, the previously mentioned alternative circuit for energizing the left-hand winding of the position relay R630, this circuit extending from ground by way of the contacts 562, C502, the contacts 595 of the A operator position distributor key K590, C684, the contacts 671 and the left-hand winding of R630 to battery. When this circuit is completed the position relay R630 operates, thereby to initiate further operation of the main A operator position distributor 630; whereupon the main A operator position distributor 630 operates in order to cause the particular one of the position relays R630, R640, R650, etc., to remain operated, which corresponds to the idle A operator position, thereby to condition the idle A operator position to receive the next incoming call.

Further it is noted that the operation of the auxiliary A operator position distributor 695 is the same as the main A operator position distributor 630, previously explained. In the event the main A operator position distributor 630 becomes defective, the operator at the first A operator position 500 may substitute the auxiliary A operator position distributor 695 for the main A operator position distributor 630 by operating the A operator position distributor key K590. When the A operator position distributor key K590 is thus operated the previously traced connections between the control conductors C684, C683 and C685 extending to the main A operator position distributor 630 and the common control conductors C502, C501 and C680 are respectively interrupted at the contacts 595, 594 and 592 of the A operator position distributor key K590; and obvious alternative connections are completed, at the contacts 596, 593 and 591 of the A operator position distributor key K590, between the common control conductors C502, C501 and C680 and the control conductors C693, C692 and C691, respectively, extending to the auxiliary A operator position distributor 695.

Accordingly, at this time, after the sequence

switch 380 seizes the trunk 520 extending to the first A operator position 500 and both the apparatus at the first A operator position 500 and the main A operator position distributor 630 operate in the manner previously explained, a connection is established between the calling subscriber substation T1 and the telephone apparatus 517 at the first A operator position 500 and the second A operator position is conditioned to receive the next incoming call. More particularly, both the receiver and the transmitter at the telephone instrument included in the telephone apparatus 517 are operatively connected to the subscriber substation T1. Accordingly, the operator at the first A operator position 500 may converse with the subscriber at the calling subscriber substation T1 and ascertain the destination of the call. After learning the destination of the call, the operator at the first A operator position 500 initiates the extension of the call by operating the key sender K520 in order appropriately to control the selector switch 400 in a manner more fully described hereinafter.

Paystation call

A call from a paystation, such, for example, as the paystation T2, is initiated by removing the receiver of the telephone instrument thereat from its associated switchhook and depositing a coin in the coin slot of the coin collect and refund mechanism thereat. When the receiver of the telephone instrument at the paystation T2 is removed from its switchhook and the coin is deposited in the coin slot of the coin collect and refund mechanism thereat, a bridge path is completed between the line conductors C246 and C247 of the telephone line 245 extending to the paystation T2, thereby to complete a circuit for energizing in series the upper and lower windings of the line relay R250. This circuit extends from ground by way of the contacts 287, C294, the lower winding of R250, the contacts 262, C247, the bridge path between the line conductors C247 and C246 of the telephone line 245 at the paystation T2, C246, the contacts 261 and the upper winding of R250 to battery. When energized over the above-traced circuit the line relay R250 operates to complete, at the contacts 253, a path for applying ground potential to the control conductor C249 of the telephone line 245, thereby to mark the telephone line 245 as busy to the first B operator position 494 and the other B operator positions in the local exchange 20. The last-mentioned path extends from ground by way of the contacts 287, C294 and the contacts 253 and 274 to the control conductor C249 of the telephone line 245. Also the line relay R250 completes, at the contacts 252, an obvious multiple path for applying battery potential by way of the winding of the cutoff relay R260 and the resistor 267 to the control conductor C248 of the telephone line 245, thereby to mark the telephone line 245 as a calling line. Further the line relay R250 completes, at the contacts 251, an obvious path for applying direct ground potential to the marking conductor C284 terminated by the fifth contacts in the vertical control contact banks of the finder switches, thereby to mark the telephone line 245 as terminating in the fifth level of the main contact banks of the finder switches. Finally, the line relay R250 completes, the contacts 251, a path for applying resistance ground potential to the start conductor C308 extending to the link distributor 301, this path extending from ground by way of

the contacts 251 and 271, C284, the resistor 281 and the contacts 288 to the start conductor C308. The application of ground potential to the start conductor C308 initiates operation of the link distributor 301 in the manner previously explained.

The link distributor 301 then operates to cause the previously selected link to be assigned to the use of the calling paystation T2 in the previously described manner. Assuming that the link distributor 301 operates to assign the link illustrated to the use of the calling paystation T2, the finder switch 300 operates in the manner previously explained to seize the telephone line 245 extending to the calling paystation T2. Also the selector switch 400 and the sequence switch 380 operate in the manners previously described. Assuming that the main A operator position distributor 630 has previously selected the first A operator position 500 at this time, the sequence switch 380 operates to seize the trunk 520 extending to the first A operator position 500 in the manner previously explained.

When the first A operator position 500 is seized by the sequence switch 380 the cut-in relay R370 operates in order to complete, at the contacts 372 and 375, the previously traced loop circuit between the line relay R450 in the selector switch 400 and the retarder coil 530 at the first A operator position 500, and to complete, at the contacts 371 and 374, a loop circuit between the calling paystation T2 and the retarder coil 530 at the first A operator position 500. The last-mentioned loop circuit extends from the line conductor C246 of the telephone line 245 by way of the wiper 314, the contacts 331 and 371, the line conductor C321 in the cable 320, the wiper 387 and engaged contact in the associated contact bank 388 of the sequence switch 380, the line conductor C521 of the trunk 520, the contacts 551 and 531, the retarder coil 530, the contacts 533 and 552, the line conductor C523 of the trunk 520, the wiper 333 and engaged contact in the associated contact bank 384 of the sequence switch 380, the line conductor C323 in the cable 320, the contacts 374 and 332 and the wiper 315 to the line conductor C247 of the telephone line 245, the line conductors C246 and C247 of the telephone line 245 being connected together by way of the bridge path at the calling paystation T2.

Also, when the finder switch 300 seizes the telephone line 245, direct ground potential is applied by way of the wiper 316 to the control conductor C248 of the telephone line 245, thereby to complete a circuit for energizing the winding of the cutoff relay R260, this circuit extending from the grounded control conductor C248 of the telephone line 245 by way of the contacts 252 and 276 and the winding of R260 to battery. When thus energized the cutoff relay R260 operates to complete, at the contacts 264, an obvious holding circuit for energizing the winding thereof by way of the control conductor C248 of the telephone line 245, to interrupt, at the contacts 265, the previously traced path for applying battery potential by way of the resistor 267 to the control conductor C248 of the telephone line 245, and to interrupt, at the contacts 266, a point in a circuit traced hereinafter for illuminating the signal lamp L268. Also the cutoff relay R260 completes, at the contacts 263, an obvious circuit for energizing the winding of the lockout relay R270, thereby to cause the latter relay to operate. Finally the cutoff relay R260 interrupts, at 75

the contacts 261 and 262, the previously traced circuit for energizing in series the upper and lower windings of the line relay R250, thereby to cause the latter relay to restore and free the telephone line 245 of impedance elements. Upon restoring, the line relay R250 interrupts, at the contacts 251, the previously mentioned path for applying direct ground potential to the marking conductor C284 and the previously traced path for applying resistance ground potential to the start conductor C308 in order to remove the marking from the telephone line 245 and to arrest further operation of the link distributor 301. Upon operating, the lockout relay R270 prepares, at the contacts 272, a point in a holding circuit traced hereinafter for energizing the winding thereof and completes, at the contacts 273, an obvious alternative path for applying ground potential to the control conductor C249 of the telephone line 245, thereby to mark the telephone line 245 as busy to the B operator positions in the local exchange 20 having access thereto. Finally, the lockout relay R270 prepares, at the contacts 275, a further point in the previously mentioned circuit for illuminating the signal lamp L268.

The operator at the first A operator position 500 then answers the call and is advised concerning the extension of the call by the subscriber at the calling paystation T2. After learning the destination of the call the operator at the first A operator position 500 initiates the extension of the call by operating the key sender K520 in order appropriately to control the selector switch 400, in a manner more fully described hereinafter.

Initiation of a call when all of the links are busy

As previously explained, when an assigned link, such, for example, as the link illustrated, is taken for use the finder switch thereof is operated in order to seize the calling telephone line and to cause ground potential therein to be removed from the all-link-busy conductor C309. Accordingly, when all of the links associated with the link distributor 301 are busy, ground potential is removed from the all-link-busy conductor C309, thereby to interrupt the obvious, normally completed, circuit for energizing the winding of the busy relay R285 in the marking network 280, whereupon the latter relay restores. Upon restoring, the busy relay R285 interrupts, at the contacts 287, an obvious path for applying ground potential to the control conductor C294 and an obvious path for short-circuiting the secondary winding 292 of the tone transformer 290, the primary winding 291 of the tone transformer 290 being connected to a suitable tone current, not shown. Hence, at this time, ground potential is removed from the control conductor C294 and tone potential appears thereon. Also, upon restoring, the busy relay R285 interrupts, at the contacts 288, a point in the previously traced path for applying resistance ground potential to the start conductor C308 extending to the link distributor 301.

In the event a call is initiated at any one of the subscriber substations or paystations at this time, a circuit is completed for projecting busy tone current to the subscriber substation or paystation over the associated telephone line. For example, in the event a call is initiated at the subscriber substation T1 at this time, a circuit is completed for projecting busy tone current over the telephone line 205 to the subscriber substa-

tion T1, this circuit extending from ground by way of the secondary winding 292 of the tone transformer 290, C294, the lower winding of R210, the contacts 222, C207, the bridge path at the subscriber substation T1 between the line conductors C207 and C296 of the telephone line 205, C206, the contacts 221 and the upper winding of R210 to battery. The tone current traversing the above-traced circuit operates the receiver of the telephone instrument at the subscriber substation T1, thereby to indicate to the subscriber thereat that all of the links are busy and that the connection may not be extended at this time. Accordingly, the subscriber at the subscriber substation T1 replaces the receiver of the telephone instrument thereat upon its associated switch-hook and again initiates the call after the lapse of a suitable time interval.

In view of the above explanation of the mode of operation of the marking network 280, it will be understood that, in the event a call is initiated at any of the other subscriber substations or at any of the paystations at this time, tone current will be projected over the associated telephone line to the subscriber substation or paystation, thereby to indicate to the subscriber thereat that all of the links are busy.

At this point it is noted that the operation of the finder switch of any one of the links, such, for example, as the finder switch 300 of the link illustrated, to seize a calling telephone line in the second group of one hundred lines is substantially identical to the operation thereof to seize a calling telephone line in the first group of one hundred lines, as previously explained. More particularly, it is noted that the finder switch 300 is operative to seize a calling telephone line in the first group of one hundred lines by way of the first wiper set, including the wipers 314, 315 and 316, whereupon the switching relay R330 operates to switch the seized line through to the selector switch 400. Similarly, the finder switch 300 is operative to seize a calling telephone line in the second group of one hundred lines by way of the second wiper set, including the wipers 311, 312 and 313, whereupon the switching relay R320 operates to switch the seized line through to the selector switch 400.

Extension of a call from an A operator position

In order to extend a call from an A operator position, such, for example, as a call from the subscriber substation T1 to the first A operator position 500, to a B operator position in the local exchange 20, such, for example, as the first B operator position 494, the operator at the first A operator position 500 operates the key sender K520, thereby to cause the send relay R540 to operate. Upon operating, the send relay R540 completes, at the contacts 541 and 543, an alternative loop circuit substantially identical to that previously traced between the line relay R450 in the selector switch 400 and the key sender K520, and interrupts, at the contacts 542 and 544, the previously traced loop circuit between the retarder coil 530 and the line relay R450 in the selector switch 400. The key sender K520 then operates to interrupt intermittently the previously mentioned alternative loop circuit extending to the line relay R450 in the selector switch 400, thereby to cause the line relay R450 to follow the impulses of the digit transmitted in the usual manner. Each time the line relay R450 restores it interrupts, at the contacts 453 and 451, the previously traced circuit for energizing

the winding of the hold relay R480 and completes, at the contacts 452, the previously mentioned multiple circuit for energizing the lower winding of the transfer relay R485 and the vertical magnet M414. This circuit extends from ground by way of the contacts 496, 452 and 484, the set of switch springs S424, the contacts 438 and the lower winding of R485 to battery, and from the contacts 488 and the vertical magnet M414 to battery. Due to the fact that the hold relay R480 and the transfer relay R485 are of the slow-to-release type, these relays remain operated during impulsing. Each time the vertical magnet M414 is energized it operates, thereby to drive the wiper set of the mechanism 410 one step in the vertical direction. When the wiper set of the mechanism 410 is driven one step in the vertical direction the sets of switch springs S419, S420 and S421 are actuated. More particularly, the sets of switch springs S419 and S421 are actuated into engagement, thereby respectively to prepare a circuit traced hereinafter for energizing the rotary magnet M416 and to prepare a circuit traced hereinafter for energizing the release magnet M418; while the set of switch springs S420 is actuated into disengagement, thereby to interrupt the previously traced circuit for energizing the upper winding of the transfer relay R485.

At the conclusion of the digit transmitted by the key sender K520, the send relay R540 restores, thereby to recomplete, at the contacts 542 and 544, the previously traced loop circuit extending between the retarder coil 530 and the line relay R450 in the selector switch 400, and to interrupt, at the contacts 541 and 543, the previously mentioned alternative loop circuit extending between the key sender K520 and the line relay R450 in the selector switch 400. Shortly following the conclusion of the digit transmitted from the key sender K520 to the selector switch 400 the transfer relay R485 restores, the line relay R450 being operated at this time. Upon restoring, the transfer relay R485 interrupts, at the contacts 488, a further point in the previously traced circuit for energizing in multiple the lower winding of the transfer relay R485 and the vertical magnet M414 and prepares, at the contacts 489, a further point in the previously mentioned circuit for energizing the release magnet M418. Also the transfer relay R485 interrupts, at the contacts 486, the previously mentioned path for applying ground potential to the control conductor C363 of the trunk 360, thereby to insure no further operation of the sequence switch 380 at this time. Finally, the transfer relay R485 completes, at the contacts 487, the previously mentioned circuit for energizing the rotary magnet M416, this circuit extending from ground by way of the contacts 453, 451, 417, 487 and 495, the rotary magnet M416 and the set of switch springs S419 to battery. When thus energizing the rotary magnet M416, thereby to drive the wiper set of the mechanism 410 one step in the rotary direction and to interrupt, at the contacts 417, the previously traced circuit for energizing the rotary magnet M416, thereby to cause the rotary magnet M416 to restore. Upon restoring the rotary magnet M416 re completes, at the contacts 417, the previously traced circuit for energizing the rotary magnet M416. Accordingly, the rotary magnet M416 operates intermittently, thereby to drive the wiper set of the mechanism 410 step by step in the rotary direction until the wiper 413 of the wiper set engages a

contact terminating the control conductor of a trunk having battery potential thereon and extending to the first B operator position 494, battery potential being present upon the control conductor of a trunk extending to the first B operator position 494 in the event the trunk is idle, whereupon a circuit is completed for energizing the lower winding of the switching relay R490.

Assuming that the trunk 490 is the first idle trunk in the group of trunks extending to the first B operator position 494, when the wiper 413 engages the contact terminating the control conductor C493 of the trunk 490, a circuit is completed for energizing in series the winding of the line relay R401 and the lower winding of the switching relay R490, this circuit extending from ground by way of the contacts 483, the lower winding of R490, the contacts 482, the wiper 413, the control conductor C493 of the trunk 490, the contacts 404 and the winding of R401 to battery. When the lower winding of the switching relay R490 is thus energized this relay operates exceedingly fast to complete, at the contacts 494, an obvious holding circuit for energizing the intermediate winding thereof. Also the switching relay R490 completes, at the contacts 493, an obvious low resistance circuit for energizing the winding of the line relay R401, thereby to cause the latter relay to operate. Upon operating, the line relay R401 interrupts, at the contacts 402, a point in a circuit traced hereinafter for energizing the winding of the busy relay R403. Also, upon operating, the switching relay R490 interrupts, at the contacts 495, the previously traced circuit for energizing the rotary magnet M416, thereby positively to arrest further operation of the rotary magnet M416 at this time. Further the switching relay R490 interrupts, at the contacts 496, a further point in the previously mentioned circuit for energizing the release magnet M418 and completes, at the contacts 491 and 492, a loop circuit between the battery supply relay R470 and the apparatus at the first B operator position 494. The last-mentioned loop circuit extends from ground by way of the lower winding of R470, the contacts 464 and 492 and the wiper 412 to the line conductor C492 of the trunk 490 and from battery by way of the upper winding of R470, the contacts 461 and 491 and the wiper 411 to the line conductor C491 of the trunk 490, the apparatus at the first B operator position 490 being connected across the line conductors C491 and C492 of the trunk 490. When this loop circuit is completed a signal is transmitted to the first B operator position 494 and the battery supply relay R470 operates to interrupt, at the contacts 471, a further point in a circuit traced hereinafter for energizing the winding of the call back relay R440 and to complete, at the contacts 472, an obvious circuit for energizing the winding of the hold relay R445, thereby to cause the latter relay to operate. Also, the battery supply relay R470 prepares, at the contacts 473, a point in an alternative path traced hereinafter for applying ground potential to the control conductor C363 of the trunk 360, interrupts, at the contacts 474, a point in a circuit traced hereinafter for energizing the winding of the coin and register relay R430 and prepares, at the contacts 475, a point in an alternative path traced hereinafter for applying ground potential to the control conductor C364 of the trunk 360.

The operator at the first B operator position

494 then answers the call extending thereto by way of the trunk 490; whereupon the telephone instrument at her position is operatively connected to the loop circuit extending between the battery supply relay R470 and the first B operator position 494. Also the telephone instrument at the subscriber substation T1 and the telephone instrument at the first A operator position 500 are operatively connected by way of the previously traced loop circuit to the line relay R450. Finally, it is noted that the loop circuit including the line relay R450 is operatively connected to the loop circuit including the battery supply relay R470 by way of the condensers 455 and 456. Accordingly, a three-way communication connection is established at this time, including the telephone instrument at the subscriber substation T1, the telephone instrument at the first A operator position 500 and the telephone instrument at the first B operator position 494. The operator at the first A operator position 500 then advises the operator at the first B operator position 494 concerning the extension of the call to the called subscriber substation in the local exchange 20. The operator at the first B operator position 494 then proceeds to extend the call to the called subscriber substation in the local exchange 20, in the usual manner.

In order to extend the call from the first B operator position 494 to a subscriber substation or paystation in the local exchange 20, such, for example, as the paystation T2, the operator at the first B operator position 494 inserts the calling plug of the cord circuit in use into the jack J202 terminating the telephone line 245 extending to the paystation T2, the answering plug of the cord circuit in use being inserted into a jack, not shown, terminating the trunk 490. When the calling plug of the cord circuit in use is inserted into the jack J202, ground potential is connected by way of the sleeves of the calling plug and the jack J202 to the control conductor C249 of the telephone line 245. The application of ground potential to the control conductor C249 of the telephone line 245 completes a circuit for energizing the winding of the cutoff relay R260, this circuit extending from the grounded control conductor C249 of the telephone line 245 by way of the contacts 274 and 254 and the winding of R260 to battery. When thus energized, the cutoff relay R260 operates to complete, at the contacts 263, the previously mentioned circuit for energizing the winding of the lockout relay R270, thereby to cause the latter relay to operate. Upon operating, the lockout relay R270 completes, at the contacts 273, an obvious holding circuit for energizing the winding thereof by way of the grounded control conductor C249 of the telephone line 245. Also the lockout relay R270 interrupts, at the contacts 274, the previously traced circuit for energizing the winding of the cutoff relay R260, thereby to cause the latter relay to restore. The operator at the first B operator position 494 then operates the apparatus at her position, thereby to cause ringing current to be projected over the line conductors C246 and C247 of the telephone line 245, whereupon the ringer at the paystation T2 is operated. The call may be answered at the paystation T2 by removing the receiver of the telephone instrument thereat from its associated switchhook, thereby to complete the previously traced circuit for energizing in series the upper and lower windings of the line relay R250. When

thus energized, the line relay R250 operates to complete, at the contacts 251, an additional holding circuit for energizing the winding of the lockout relay R270; this circuit extending from ground by way of the contacts 251 and 272 and the winding of R270 to battery. Also, it is noted that, when the operated lockout relay R270 is operated and the cutoff relay R260 is restored, the previously mentioned circuit for illuminating the signal lamp L268 is completed, the illumination of the signal lamp L268 indicating that the telephone line 245 extending to the paystation T2 is busy.

In view of the foregoing explanation of the operation of the apparatus at the first B operator position 494 to extend a call to the paystation T2 in the local exchange 20, it will be understood that the operator at the first B operator position 494 may extend a call, in a similar manner, to any one of the subscriber substations or paystations in the local exchange 20.

At this point it is noted that the operator at the first B operator position 494 may render the trunk 490 extending thereto busy, prior to the seizure of the trunk 490 by the selector switch 400, by causing battery potential to be applied to the line conductor C492 thereof. The application of battery potential to the line conductor C492 of the trunk 490 completes an obvious circuit for energizing the winding of the busy relay R403, thereby to cause the latter relay to operate. Upon operating, the busy relay R403 interrupts, at the contacts 404, the previously traced path for applying battery potential by way of the winding of the line relay R401 to the control conductor C493 of the trunk 490 and completes, at the contacts 405, an obvious path for applying ground potential to the control conductor C493 of the trunk 490, the application of ground potential to the control conductor C493 of the trunk 490 being effective to mark the trunk 490 as busy to the selector switches having access thereto.

In view of the foregoing explanation of the mode of operation of the selector switch 400 to extend a call from the first A operator position 500 to the first B operator position 494, it will be understood that the selector switch 400 is operative in a similar manner to extend a call from the first A operator position 500 to the B operator position 498 in the distant exchange 30. In order to accomplish this end, the operator at the first A operator position 500 controls the key sender K520, thereby to cause the selector switch 400 to seize an idle one of the trunks, such, for example, as the trunk 470, extending to the B operator position 498 in the distant exchange 30. When the selector switch 400 seizes the trunk 470 extending to the B operator position 498 in the distant exchange 30, the trunk line circuit 472 individually associated with the trunk line 470 is operated in a manner similar to that of the trunk line circuit 405 individually associated with the trunk line 490 extending to the first B operator position 494 in the local exchange 20, in the manner previously explained. When the trunk line 470 is seized by the selector switch 400 a loop circuit is completed between the battery supply relay R470 and the apparatus at the B operator position 498, thereby to cause a signal to be transmitted thereto. The operator at the B operator position 498 then answers the call and is advised by the operator at the first A operator position 500 concerning the extension of the call to a subscriber substation in the dis-

tant exchange 30; whereupon the operator at the B operator position 498 extends the call to the called subscriber substation in the distant exchange 30, in the usual manner.

Also it is noted that a call may be extended from the first A operator position 500 over one of the toll lines in the group of toll lines, including the toll line 499, to a remote exchange by operating the key sender K520 in order to cause the selector switch 400 to operate and seize an idle one of the toll lines extending to the remote exchange. More particularly, the operator at the first A operator position 500 operates the key sender K520 in accordance with a predetermined digit, thereby to cause the vertical magnet M414 of the mechanism 410 in the selector switch 400 to drive the wiper set of the mechanism 410 a corresponding predetermined number of steps in the vertical direction, whereupon the sets of switch springs S422 and S423 are actuated into engagement and the set of switch springs S424 is actuated into disengagement. When the set of switch springs S423 is actuated into engagement, an obvious holding circuit including the contact 497 of the switching relay R490 is completed for energizing the winding of the hold relay R480; when the set of switch springs S424 is actuated into disengagement the previously traced circuit for energizing in multiple the lower winding of the transfer relay R485 and the vertical magnet M414 is interrupted, thereby to cause the transfer relay R485 to restore shortly thereafter; and when the set of switch springs S422 is actuated into engagement an obvious circuit is completed for energizing the winding of the switch through relay R483, thereby to cause the latter relay to operate. Upon operating, the switch through relay R480 interrupts, at the contacts 461 and 464, further points in the previously traced circuit for energizing in series the upper and lower windings of the battery supply relay R470, prepares, at the contacts 462 and 465, a direct metallic connection between the first A operator position 500 and the wiper set of the mechanism 410 and interrupts, at the contacts 463 and 466, the previously traced loop circuit for energizing in series the upper and lower windings of the line relay R450, thereby to cause the latter relay to restore. Upon restoring, the line relay R450 interrupts, at the contacts 453 and 451, the previously traced original circuit for energizing the winding of the hold relay R480. However, the hold relay R480 remains in its operated position at this time due to the completed holding circuit for energizing the winding thereof.

Upon restoring, the transfer relay R485 completes, at the contacts 487, a circuit for energizing the rotary magnet M416, this circuit extending from ground by way of the set of switch springs S423, the contacts 497, 417, 487 and 495, the rotary magnet M416 and the set of switch springs S419 to battery. When thus energized the rotary magnet M416 operates intermittently, as previously explained, thereby to drive the wiper set of the mechanism 410 step by step in the rotary direction until the control wiper 413 engages a contact terminating the control conductor of a toll line having battery potential thereon, battery potential being present upon the control conductor of the toll line when the toll line is idle. When the control wiper 413 engages a contact terminating the control conductor of a toll line having battery potential thereon, such, for example, as the toll line 499 extending to

the remote exchange, a circuit is completed for energizing the lower winding of the switching relay R490, this circuit extending from ground by way of the contacts 433, the lower winding of R490, the contacts 482 and the control wiper 413 to battery potential appearing upon the control conductor of the toll line 499. When the lower winding of the switching relay R490 is thus energized, this relay operates to complete, at the contacts 494, the previously traced holding circuit for energizing the intermediate winding thereof. Also the switching relay R490 completes, at the contacts 493, an obvious path for applying direct ground potential to the control wiper 413, thereby to cause the toll line circuit 497 individually associated with the toll line 499 to operate and connect ground potential to the control conductor of the toll line 499, thereby to complete an alternative holding circuit for energizing the intermediate winding of the switching relay R490, this circuit extending from the grounded control conductor of the toll line 499 by way of the control wiper 413, the contacts 493 and 494 and the intermediate winding of R490 to battery.

Also, upon operating, the switching relay R490 interrupts, at the contacts 495 and 497, the previously traced circuit for energizing the rotary magnet M416, thereby positively to arrest further operation of the rotary magnet M416 at this time. Also the switching relay R490 interrupts, at the contacts 497, the previously traced holding circuit for energizing the winding of the hold relay R480, thereby to cause the latter relay to restore shortly thereafter, the latter relay being of the slow-to-release type. Finally, the switching relay R490 interrupts, at the contacts 496, a point in a circuit traced hereinafter for energizing the release magnet M418 and completes, at the contacts 491 and 492, a direct metallic connection between the retarder coil 530 at the first A operator position 500 and the toll line 499.

Upon restoring, the hold relay R480 interrupts, at the contacts 481, the previously mentioned circuit for energizing the upper winding of the switching relay R490, interrupts, at the contacts 482, the previously traced circuit for energizing the lower winding of the switching relay R490 and prepares, at the contacts 435, a point in the previously mentioned circuit for energizing the release magnet M418. Finally, the hold relay R480 interrupts, at the contacts 423, the previously traced original path for applying ground potential to the control conductor C364 of the trunk 360. However, ground potential is applied to the control conductor C364 of the trunk 360 at this time by way of the control conductor of the toll line 499 from the toll line circuit 497. Accordingly, the switching relay R490 in the selector switch 400 and the switching relay R330 in the finder switch 300 remain in their operated positions.

As previously noted, a direct metallic connection is completed between the retarder coil 530 at the first A operator position 500 and the toll line 499, this circuit extending from one line conductor of the toll line 499 by way of the wiper 411, the contacts 491, 462, 431, and 426, the line conductor C361 of the trunk 360, the contacts 372, the line conductor C322 in the cable 320, the wiper 389 and engaged contact in the associated contact bank 390 of the sequence switch 380, the line conductor C522 of the trunk 520, the contacts 554, 537 and 542, the retarder coil 530, the contacts 544, 538 and 555, the line conductor

C524 of the trunk 520, the wiper 385 and engaged contact in the associated contact bank 386 of the sequence switch 380, the line conductor C324 in the cable 320, the contacts 375, the line conductor C362 of the trunk 360, the contacts 428, 433, 465 and 492, and the wiper 412 to the other line conductor of the toll line 499. Accordingly, the operator at the first A operator position 500 may transmit one or more digits over the toll line 499 by again operating the key sender K520, thereby to cause the switching apparatus, not shown, associated with the toll line 499, to operate and extend the connection to a toll operator position in the remote exchange, whereupon a signal is transmitted to the toll operator position in the remote exchange. The operator at the toll operator position in the remote exchange then answers the call and is advised by the operator at the first A operator position concerning the extension of the call to a subscriber substation in the remote exchange. The operator at the toll operator position in the remote exchange then extends a call to the subscriber substation in the remote exchange, in the usual manner.

In the event the operator at the first A operator position 500 should make an error in registering the digit to be transmitted to the selector switch 400 upon the key sender K520, the operated selector switch 400 may be restored to its normal position by operating the error release key K570 at the first A operator position 500. When the error release key K570 is thus operated, an obvious circuit is completed at the contacts thereof for energizing the winding of the error relay R535, thereby to cause the latter relay to operate. Upon operating, the error relay R535 interrupts, at the contacts 536, a connection between the control conductors in the key sender K520, thereby to cause the key sender K520 to be restored to its normal position, and interrupts, at the contacts 537 and 538, the previously traced connection between the retarder coil 530 and the selector switch 400.

In the event the switch-through relay R460 is not operated at this time, when the previously traced loop circuit extending between the retarder coil 530 and the line relay R450 in the selector switch 400 is interrupted, the latter relay restores. Upon restoring, the line relay R450 interrupts, at the contacts 451 and 453, the previously traced circuit for energizing the winding of the hold relay R480, thereby to cause the latter relay to restore shortly thereafter. Upon restoring, the hold relay R480 interrupts, at the contacts 483, the previously traced holding circuit for energizing the intermediate winding of the switching relay R490, thereby to cause the latter relay to restore. Upon restoring, the switching relay R490 completes, at the contacts 496, the previously mentioned circuit for energizing the release magnet M418, this circuit extending from ground by way of the contacts 496, 452, 485 and 489, the release magnet M418 and the set of switch springs S421 to battery. When thus energized, the release magnet M418 operates and releases the wiper set of the mechanism 410, whereupon the wiper set of the mechanism 410 is returned to its normal position. When the wiper set of the mechanism 410 is returned to its normal position the sets of switch springs S419 and S421 are actuated into disengagement; and the set of switch springs S420 is actuated into engagement. When the set of switch springs S421 is actuated into disengagement the previously traced circuit for energizing the release

magnet M418 is interrupted, thereby to cause the release magnet M418 to restore. At this time, the selector switch 400 is completely released.

On the other hand, in the event the switch-through relay R460 is operated at this time when the previously traced connection between the retarder coil 530 and one of the toll lines, such, for example, as the toll line 499 is interrupted, the toll line circuit 497 individually associated with the toll line 499 is released, thereby to cause ground potential to be removed from the control conductor of the toll line 499. When ground potential is removed from the control conductor of the toll line 499 the previously traced holding circuit for energizing the intermediate winding of the switching relay R490 is interrupted, thereby to cause the latter relay to restore and complete, at the contacts 496, the previously traced circuit for energizing the release magnet M418. The release magnet M418 then operates in order to release the wiper set of the mechanism 410 and to cause it to be returned to its normal position, in the manner previously explained. When the wiper set of the mechanism 410 is returned to its normal position the sets of switch springs S422, S423, S421 and S419 are actuated into disengagement; while the sets of switch springs S420 and S424 are actuated into engagement. When the set of switch springs S422 is actuated into disengagement the previously mentioned circuit for energizing the winding of the switching relay R460 is interrupted, thereby to cause the latter relay to restore; and when the set of switch springs S421 is actuated into disengagement the previously traced circuit for energizing the release magnet M418 is interrupted, thereby to cause the release magnet M418 to restore. At this time, the selector switch 400 is completely released.

In view of the foregoing explanation of the mode of releasing the selector switch 400 at the first A operator position 500, it will be understood that it is only necessary for the operator at the first A operator position 500 to operate the error release key K570 momentarily and then return it to its normal position. When the error release key K570 is returned to its normal position the previously mentioned circuit for energizing the winding of the error relay R535 is interrupted at the contacts thereof, thereby to cause the latter relay to restore. Upon restoring, the error relay R535 re completes, at the contacts 537 and 538, the previously traced loop circuit between the retarder coil 530 at the first A operator position 500 and the line relay R450 in the selector switch 400, thereby to cause the latter relay to operate. Also the error relay R535 re completes, at the contacts 536, the previously mentioned connection between the control conductors of the key sender K520, thereby to render the key sender K520 again operative to transmit digits over the previously traced alternative loop circuit to the line relay R450 in the selector switch 400. Upon operating, the line relay R450 in the selector switch 400 renders the selector switch 400 responsive to impulses transmitted thereto, in the manner previously explained. Accordingly, the operator at the first A operator position 500 again operates the key sender K520 in accordance with the proper digit, thereby to control the selector switch 400 in a manner previously explained.

After the call has been extended from the first A operator position 500 to the first B operator

position 494 in the local exchange 20, to the B operator position 498 in the distant exchange 30, or to the toll operator position in the remote exchange, the operator at the first A operator position 500 causes the call to be transferred directly from the calling subscriber substation, such, for example, as the subscriber substation T1, to the called operator position by momentarily operating the trunk disconnect key K580 at the first A operator position 500. When the trunk disconnect key K580 is thus operated an obvious circuit is completed at the contacts 582 thereof for energizing the magnet M548 of the peg count meter associated with the first A operator position 500, whereupon the peg count meter operates to register the extension of a call by the operator at the first A operator position 500. Also when the trunk disconnect key K580 is operated, the previously traced holding circuit for energizing the winding of the disconnect relay R550 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the disconnect relay R550 interrupts, at the contacts 552', a further point in the previously traced holding circuit for energizing the winding thereof and interrupts, at the contacts 553', a point in the previously traced chain circuit for energizing the winding of the busy relay R550. Also the disconnect relay R550 interrupts, at the contacts 550, a further point in a circuit traced hereinafter for energizing the winding of the identity relay R360 in the finder switch 300, prepares, at the contacts 559, a point in the previously traced circuit for energizing the winding of the answer relay R545, and interrupts, at the contacts 551', the previously traced holding circuit for energizing the winding of the tone relay R525, thereby to cause the latter relay to restore. Further the disconnect relay R550 interrupts, at the contacts 558, a further point in the previously traced circuit for energizing the left-hand winding of the position relay R640 in the main A operator position distributor 630 and interrupts, at the contacts 557, the previously traced circuit for energizing the winding of the cut-in relay R370 in the finder switch 300. Finally the disconnect relay R550 interrupts, at the contacts 551, 552, 554 and 555, the previously traced connections between the retarder coil 530 and the line conductors C521, C523, C522 and C524 of the trunk 520 and completes, at the contacts 553 and 556, the previously mentioned connections between the respective line conductors C521, C523 and C522, C524 of the trunk 520.

Upon restoring, the cut-in relay R370 completes, at the contacts 373 and 376, the previously traced connection extending between the calling subscriber substation T1 and the trunk 360 extending to the selector switch 400, interrupts, at the contacts 371, 372, 374 and 375, the previously traced connections between the line conductors C321, C322, C323 and C324 in the cable 320 and the link illustrated. Also the cut-in relay R370 interrupts, at the contacts 378, a further point in the previously mentioned circuit for energizing the winding of the identity relay R360, prepares, at the contacts 377, the previously traced circuit for energizing the winding of the stop relay R350 and prepares, at the contacts 379, the previously traced circuit for energizing the rotary magnet M393 of the sequence switch 380. Also the cut-in relay R370 completes, at the contacts 373', the previously traced original holding circuit for energizing the lower winding of the switching relay R330 in series with the rotary

magnet M367 and interrupts, at the contacts 372', the previously traced alternative holding circuit for energizing the lower winding of the switching relay R330 in series with the rotary magnet M367. Finally, the cut-in relay R370 prepares, at the contacts 370, the previously mentioned holding circuit for energizing the winding of the call back relay R440 in the selector switch 400 and prepares, at the contacts 371', the previously mentioned circuit for energizing the winding of the coin and register relay R430 in the selector switch 400.

At this time, the first A operator position 500 is idle and available to be assigned for use by the main A operator position distributor 630; while the subscriber at the calling subscriber substation T1 may converse with the operator at the called operator position; and may ultimately converse with the called subscriber substation after the operator at the called operator position has extended the connection to the called subscriber substation.

Release of an established connection between a calling subscriber substation or paystation and a called operator position

The complete release of an established connection between a calling subscriber substation or paystation in the local exchange 20 and a called operator position in the local exchange 20 or in the distant exchange 30 is under the joint control of the subscriber at the calling subscriber substation or paystation and the operator at the called operator position.

The operator at a B operator position in the local exchange 20, such, for example, as the first B operator position 494, first releases the connection to the called subscriber substation in the local exchange 20 by operating the apparatus at her position in the usual manner, and then initiates the release of the link utilized, such, for example, as the link illustrated, by operating the apparatus at her position in order to interrupt the loop circuit between her position and the battery supply relay R470 in the selector switch 400.

Similarly, the operator at the B operator position 498 in the distant exchange 30 first releases the connection to the called subscriber substation in the distant exchange 30 by operating the apparatus at her position in the usual manner, and then initiates the release of the link utilized, such, for example, as the link illustrated, by operating the apparatus at her position in order to interrupt the loop circuit between her position and the battery supply relay R470 in the selector switch 400.

Assuming that the subscriber at the calling subscriber substation or at the paystation in the local exchange 20 has replaced the receiver of the telephone instrument thereat upon its associated switchhook at this time, thereby to interrupt the previously traced loop circuit to the line relay R450 in the selector switch 400, the latter relay then restores to interrupt, at the contacts 453 and 451, the previously traced circuit for energizing the winding of the hold relay R480, thereby to cause the latter relay to restore. Upon restoring, the hold relay R480 interrupts, at the contacts 483, the previously mentioned path for applying ground potential to the control conductor C364 of the trunk 360. However, ground potential remains upon the control conductor C364 of the trunk 360 due to the operated condition of the hold relay R445. When

the battery supply relay R470 restores it interrupts, at the contacts 472, the previously mentioned circuit for energizing the winding of the hold relay R445. However, the latter relay, being of the slow-to-release type, does not immediately restore. Also, upon restoring, the battery supply relay R470 completes, at the contacts 471, the previously mentioned circuit for energizing the winding of the call back relay R440, this circuit extending from ground by way of the contacts 471, 447 and the winding of R440 to battery. When thus energized, the call back relay R440 operates to complete, at the contacts 442, the previously mentioned holding circuit for energizing the winding thereof, this circuit extending from ground by way of the contacts 446, C400, the contacts 370, C407, the contacts 442 and the winding of R440 to battery. Also, upon operating, the call back relay R440 completes, at the contacts 441, the previously mentioned circuit for energizing the winding of the coin and register relay R430, this circuit extending from ground by way of the contacts 474, C406, the contacts 371', C405, the contacts 441 and the winding of R430 to battery. Shortly after the coin and register relay R430 is thus energized this relay operates, this relay being of the combination slow-to-operate and slow-to-release type. Upon operating, the coin collect relay R430 completes, at the contacts 434, an obvious circuit for energizing the winding of the control relay R425, thereby to cause the latter relay to operate. Also the coin collect relay R430 completes, at the contacts 435, a path for applying booster battery potential to the control conductor C364 of the trunk 360, this path extending from ground by way of the booster battery 457 and the contacts 476 and 435 to the control conductor C364 of the trunk 360. The booster battery applied to the control conductor C364 of the trunk 360 is conducted by way of the contacts 373', 362, 333 and 324 to the control wiper 316 of the first wiper set of the mechanism 310 in the finder switch 300. Upon operating, the control relay R425 completes, at the contacts 427 and 429, a path for connecting positive 110 volt potential to the line wipers 314 and 315 of the first wiper set of the mechanism 310 in the finder switch 300, this path extending from positive 110 volt potential appearing upon the control conductor C406 by way of the contacts 432 and 427, 429 to the line conductors C361 and C362 of the trunk 360, from the line conductor C361 of the trunk 360 by way of the contacts 373 and 331 to the line wiper 314 and from the line conductor C362 of the trunk 360 by way of the contacts 376 and 332 to the line wiper 315.

Subsequent to the operation of the coin collect relay R430 and the control relay R425, the hold relay R445 restores to interrupt, at the contacts 447 and 446, respectively, the previously traced original and holding circuits for energizing the winding of the call back relay R440, thereby to cause the latter relay to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the call back relay R440 interrupts, at the contacts 441, the previously traced circuit for energizing the winding of the coin and register relay R430, thereby to cause the latter relay to restore shortly thereafter. Upon restoring, the coin collect relay R430 interrupts, at the contacts 434, the previously mentioned circuit for energizing the winding of the control relay R425, thereby to cause the latter relay to restore shortly thereafter,

the latter relay being of the slow-to-release type. Upon restoring, the coin and register relay R430 interrupts, at the contacts 432, the previously traced path for applying positive 110 volt potential to the line wipers 314 and 315 of the first wiper set of the mechanism 310 in the finder switch 300 and interrupts, at the contacts 435, the previously traced path for applying booster battery potential to the control wiper 316 of the first wiper set of the mechanism 310 in the finder switch 300.

Also, upon restoring, the hold relay R445 interrupts, at the contacts 448, the previously mentioned path for applying ground potential to the control conductor C364 of the trunk 360, thereby to interrupt the previously traced holding circuit for energizing the intermediate winding of the switching relay R490. The switching relay R490 then restores to complete, at the contacts 496, the previously traced circuit for energizing the release magnet M418. The release magnet M418 then operates and releases the wiper set of the mechanism 410 and causes it to be returned to its normal position, in the manner previously explained.

It is noted that the application of booster battery potential to the control conductor C364 of the trunk 360 completes an alternative holding circuit substantially identical to that previously traced for energizing the lower winding of the switching relay R330 in series with the rotary magnet M367. Accordingly, the switching relay R330 remains in its operated position, thereby to prevent the release of the finder switch 300, while booster battery potential is applied to the control conductor C364 of the trunk 360. However, when booster battery potential is removed from the control conductor C364 of the trunk 360, the previously mentioned alternative holding circuit for energizing in series the lower winding of the switching relay R330 and the rotary magnet M367 is interrupted, thereby to cause the switching relay R330 to restore. Upon restoring, the switching relay R330 completes, at the contacts 339, the previously mentioned circuit for energizing the release magnet M369, this circuit extending from ground by way of the contacts 346, the contacts 357 of the set of switch springs S356, the release magnet M369 and the contacts 329 and 339 to battery. When thus energized the release magnet M369 operates, thereby to release the first and second wiper sets of the mechanism 310 and to cause these wiper sets to be returned to their normal position. When the first and second wiper sets of the mechanism 310 are returned to their normal positions, the set of switch springs S356 is actuated in order to interrupt, at the contacts 357 thereof, the previously traced circuit for energizing the release magnet M369 and to complete, at the contacts 358, the previously traced path for applying ground potential, in the finder switch 300, to the all-link-busy conductor C309 extending to the link distributor 301. The release magnet M369 then restores. Also the set of switch springs S352 is actuated, thereby to interrupt, at the contacts 353 thereof, the previously traced path for applying ground potential to the guard conductor C303 extending to the link distributor 301 in order to mark the link illustrated as idle to the link distributor 301. At this time, the link illustrated is completely released.

It is noted that positive 110 volt potential was connected to the line wipers 314 and 315 of the

first wiper set of the mechanism 310 and booster battery potential was connected to the control wiper 316 of the first wiper set of the mechanism 310 prior to the actual release of the finder switch 300 and the selector switch 400 of the link illustrated. Accordingly, for a brief time interval, booster battery potential is projected over the control conductor and positive 110 volt potential is projected over the line conductors of the line included in the established connection and extending to the calling subscriber substation or paystation prior to the actual release of the link illustrated.

In the event the calling telephone station included in the established connection is rendered message register service, such, for example, as the subscriber substation T1, the application of booster battery potential to the control conductor C208 of the telephone line 205 extending to the subscriber substation T1 is effective to operate the message register included in the message rate line circuit 200 individually associated with the telephone line 205. More particularly, a circuit is completed for energizing the meter magnet M217 of the message register included in the message rate line circuit 200, this circuit extending from booster battery potential appearing upon the control conductor C208 of the telephone line 205 by way of the contacts 224 and the winding of the meter magnet M217 to battery. Accordingly, the meter magnet M217 operates, thereby to cause the message register individually associated with the telephone line 205 extending to the subscriber substation T1 to register a call.

On the other hand, in the event the calling telephone station included in the established connection is rendered prepay service, such, for example, as the paystation T2, the application of positive battery potential to the line conductors C246 and C247 of the telephone line 245 extending to the paystation T2 is effective to cause the coin collect and refund mechanism at the paystation T2 to operate and collect the coin inserted in the coin slot thereof.

Finally, it is noted that, in the event the subscriber substation included in the established connection is rendered neither message register nor prepay service, the application of booster battery potential to the control conductor of the telephone line extending to the subscriber substation and the application of positive 110 volt potential to the line conductors of the telephone line extending to the subscriber substation have no effect.

Accordingly, the operation of the apparatus included in the selector switch 400, incident to the release thereof, is the same regardless of the type of telephone station included in the established connection.

In connection with the release of an established connection between a calling subscriber substation or paystation in the local exchange 20 and a B operator position in the local exchange 20, such, for example, as the first B operator position 494, and the release of an established connection between a calling subscriber substation or paystation in the local exchange 20 and the B operator position 498 in the distant exchange 30, it is noted that the link utilized, such, for example, as the link illustrated, is forcibly released under the control of the operator at the first B operator position 494 or at the B operator position 498, even though the subscriber at the calling subscriber substation or paystation in the local exchange 20 does not replace the receiver of the

telephone instrument thereat upon its associated switchhook. More particularly, when the operator at the first B operator position 494 or the operator at the B operator position 498 interrupts the loop circuit extending between the battery supply relay R470 in the selector switch 400 and her position, the latter relay restores, thereby to cause the call back relay R440, the coin and register relay R430 and the control relay R425 to operate in the manner explained. Upon operating, the coin and register relay R430 interrupts, at the contacts 431 and 433, the previously traced loop circuit between the calling subscriber substation or paystation in the local exchange 20 and the line relay R450 in the selector switch 400, thereby to cause the latter relay to restore. Upon restoring, the line relay R450 interrupts, at the contacts 453 and 451, the previously traced circuit for energizing the winding of the hold relay R480, thereby to cause the latter relay to restore. Accordingly, when the coin and register relay R430 subsequently restores as previously noted, both ground and booster battery potentials are completely removed from the control conductor C304 of the trunk 350, whereupon the finder switch 300 and the selector switch 400 are released in the manner previously explained.

Also in this connection, it is noted that the line circuit individually associated with the telephone line extending to the calling subscriber substation or paystation included in an established connection is released, thereby to effect the complete release of the apparatus utilized in an established connection only in the event the subscriber at the calling subscriber substation or paystation replaces the receiver of the telephone instrument thereat upon its associated switchhook. For example, assuming that the subscriber substation T1 is included in an established connection which is released, the message rate line circuit 200 individually associated with the telephone line 205 extending to the subscriber substation T1 is completely released only in the event the subscriber at the subscriber substation T1 replaces the receiver of the telephone instrument thereat upon its associated switchhook.

In the event the subscriber at the subscriber substation T1 replaces the receiver of the telephone instrument thereat upon its associated switchhook prior to the release of the link included in the established connection, the release of the link included in the established connection is effective to interrupt the previously traced holding circuit for energizing the winding of the cutoff relay R220, thereby to cause the latter relay to restore. Upon restoring, the cutoff relay R220 interrupts, at the contacts 223, the previously mentioned circuit for energizing the winding of the lockout relay R230, thereby to cause the latter relay to restore. At this time, the message rate line circuit 200 is completely released, battery potential being applied by way of the winding of the cutoff relay R220 over the previously traced path to the control conductor C209 of the telephone line 205 in order to mark the telephone line 205 as idle to the B operator positions in the local exchange 20 having access thereto, as previously explained.

On the other hand, in the event the subscriber at the subscriber substation T1 has not replaced the receiver of the telephone instrument thereat upon its associated switchhook when the link included in the established connection is released, the release of the link included in the established connection is effective to interrupt the previously

traced holding circuit for energizing the winding of the cutoff relay R220, thereby to cause the latter relay to restore. Upon restoring, the cutoff relay R220 interrupts, at the contacts 223, the previously mentioned circuit for energizing the winding of the lockout relay R230 and completes, at the contacts 221 and 222, the previously traced original circuit for energizing in series the upper and lower windings of the line relay R210 including the bridge path at the subscriber substation T1. Accordingly, the line relay R210 operates prior to the release of the lockout relay R230. Upon operating, the line relay R210 completes, at the contacts 211, the previously traced holding circuit for energizing the winding of the lockout relay R230 and a path for applying ground potential to the control conductor C209 of the telephone line 205, thereby to mark the telephone line 205 as busy to the B operator positions in the local exchange 20 having access thereto. The last mentioned path extends from ground by way of the contacts 211, 232 and 233 to the control conductor C209 of the telephone line 205. Also, upon restoring, the cutoff relay R220 completes, at the contacts 226, the previously mentioned circuit for illuminating the signal lamp L213, the illumination of the signal lamp L213 being effective to indicate that the telephone line 205 extending to the subscriber substation T1 is locked out of service.

In order to again place the telephone line 205 extending to the subscriber substation T1 in service, it is only necessary for the subscriber at the subscriber substation T1 to replace the receiver of the telephone instrument thereat upon its associated switchhook, whereupon the previously traced circuit for energizing in series the upper and lower windings of the line relay R210 are interrupted. The line relay R210 then restores to interrupt, at the contacts 211, the previously traced holding circuit for energizing the winding of the lockout relay R230, thereby to cause the latter relay to restore shortly thereafter. Upon restoring, the lockout relay R230 interrupts, at the contacts 232, a further point in the previously traced holding circuit for energizing the winding thereof, interrupts, at the contacts 235, the previously mentioned circuit for illuminating the signal lamp L213 and completes, at the contacts 234, the previously traced path for applying battery potential by way of the winding of the cutoff relay R220 to the control conductor C209 of the telephone line 205, thereby to mark the telephone line 205 as idle to the B operator positions in the local exchange 20 having access thereto. At this time, the message rate line circuit 200 individually associated with the telephone line 205 is completely released.

On the other hand, the complete release of an established connection between a calling subscriber substation or paystation in the local exchange 20 and the toll operator position in the remote exchange may be effected only when both the subscriber at the calling subscriber substation or paystation in the local exchange 20 replaces the receiver of the telephone instrument thereat upon its associated switchhook and the operator at the toll operator position in the remote exchange interrupts the connection between the toll operator position in the remote exchange and the toll line extending between the local exchange 20 and the remote exchange. When the subscriber at the subscriber substation or paystation in the local exchange 20 replaces the receiver of the telephone instrument thereat upon

its associated switchhook the previously traced connection between the subscriber substation or paystation and the toll line is interrupted, as previously noted. Accordingly, when both connections to the toll line are interrupted, the toll line circuit individually associated therewith is released, thereby to cause ground potential to be removed from the control conductor of the toll line, whereupon the link utilized in the established connection is released. Assuming that the link illustrated is utilized in the established toll connection, when ground potential is removed from the control conductor of the toll line the switching relay R490 and the switch through relay R460 restore in order to cause the link illustrated to be released in a manner similar to that previously explained. However, in this instance it is noted that the call back relay R440, the coin and register relay R430 and the control relay R425 are not operated and restored as previously explained due to the fact that the battery supply relay R470 and the hold relay R445 occupy their restored positions prior to the release of the link illustrated. Also, ground potential is removed from the control conductor C364 of the trunk 360, thereby to cause the switching relay R330 in the finder switch 300 to restore, whereupon the finder switch 300 is released in a manner previously explained.

Recall of an A operator position from a B operator position

After a connection from a calling subscriber substation or paystation in the local exchange 20 has been transferred from an A operator position directly by way of the link utilized to a B operator position in the local exchange 20 or to the B operator position 498 in the distant exchange 30, the operator at the B operator position in the local exchange 20 or at the B operator position 498 in the distant exchange 30 may have occasion to recall an A operator position. For example, after the connection from the calling paystation T2 in the local exchange 20 has been transferred from the first A operator position 500 directly by way of the link illustrated to the first B operator position 494 in the local exchange 20, the operator at the first B operator position 494 may have occasion to recall an A operator position due to the fact that the connection cannot be immediately completed to a called subscriber substation in the local exchange 20. In this event the operator at the first B operator position 494 in the local exchange 20 recalls an operator at an idle one of the operator positions in the local exchange 20 and advises her to refund the coin deposited in the coin slot of the coin collect and refund mechanism at the paystation T2. An idle A operator position in the local exchange 20 may be recalled over the established connection between the calling paystation T2 and the first B operator position 494 in the local exchange 20 including the link illustrated under the control of the operator at the first B operator position 494. In order to accomplish this end, the operator at the first B operator position 494 operates the apparatus at her position, thereby to cause the loop circuit extending between the battery supply relay R470 in the selector switch 490 and the first B operator position 494 to be momentarily interrupted and then recompleted, thereby to cause the battery supply relay R470 momentarily to restore and then reoperate. Upon restoring, the battery supply relay R470 completes, at the contacts 471, the previously traced circuit for

energizing the winding of the call back relay R440, thereby to cause the latter relay to operate. Upon operating, the call back relay R440 completes, at the contacts 442, the previously traced holding circuit for energizing the winding thereof. Also the call back relay R440 completes, at the contacts 441, the previously traced circuit for energizing the winding of the coin and register relay R430. However, the latter relay, being of the slow-to-operate type, does not immediately operate. Accordingly, when the battery supply relay R470 reoperates it interrupts, at the contacts 474, the previously traced circuit for energizing the winding of the coin and register relay R430, thereby to prevent operation of the last-mentioned relay. Also, upon reoperating, the battery supply relay R470 completes, at the contacts 473, a path for applying ground potential to the control conductor C363 of the trunk 360, the call back relay R440 being operated at this time. The last-mentioned path extends from ground by way of the contacts 443 and 473 to the control conductor C363 of the trunk 360.

The application of ground potential to the control conductor C363 of the trunk 360 completes the previously traced circuit for energizing the rotary magnet M393 of the sequence switch 380, thereby to cause the rotary magnet M393 to operate intermittently in order to drive the wipers noted of the sequence switch 380 step by step in a clockwise direction, in the manner previously explained. When the wiper 391 of the sequence switch 380 is driven into engagement with the seventh contact in the associated contact bank 392 thereof, the previously traced circuit for energizing in series the winding of the marking relay 1M and the winding of the stop relay R350 is completed in the manner previously explained, assuming that there is an idle A operator position at this time. Upon operating, the stop relay R350 interrupts, at the contacts 351, the previously traced circuit for energizing the rotary magnet M393 of the sequence switch 380, in the manner previously explained. Also, upon operating, the marking relay 1M completes, at the contacts 1M2, a circuit for energizing the winding of the release relay R620 from ground at one of the A operator positions under the control of the main A operator position distributor 630, in the manner previously explained. The release relay R620 then operates, thereby to cause the control relay R610 to operate and the stop relay R350 to restore, whereupon further operation of the rotary magnet M393 of the sequence switch 380 is initiated, as previously explained. The sequence switch 380 then operates to select the trunk extending to the idle A operator position assigned by the main A operator position distributor 630; whereupon a circuit substantially identical to that previously traced is completed for energizing in series the winding of the stop relay R350 and the winding of the answer relay at the selected A operator position. Upon operating, the answer relay at the selected A operator position causes operation of the disconnect relay thereat, whereupon a circuit substantially identical to that previously traced is completed for energizing the winding of the cut-in relay R370, thereby to cause the latter relay to operate. Upon operating, the cut-in relay R370 interrupts, at the contacts 379, the previously traced circuit for energizing the rotary magnet M393 of the sequence switch 380, thereby positively to arrest further operation of the sequence switch 380 at this time. Also the cut-in relay R370 interrupts,

at the contacts 370, the previously traced holding circuit for energizing the winding of the call back relay R440, thereby to cause the latter relay to restore shortly thereafter. Upon restoring, the call back relay R440 interrupts, at the contacts 443, the previously traced path for applying ground potential to the control conductor C363 of the trunk 360, thereby to prevent further operation of the rotary magnet M393 of the sequence switch 380 after the call has been answered at the selected A operator position and again transferred to recomplete the established connection between the calling paystation T2 and the first B operator position 494 in the local exchange 20, in the event this service is desired. Further, the cut-in relay R370 prepares, at the contacts 378, the previously mentioned circuit for energizing the winding of the identity relay R360, completes, at the contacts 372, the previously traced alternative holding circuit for energizing in series the lower winding of the switching relay R330 and the rotary magnet M367, completes, at the contacts 371, 372, 374 and 375, the previously traced connections between the line conductors C321, C322, C323 and C324 in the cable 320 and the line conductors of the link illustrated, and interrupts, at the contacts 373 and 376, the previously traced direct loop circuit between the calling paystation T2 and the line relay R450 in the selector switch 400. Accordingly, at this time, the retarder coil 530 included in the apparatus at the selected A operator position is connected to the calling paystation T2 and to the line relay R450 in the selector switch 400, thereby to retain the latter relay in its operated position. Also at this time, a three-way communication connection is completed, including the telephone instrument at the calling paystation T2, the telephone instrument at the first B operator position 494 and the telephone instrument at the selected A operator position. Accordingly, at this time, the operator at the selected A operator position may converse with either the subscriber at the calling paystation T2 or the operator at the first B operator position 494.

Assuming that the first A operator position 500 is the A operator position selected by the sequence switch 380 under the control of the main A operator position distributor 530 at this time, the disconnect relay R550 at the first A operator position 500 occupies its operated position and the three-way communication connection previously mentioned includes the telephone instruments at the paystation T2, at the first B operator position 494 and at the first A operator position 500. The operator at the first B operator position 494 then advises the operator at the first A operator position 500 why the recall was made or request any other service that the operator at the first A operator position 500 is able to render.

For example, the operator at the first A operator position 500 might have extended the connection to the first B operator position 494 in the local exchange 20 when she should have extended the connection to the B operator position 498 in the distant exchange 30. In this event, the operator at the first A operator position 500 operates the error release key K570, thereby to complete the previously mentioned circuit for energizing the winding of the error relay R535 in order to cause the latter relay to operate. Upon operating, the error relay R535 interrupts, at the contacts 537 and 538, the previously traced loop circuit between the retarder coil 530 at the first A operator position 500 and the line relay R450

in the selector switch 400, thereby to cause the latter relay to restore. Assuming that the operator at the first B operator position 494 has operated the apparatus at her position in order to interrupt the loop circuit extending between the battery supply relay R470 and the first B operator position 494 at this time, the battery supply relay R470 occupies its restored position. When both the line relay R450 and the battery supply relay R470 are restored, the selector switch 400 is released in the manner previously explained. Accordingly, the operator at the first A operator position 500 then returns the error release key K570 to its normal position, thereby to recomplete, at the contacts 537 and 538, the previously traced loop circuit between the retarder coil 530 and the line relay R450 in the selector switch 400. The operator at the first A operator position 500 may then operate the key sender K520, thereby to establish the desired connection between the first A operator position 500 and the B operator position 498 in the distant exchange 30. After the call is answered at the B operator position 498 in the distant exchange 30, the operator at the first A operator position 500 momentarily operates the trunk disconnect key K580, thereby to cause the connection to be transferred directly from the calling paystation T2 to the B operator position 498 in the distant exchange 30 by way of the link illustrated, whereupon the apparatus at the first A operator position 500 is released in the manner previously explained.

On the other hand, when the operator at the first A operator position 500 answers the recall upon the established connection extending between the paystation T2 and the first B operator position 494 in the local exchange 20, she may be advised that the operator at the first B operator position 494 is not able immediately to complete the connection to the desired called subscriber substitution in the local exchange 20 and that a refund of the coin deposited in the coin slot of the coin collect and refund mechanism at the paystation T2 is desired by the subscriber thereat. The operator at the first A operator position 500 then momentarily operates the error release key K570, thereby to cause the selector switch 400 to be released in the manner previously explained, assuming that the operator at the first B operator position 494 has previously disconnected the apparatus at her position from the selector switch 400.

The operator at the first A operator position 500 then operates the refund key K565, thereby to complete, at the contacts 568 thereof, an obvious circuit for energizing the winding of the refund relay R530. When thus energized the refund relay R530 operates to interrupt, at the contacts 531 and 533, the previously traced connection between the retarder coil 530 and the calling paystation T2 and to complete, at the contacts 532 and 534, a path for projecting negative 110 volt potential over the line conductors of the telephone line 245 extending to the paystation T2. The last-mentioned path extends from negative 110 volt potential appearing upon the control conductor C560 by way of the contacts 567 of the refund key K565 and the contacts 534 and 532 to the line conductor C523 of the trunk 520, and from negative 110 volt potential appearing upon the control conductor C569 by way of the contacts 570 and 566 of the refund key K565 and the contacts 532 and 531 to the line conductor C521 of the trunk 520, the line conductors C523 and C521 of the trunk 520 being

respectively connected by way of the previously traced path to the line conductors C247 and C246 of the telephone line 245 extending to the paystation T2. The application of negative 110 volt potential to the line conductors C246 and C247 of the telephone line 245 extending to the paystation T2 operates the coin collect and refund mechanism at the paystation T2 to refund the coin deposited in the coin slot of the coin collect and refund mechanism.

The operator at the first A operator position 500 then returns the refund key K565 to its normal position, thereby to interrupt, at the contacts 558 thereof, the previously mentioned circuit for energizing the winding of the refund relay R530 and to interrupt, at the contacts 566 and 567 thereof, the previously traced path for projecting negative 110 volt potential over the line conductors C246 and C247 of the telephone line 245 extending to the paystation T2. The refund relay R530 then restores. The operator at the first A operator position 500 then momentarily operates the trunk disconnect key K580, thereby to cause the disconnect relay R550 to restore. Upon restoring, the disconnect relay R550 interrupts, at the contacts 557, the previously traced circuit for energizing the winding of the cut-in relay R370, thereby to cause the latter relay to restore. Upon restoring, the cut-in relay R370 interrupts, at the contacts 372', the previously traced alternative holding circuit for energizing the lower winding of the switching relay R330 in series with the rotary magnet M367, thereby to cause the latter relay to restore and effect the release of the finder switch 300, in the manner previously explained.

Line identification

When either a call or a recall is routed to an idle one of the A operator positions to be answered, the operator thereat may wish to identify the directory number of the telephone line extending to the calling subscriber substation or paystation in the local exchange 20. For example, when the call on the telephone line 245 extending to the paystation T2 is routed by way of the link illustrated to the first A operator position 500 or when the recall upon the established connection between the paystation T2 and the first B operator position 494 is routed by way of the link illustrated to the first A operator position 500, the operator at the first A operator position 500 may wish to identify the directory number of the telephone line 245 extending to the calling paystation T2.

In order to identify the directory number of a calling telephone line in the local exchange 20 included in an established connection to the first A operator position 500, the operator at the first A operator position 500 operates the identity key K575. When the identity key K575 is thus operated there is completed, at the contacts 578 thereof, an obvious circuit for illuminating the signal lamp L583, thereby to indicate to the operator at the first A operator position 500 that the identity key K575 occupies its operated position. Also, when the identity key K575 is operated there is completed, at the contacts 577 thereof, the previously mentioned circuit for energizing the winding of the identity relay R360, this circuit extending from ground by way of the contacts 577 of the identity key K575, the contacts 550, the control conductor C525 of the trunk 520, the wiper 391 and engaged contact in the associated contact bank 392 of the sequence

switch 330, the control conductor C325 in the cable 320, the contacts 378 and the winding of R360 to battery. When thus energized, the identity relay R360 operates to complete, at the contacts 363, an alternative path for applying ground potential to the control wiper 316 of the first wiper set of the mechanism 310, this path extending from ground by way of the resistor 396, the control conductor C331 in the cable 330, the contacts 363, 333 and 324 to the control wiper 316 of the first wiper set of the mechanism 310. This application of ground potential to the control wiper 316 of the first wiper set of the mechanism 310 retains ground potential upon the control conductor C248 of the telephone line 245, thereby to retain the cutoff relay R260 in its operated position. Also, the identity relay R360 interrupts, at the contacts 362, the previously traced path for applying ground potential by way of the control conductor C364 of the trunk 360 to the control wiper 316 of the first wiper set of the mechanism 310 and prepares, at the contacts 364 and 365, paths for applying ground potential to the control conductors C332 and C333 in the cable 330. One of the last-mentioned paths is completed, depending upon which one of the switching relays R320 and R330 in the finder switch 300 occupies its operated position at this time. More particularly, in the present example, the switching relay R330 occupies its operated position due to the fact that the telephone line 245 is seized by the first wiper set of the mechanism 310. On the other hand, when a telephone line is seized by the second wiper set of the mechanism 310, the switching relay R320 occupies its operated position. Accordingly, in the present instance, ground potential is connected to the control conductor C332 in the cable 330 and no ground potential is connected to the control conductor C333 in the cable 330. The path for connecting ground potential to the control conductor C332 in the cable 330 extends from ground by way of the contacts 335 of the operated switching relay R330 and the contacts 364 to the control conductor C332 in the cable 330. Also, when the identity key K575 is thus operated there is prepared, at the contacts 576, a circuit traced hereinafter for energizing the winding of the lockout relay R750 in series with either the first start relay R730 or the second start relay, not shown, depending upon the one of the control conductors C332 or C333 in the cable 330 to which ground potential is applied. In the present instance, ground potential is applied to the control conductor C332 in the cable 330, thereby to complete a circuit for energizing the upper winding of the first start relay R730. The last-mentioned circuit extends from the grounded control conductor C332 in the cable 330 by way of the contacts 731, the upper winding of R730, the contacts 751 and the resistor 758 to battery. When thus energized, the first start relay R730 operates to complete, at the contacts 732, the previously mentioned circuit for energizing in series the winding of the lockout relay R750 and the lower winding of the first start relay R730. The last-mentioned circuit extends from ground by way of the contacts 576 of the identity key K575, the winding of R750, the lower winding of R730 and the contacts 732 to battery. When thus energized, the lockout relay R750 operates to interrupt, at the contacts 751, the previously traced circuit for energizing the upper winding of the first start relay R730. Also, upon operating, the first start relay R730

interrupts, at the contacts 731, a further point in the previously traced circuit for energizing the upper winding thereof.

In view of the foregoing explanation of the mode of operation of the first start relay R730 and the lockout relay R750 incident to the operation of the identity key K575, it will be understood that, in the event ground potential appears upon the control conductor C333 in the cable 330, a circuit is completed for energizing the upper winding of the second start relay, not shown, thereby to cause the second start relay to operate and complete a circuit for energizing the lower winding thereof in series with the lockout relay R750, in a manner similar to that previously explained. However, in the present instance, the first start relay R730 occupies its operated position; and the lockout relay R750 occupies its operated position, thereby positively to prevent operation of the second start relay.

Continuing now with the operation of the first identity unit 700 incident to the operation of the first start relay R730 and the lockout relay R750, upon operating, the lockout relay R750 completes, at the contacts 752 and 753, a path for short-circuiting the winding of the first stop relay R740. The last-mentioned path extends from ground by way of the contacts 752 and 733, the winding of R740, the contacts 739, 744, 90U2, 78U2, 56U2, 34U2, 12U2 and 753 to ground. When the above-traced path for short-circuiting the winding of the first stop relay R740 is completed, operation of the first stop relay R740 is positively prevented. Also, the lockout relay R750 completes, at the contacts 753, a circuit for energizing the rotary magnet M723 of the first test switch 710, this circuit extending from ground by way of the contacts 753, 12U2, 34U2, 56U2, 78U2, 90U2, 744, 739 and 723 and the winding of M723 to battery. When thus energized, the rotary magnet M723 operates, thereby to condition the wipers noted of the first test switch 710 to be driven one step in the counterclockwise direction and to interrupt, at the contacts 723, the previously traced circuit for energizing the rotary magnet M723. The rotary magnet M723 then restores to recomplete, at the contacts 723, the previously traced circuit for energizing the rotary magnet M723. Accordingly, the rotary magnet M723 operates intermittently, thereby to drive the wipers noted of the first test switch 710 step by step in the counterclockwise direction until one of the test relays 12U, 34U, 56U, 78U or 90U is operated in a manner more fully described hereinafter.

Also, upon operating, the first start relay R730 completes, at the contacts 734, 735, 736, 737 and 738, test circuits between the wipers 713, 715, 717, 719 and 721, respectively, of the first test switch 710 and the test relays 12U, 34U, 56U, 78U and 90U, respectively. These test circuits extend from the control wiper 316 of the first wiper set of the mechanism 310 in the finder switch 300 by way of the contacts 324, 333 and 363, the control conductor C331 in the cable 330, the secondary windings 756 of the test transformer 755 to one terminal of each of the condensers 744, 745, 746, 747 and 748, the primary winding 757 of the test transformer 755 being connected to a suitable source of alternating current. Finally, the wipers 713, 715, 717, 719 and 721 of the first test switch 710 are connected by way of the contacts 734, 735, 736, 737 and 738, respectively, and the windings of the test relays 12U, 34U, 56U, 78U and 90U, respectively, to the other terminals of

the condensers 744, 745, 746, 747 and 748, respectively. In the present example, the control wiper 316 of the first wiper set of the mechanism 310 in the finder switch 300 engages the contact in the associated contact bank terminating the control conductor C248 of the telephone line 245 extending to the paystation T2, the control conductor C248 of the telephone line 245 being connected to the test conductor CUI54 terminating on a contact in the contact bank 716 associated with the wiper 715 of the first test switch 710.

At this point, it is noted that the first contacts in the contact banks 714, 716, 718, 720 and 722, respectively, associated with the wipers 713, 715, 717, 719 and 721 of the first test switch 710, respectively, terminate the test conductors CUI11, CUI13, CUI15, CUI17 and CUI19; while the second contacts in the respective contact banks mentioned respectively terminate the test conductors CUI12, CUI14, CUI16, CUI18 and CUI10. Accordingly, it will be understood that the contacts in the contact bank 714 terminate the twenty test conductors CUI11, CUI12, CUI21, CUI22, CUI31, CUI32, —, CUI01, CUI02; the contacts in the contact bank 716 terminate the twenty test conductors CUI13, CUI14, CUI23, CUI24, CUI33, CUI34, —, CUI03, CUI04; and the contacts in the contact bank 722 terminate the twenty test conductors CUI19, CUI10, CUI29, CUI20, CUI39, CUI30, —, CUI09 and CUI00. Hence, it will be understood that the wiper 713 associated with the contact bank 714 in the first test switch 710 has access to each of the twenty test conductors corresponding to the twenty lines in the first group of one hundred lines having directory numbers, the unit digit of which is either 1 or 2; the wiper 715 associated with the contact bank 716 in the first test switch 710 has access to each of the twenty test conductors corresponding to the twenty lines in the first group of one hundred lines having directory numbers, the unit digit of which is either 3 or 4; —; and the wiper 721 associated with the contact bank 722 in the first test switch 710 has access to each of the twenty test conductors corresponding to the twenty lines in the first group of one hundred lines having directory numbers, the unit digit of which is either 9 or 0.

Further, it is noted that the first to the twentieth contacts in the contact bank 712 associated with the wiper 711 of the first test switch 710 terminate the marking conductor C1DO, C1DE, C2DO, C2DE, —, C5DO, C5DE, —, C10DO and C10DE. The marking conductors C1DO and C1DE respectively correspond to the two groups of five lines each in each group of one hundred lines having directory numbers, the tens digit of which is 1 and the unit digits of which are respectively odd and even. Similarly, the marking conductors C10DO and C10DE respectively correspond to the two groups of five lines each in each group of one hundred lines having directory numbers, the tens digit of which is 0 and the unit digits of which are respectively odd and even.

Accordingly, in the present instance, the rotary magnet M723 operates intermittently until the wiper 715 engages the contact in the associated contact bank 716 of the first test switch 710 terminating the test conductor CUI54 corresponding to the telephone line 245 extending to the paystation T2, the directory number of the telephone line 245 extending to the paystation T2 being 1154. When the wiper 715 engages the contact in the associated contact bank 716 of the first

test switch 710 terminating the test conductor CUI54, a test circuit is completed for energizing the winding of the test relay 34U, this circuit extending from one terminal of the secondary winding 755 of the test transformer 755 by way of the condenser 745, the winding of 34U, the contacts 735, the wiper 715 and engaged contact in the associated contact bank 716 of the first test switch 710, the test conductor CUI54 in the cable 725, the control conductor C248 of the telephone line 245, the control wiper 316 of the first wiper set of the mechanism 310, the contacts 324, 333 and 363 and the control conductor C331 in the cable 330 to the other terminal of the secondary winding 756 of the test transformer 755. When this test circuit is completed the test relay 34U operates to interrupt, at the contacts 34U2, the previously traced path for short-circuiting the winding of the first stop relay R740, whereupon a circuit is completed for energizing in series the winding of the first stop relay R740 and the rotary magnet M723. The last-mentioned circuit extends from ground by way of the contacts 752, 733, the winding of R740, the contacts 723 and the rotary magnet M723 to battery. When thus energized, the first stop relay R740 operates, while further operation of the rotary magnet M723 is arrested due to the high series resistance of the circuit previously traced for energizing the rotary magnet M723.

At this time, the wiper 711 engages the contact in the associated contact bank 712 of the first test switch 710 terminating the marking conductor C5DE, the directory number of the telephone line 245 extending to the paystation T2 being 1154, a number, the ten digit of which is 5 and the unit digit of which is even. Upon operating, the first stop relay R740 completes, at the contacts 741 and 742, obvious circuits for illuminating the identity lamps ML1 and CL1. Also, the first stop relay R740 completes, at the contacts 743, a circuit for illuminating the identity lamp DL5; this circuit extending from ground by way of the contacts 743, the wiper 711 and engaged contact in the associated contact bank 712 of the first test switch 710, C5DE and the identity lamp DL5 to battery. Also, upon operating, the test relay 34U completes, at the contacts 34U1, a circuit for illuminating the identity lamp UL4, this circuit extending from ground by way of the contacts 753, 12U2, 34U1 and 764 and the identity lamp UL4 to battery. Accordingly, at this time, the identity lamps ML1, CL1, DL5 and UL4, respectively corresponding to the thousand digit 1, the hundred digit 1, the ten digit 5 and the unit digit 4, are illuminated, thereby to indicate to the operator at the first A operator position 500 that the directory number of the telephone line 245 extending to the paystation T2 seized by the finder switch 300 is 1154.

At this point it is noted that the operation of the first identity unit 700 to identify any other telephone line, such, for example, as the telephone line 295 extending to the subscriber substation T1, is substantially identical to that previously explained. More particularly, in the last-mentioned instance, the rotary magnet M723 continues to operate intermittently, thereby to drive the wipers noted of the first test switch 710 step by step in the counterclockwise direction until the wiper 713 engages the first contact in the contact bank 714 of the first test switch 710 terminating the test conductor CUI111 connected to the control conductor C208 of the telephone line 295 extending to the subscriber substation T1.

In the present example, the test conductor CUI111 is terminated by the first contact in the contact bank 714 of the first test switch 710. Accordingly, a test circuit substantially identical to that previously traced is completed for energizing the winding of the test relay 12U immediately the first start relay R730 operates. Hence, the test relay 12U operates immediately in order to interrupt, at the contacts 12U2, the previously traced circuit for energizing the rotary magnet M723 prior to operation thereof. Also, the first stop relay R740 operates at this time, thereby to complete, at the contacts 741 and 742, the previously mentioned circuits for respectively illuminating the identity lamps ML1 and CL1. In the present example, the first stop relay R740 also completes, at the contacts 743, a circuit for energizing the winding of the marking relay 1D, this circuit extending from ground by way of the contacts 743, the wiper 711 and engaged contact in the associated contact bank 712 of the first test switch 710, C1D0 and the winding of 1D to battery. When thus energized the marking relay 1D operates to complete, at the contacts 1D2, an obvious circuit for illuminating the identity lamp DL1. Also, the marking relay 1D completes, at the contacts 1D1, an obvious circuit for energizing the winding of the switching relay R760, thereby to cause the latter relay to operate. Upon operating, the switching relay R760 completes, at the contacts 761, a circuit for illuminating the identity lamp UL1, this circuit extending from ground by way of the contacts 753, 12U1 and 761 and the identity lamp UL1 to battery. Accordingly, at this time, the identity lamps ML1, CL1, DL1 and UL1, respectively corresponding to the thousand digit 1, the hundred digit 1, the ten digit 1 and the unit digit 1, are illuminated, thereby to indicate to the operator at the first A operator position 500 that the directory number of the telephone line 295 extending to the subscriber substation T1 seized by the finder switch 300 is 1111.

In view of the above explanation of the mode of operation of the first identity unit 700, it will be understood that, in the event the unit digit of the directory number of a line being identified is odd, one of the marking relays 1D to 10D, inclusive, is operated, thereby to cause operation of the switching relay R760; on the other hand, in the event the unit digit of the directory number of a line being identified is even, none of the marking relays 1D to 10D, inclusive, is operated, thereby to prevent operation of the switching relay R760. Accordingly, the illumination of the identity lamps UL2, UL4, UL6, UL8 and UL10 are under the direct control of the respective test relays 12U, 34U, 56U, 78U and 90U; while the illumination of the identity lamps UL1, UL3, UL5, UL7 and UL9 are under the joint control of the switching relay R760 and the respective test relays 12U, 34U, 56U, 78U and 90U.

After the operator at the first A operator position 500 operates the identity key K575, thereby to cause the first identity unit 700 to operate and identify the directory number of the calling telephone line seized by the finder switch 300 and this directory number is noted, the operator at the first A operator position 500 returns the identity key K575 to its normal position, thereby to interrupt, at the contacts 578 thereof, the previously mentioned circuit for illuminating the signal lamp L583 in order to indicate that the identity key K575 occupies its normal position. Also, when the identity key K575 is returned to

its normal position, the previously traced circuit for energizing the winding of the identity relay R360 is interrupted at the contacts 577 thereof; while the previously traced circuit for energizing in series the winding of the lockout relay R750 and the lower winding of the first start relay R730 is interrupted at the contacts 576 thereof. Accordingly, the identity relay R360, the lockout relay R750 and the first start relay R730 restore. Upon restoring, the lockout relay R750 interrupts, at the contacts 752, the previously traced circuit for energizing in series the first stop relay R740 and the rotary magnet M723, thereby to cause the first stop relay R740 to restore. Upon restoring, the first start relay R730 interrupts, at the contacts 734, 735, 736, 737 and 738, one of the previously traced test circuits for energizing one of the respective test relays 12U, 34U, 56U, 78U and 90U, thereby to cause the operated one of the test relays mentioned to restore. Further, the first stop relay R740 interrupts, at the contacts 743, the circuit for energizing the winding of the operated one of the marking relays 1D to 10D, inclusive, in the event one of these relays is operated, thereby to cause the switching relay R760 to restore in the event it is operated. Accordingly, at this time, all of the apparatus in the first identity unit 700 is completely released, all of the identity lamps being extinguished at this time. It is noted that, upon restoring, the lockout relay R750 prepares, at the contacts 751, the previously mentioned circuit for energizing the upper winding of the first start relay R730 or the second start relay, not shown.

From the foregoing explanation of the mode of operation of the first test switch 710 in order to cause the first identity unit 700 to identify the directory number of any line in the first group of one hundred lines seized by the first wiper set of the mechanism 310 in the finder switch 300, it will be understood that the second test switch, not shown, is operative in a similar manner in order to cause the first identity unit 700 to identify the directory number of any line in the second group of one hundred lines seized by the second wiper set of the mechanism 310 in the finder switch 300. At this point it is noted that the directory number of any line identified by the first identity unit 700 has a thousand digit 1, a hundred digit 1 or 2, a ten digit 1 to 0 and a unit digit 1 to 0. In other words, the first identity unit 700 is restricted to identify the directory numbers of the particular group of lines accessible to the finder switch 300 and having directory numbers disposed between 1111 and 1200.

Upon restoring, the identity relay R360 re-completes, at the contacts 362, the previously traced path for applying ground potential by way of the control conductor C364 of the trunk 360 to the control wiper 316 of the first wiper set of the mechanism 310 in the finder switch 300, thereby to retain energized the cutoff relay in the line circuit individually associated with the telephone line seized by the first wiper set of the mechanism 310 in the finder switch 300.

After the operator at the first A operator position 500 has identified the directory number of a telephone line seized by the finder switch 300, she then performs the desired service over the connection including the link illustrated, regardless of whether the connection is to be extended or released incident to either a call or recall, as previously explained.

The connection and arrangement of the ap- 75

paratus at each A operator position, whereby the particular multi-symbol character identifying a telephone line having a call thereon routed to the A operator position to be answered, or the particular multi-symbol character identifying a calling telephone line included in an established connection having a recall thereon routed to the A operator position to be answered, may be detected by the operator at the A operator position, are disclosed and claimed in the copending divisional application of Thomas F. Crocker, Serial No. 539,871, filed October 5, 1940.

Call and recall storage

In the previous explanation of the mode of operation of the system it was assumed that the main A operator position distributor 630 had previously selected an idle A operator position when the calls were initiated at the subscriber substation T1 and at the paystation T2, and when the recall was initiated at the first B operator position 494 in the local exchange 20. However, it may occur that all of the A operator positions are busy when one or more calls are initiated at the subscriber substations or pay-stations or when one or more recalls are initiated at the various called operator positions. More particularly, when all of the A operator positions are busy the previously traced chain circuit for energizing the winding of the busy relay R560 is completed, thereby to cause the latter relay to operate. Upon operating, the busy relay R560 interrupts, at the contacts 562, the previously traced circuit for energizing the left-hand winding of the position relay R630 and interrupts, at the contacts 561, the previously traced holding circuit for energizing the winding of the hold relay R670 in series with the right-hand winding of one of the position relays R630, R640, R650, etc. Accordingly, at this time, all of the position relays R630, R640, R650, etc., occupy their restored positions, thereby to interrupt, at the contacts 632, 642, 652, etc., the previously traced circuits for energizing the windings of the answer relays at the various A operator positions. Further, the position relays R630, R640, R650, etc., interrupt, at the contacts 631, 641, 651, etc., the previously traced paths for applying ground potential in the various operator positions to the control conductor C680, thereby to interrupt the previously traced holding circuit for energizing the winding of the release relay R620. Thus, the release relay R620 occupies its restored position to retain interrupted, at the contacts 623, the previously mentioned circuit for energizing the winding of the control relay R610, thereby to retain the latter relay in its restored position. Also, the release relay R620 prepares, at the contacts 621, the previously traced circuit for energizing the winding of the first marking relay 1M.

Assuming that one or more calls are initiated in sequence at this time when all of the A operator positions are busy, the sequence switch associated with the first link taken for use will operate, in the previously described manner, until the wiper thereof engages the seventh contact in the associated contact bank or occupies a setting corresponding to the first storage setting of the call storage unit 600; whereupon, a series circuit is completed for energizing the winding of the first marking relay 1M and the winding of the stop relay in the finder switch of the first link, thereby to cause operation of the marking relay 1M shortly thereafter, this relay being of the slow-to-operate type, and to cause

operation of the stop relay in the finder switch of the first link. The operation of the stop relay in the finder switch of the first link arrests operation of the associated sequence switch, in the manner previously explained, and operation of the first marking relay 1M completes, at the contacts 1M1, a path for applying battery potential by way of the winding of the second marking relay 2M to the marking conductor C535. Also, the first marking relay 1M prepares, at the contacts 1M2, the previously traced circuit for energizing the winding of the release relay R620; however, this circuit is not completed at this time due to the absence of ground potential upon the control conductor C680, all of the position relays R630, R640, R650, etc., being restored at this time in the main A operator position distributor 630. Finally, the first marking relay 1M completes, at the contacts 1M3, an obvious circuit for illuminating the first storage lamp L601. The illumination of the first storage lamp L601 indicates to the operators at the various A operator positions that a call is stored in the first position or setting of the call storage unit 600.

The sequence switch associated with the second link taken for use will operate in the previously described manner until the wiper thereof engages the sixth contact in the associated contact bank, whereupon a series circuit is completed for energizing the winding of the second marking relay 2M and the winding of the stop relay in the finder switch of the second link, thereby to cause operation of the second marking relay 2M shortly thereafter, this relay being of the slow-to-operate type, and operation of the stop relay in the finder switch of the second link. The operation of the stop relay in the finder switch of the second link arrests operation of the associated sequence switch in a manner previously explained; and the operation of the second marking relay 2M completes, at the contacts 2M1, a path for applying battery potential by way of the winding of the third marking relay 3M to the marking conductor C534. Finally, the second marking relay 2M completes, at the contacts 2M2, an obvious circuit for illuminating the second storage signal lamp L602. The illumination of the second storage lamp L602 indicates to the operators at the various A operator positions that a call is stored in the second position of the call storage unit 600.

In view of the foregoing explanation of the manner in which the first and second calls initiated at a time when all of the A operator positions are busy are stored in the first and second positions of the call storage unit 600 respectively corresponding to the first and second marking relays 1M and 2M, it will be understood that the third, fourth, fifth and sixth calls initiated at this time will be stored in the respective third, fourth, fifth and sixth storage positions of the call storage unit 600 corresponding to the marking relays 3M, 4M, 5M and 6M. Further, it will be understood that, upon operating, the marking relays 3M, 4M, 5M and 6M respectively and sequentially complete the circuits for illuminating the storage signal lamps L603, L604, L605 and L606. Finally, upon operating, the sixth marking relay 6M completes, at the contacts 6M1, a path for applying battery potential by way of the resistor 612' to the marking conductor C530, thereby to cause the sequence switch associated with each of the links, in addition to the previously mentioned six links, to be arrested when

the wiper thereof engages the first contact in the associated contact bank, thereby to cause the remainder of the calls initiated at this time, in excess of six, to be conserved until there is storage facility in the call storage unit 600.

In view of the foregoing explanation of the mode of operation of the call storage unit 600, it will be understood that all incoming calls and recalls are routed in a predetermined order to idle ones of the A operator positions when one or more of the A operator positions are idle under the control of the main A operator position distributor 630; when all of the A operator positions are busy the next six calls and recalls initiated are stored in order in the respective six storage positions of the call storage unit 600; and when all of the storage positions in the call storage unit 600 are occupied subsequent calls and recalls are conserved until there is storage facility in the call storage unit 600.

Continuing now with the operation of the call storage unit 600, it is assumed that one or more of the A operator positions become idle at this time. When an A operator position becomes idle at this time, the corresponding position relay R630, R640, R650, etc., in the main A operator position distributor 630 operates, thereby to cause the idle A operator position to be selected by the main A operator position distributor 630 for use. When the idle A operator position is selected for use by the main A operator position distributor 630, ground potential is applied due to the operation of the corresponding one of the position relays R630, etc., to the control conductor C680, thereby to complete the previously traced circuit for energizing the winding of the release magnet M620, whereupon the release magnet M620 operates immediately, thereby to complete, at the contacts 623, the previously mentioned circuit for energizing the winding of the control relay R610, the control relay R610 being operative shortly thereafter. Also, upon operating, the release relay R620 interrupts, at the contacts 621, the previously traced series circuit for energizing the winding of the first marking relay 1M and the winding of the stop relay in the finder switch of the first link, thereby to cause the first marking relay 1M and the stop relay mentioned to restore. Upon restoring, the stop relay in the finder switch of the first link initiates further operation of the sequence switch associated with the first link, whereupon this sequence switch operates to seize the trunk extending to the idle A operator position in the manner previously explained.

Upon restoring, the first marking relay 1M interrupts, at the contacts 1M1, the previously traced series circuit for energizing the winding of the second marking relay 2M and the winding of the stop relay in the finder switch of the second link, thereby to cause the second marking relay 2M and the stop relay mentioned to restore. When the stop relay in the finder switch of the second link restores, further operation of the associated sequence switch is initiated, whereupon the sequence switch operates to cause the wiper to engage the seventh contact in the associated contact bank terminating the marking conductor C536, thereby to cause a series circuit for energizing the stop relay in the finder switch of the second link and the winding of the first marking relay 1M to be completed. The stop relay in the finder switch of the second link thus operates to arrest further operation of the associated sequence switch;

while the marking relay 1M operates to cause reoperation of the release relay R620 in the event there is an idle operator position selected by the main A operator position distributor 630 at this time.

On the other hand, in the event there is no idle A operator position selected by the main A operator position distributor 630 at this time, the release relay R620 is not reoperated. Hence, the sequence switch associated with the second link is not operated further at this time. Accordingly, the first marking relay 1M restores and subsequently reoperates. The restoration of the first marking relay 1M causes sequential restoration of the marking relays 2M, 3M, 4M, 5M and 6M, thereby to initiate sequential operations of the sequence switches associated with the second, third, fourth, fifth and sixth links. Upon reoperating, the first marking relay 1M prepares, at the contacts 1M1, the previously traced path for applying battery potential by way of the winding of the second marking relay 2M to the marking conductor C535, thereby to cause the sequence switch associated with the third link to be arrested when the wiper thereof engages the sixth contact in the associated contact bank. The second marking relay 2M then operates to prepare, at the contacts 2M1, the previously traced path for applying battery potential by way of the winding of the third marking relay 3M to the marking conductor C534. In view of the above explanation of the restoration and subsequent operation of each of the marking relays 1M to 6M, inclusive, it will be understood that the first link occupying the first storage position in the call storage unit 600 is operated to find the idle A operator position; while the sequence switches associated with the second, third, fourth, fifth and sixth links, respectively occupying the second, third, fourth, fifth and sixth storage positions in the call storage unit 600, are advanced one position in order respectively to occupy the first, second, third, fourth and fifth storage positions of the call storage unit 600.

Further, it is noted that, when the sixth marking relay 6M restores, it interrupts, at the contacts 6M1, the previously traced path for applying battery potential to the marking conductor C530, thereby to cause the sequence switches associated with the seventh, eighth, etc., links to operate further; whereupon, the wiper of the sequence switch associated with one of the seventh, eighth, etc., links engages the seventh contact in the associated contact bank, thereby to cause subsequent operation of the sequence switch associated with the last-mentioned link to be arrested. Accordingly, at this time, the call on the last-mentioned link is stored in the sixth position of the call storage unit 600; and the sequence switches associated with the remainder of the links continue to operate until the wipers thereof reengage the first contacts in the associated contact banks, thereby to cause the calls on the remainder of the links to be conserved until there is storage facility in the call storage unit 600.

In view of the foregoing explanation of the mode of operation of the call storage unit 600 in order to release calls from storage, it will be understood that the call stored in the first position of the call storage unit 600 is first released and the remainder of the calls are advanced one storage position. Accordingly, calls are stored in the call storage unit 600,

when all of the A operator positions are busy, in a predetermined order and are released as the A operator positions become idle in the same predetermined order. Furthermore, all incoming calls are conserved to be stored later when all of the storage facilities of the call storage unit 600 are utilized and are subsequently advanced to call storage positions indiscriminately. Hence, the unit 600 comprises not only a call storage unit, but also a call storage distributor.

Conclusions

From the foregoing, it is apparent that a telephone system is provided which comprises an exchange including a number of operator positions and an improved distributor arrangement for routing, in a predetermined order, incoming calls and recalls to the exchange to the operator positions to be answered. Also, each operator position is provided with improved apparatus for identifying the directory number of a telephone line included in a connection upon which a call or recall is routed to the operator position to be answered. Further, the exchange comprises improved switching apparatus for routing connections to the operator positions and for completing connections independently of the operator positions, which switching apparatus embodies automatic coin collecting and meter registering equipment.

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 paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a plurality of A operator positions, a B operator position, a line extending to said paystation, a trunk extending to said B operator position, means for routing a call from said paystation over said line to an idle one of said A operator positions to be answered, means for routing a call from said one A operator position over said trunk to said B operator position, means under the control of an operator at said one A operator position for establishing a connection between said line and said trunk independent of said one A operator position, means controllable from said B operator position over said trunk for positively selecting an idle one of said A operator positions to supervise said established connection, and additional means controllable from said B operator position over said trunk for governing said coin collection and refund control means.

2. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a plurality of A operator positions, a B operator position, a line extending to said paystation, a trunk extending to said B operator position, means for routing a call from said paystation over said line to an idle one of said A operator positions to be answered, means for routing a call from said one A operator position over said trunk to said B operator position, means under the control of an operator at said one A operator position for establishing a connection between

said line and said trunk independent of said one A operator position, means controllable from said B operator position over said trunk for positively routing a recall upon said established connection to an idle one of said A operator positions to be answered, and additional means controllable from said B operator position over said trunk for governing said coin collection and refund control means.

3. In a telephone system, a substation, a plurality of A operator positions, a B operator position, a line extending to said substation, a message register associated with said line, a trunk extending to said B operator position, means for routing a call from said substation over said line to an idle one of said A operator positions to be answered, means for routing a call from said one A operator position over said trunk to said B operator position, means under the control of an operator at said one A operator position for establishing a connection between said line and said trunk independent of said one A operator position, means controllable from said B operator position over said trunk for positively selecting an idle one of said A operator positions to supervise said established connection, and additional means controllable from said B operator position over said trunk for operating said message register.

4. In a telephone system, a substation, a plurality of A operator positions, a B operator position, a line extending to said substation, a message register associated with said line, a trunk extending to said B operator position, means for routing a call from said substation over said line to an idle one of said A operator positions to be answered, means for routing a call from said one A operator position over said trunk to said B operator position, means under the control of an operator at said one A operator position for establishing a connection between said line and said trunk independent of said one A operator position, means controllable from said B operator position over said trunk for positively routing a recall upon said established connection to an idle one of said A operator positions to be answered, and additional means controllable from said B operator position over said trunk for operating said message register.

5. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a substation, a plurality of A operator positions, a B operator position, a first line extending to said paystation, a second line extending to said substation, a message register associated with said second line, a trunk extending to said B operator position, means for selectively routing a call from said paystation over said first line or from said substation over said second line to an idle one of said A operator positions to be answered, means for routing a call from said one A operator position over said trunk to said B operator position, means under the control of an operator at said one A operator position for establishing a connection between said first line or said second line and said trunk independent of said one A operator position, means controllable from said B operator position over said trunk for positively selecting an idle one of said A operator positions to supervise said established connection, and additional means controllable from said B operator position over said trunk for governing said coin collection and refund control means in the event

said first line is included in said established connection and for operating said message register in the event said second line is included in said established connection.

6. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a substation, a plurality of A operator positions, a B operator position, a first line extending to said paystation, a second line extending to said substation, a message register associated with said second line, a trunk extending to said B operator position, means for selectively routing a call from said paystation over said first line or from said substation over said second line to an idle one of said A operator positions to be answered, means for routing a call from said one A operator position over said trunk to said B operator position, means under the control of an operator at said one A operator position for establishing a connection between said first line or said second line and said trunk independent of said one A operator position, means controllable from said B operator position over said trunk for positively routing a recall upon said established connection to an idle one of said A operator positions to be answered, and additional means controllable from said B operator position over said trunk for governing said coin collection and refund control means in the event said first line is included in said established connection and for operating said message register in the event said second line is included in said established connection.

7. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a second line, a plurality of operator positions, means for establishing a connection independent of said operator positions between said first line and said second line, means controllable over said established connection for positively selecting an idle one of said operator positions to supervise said established connection, and additional means controllable over said established connection for governing said coin collection and refund control means.

8. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a second line, a plurality of operator positions, means for establishing a connection independent of said operator positions between said first line and said second line, means controllable over said established connection for creating a call-back upon said established connection, means responsive to the presence of a call-back upon said established connection for positively selecting an idle one of said operator positions to answer the call-back upon said established connection, and additional means controllable over said established connection for governing said coin collection and refund control means.

9. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a second line, a plurality of operator positions, means for establishing a connection between said first line and an idle one of said operator positions, there-

by to extend a call from said first line to said one operator position to be answered, means for establishing a connection between said one operator position and said second line, thereby to extend a call from said one operator position to said second line, means for establishing a connection between said first line and said second line independent of said one operator position, thereby to extend a call from said first line to said second line, means controllable over said last-mentioned established connection for creating a recall upon said last-mentioned established connection, means responsive to the presence of a recall upon said last-mentioned established connection for positively selecting an idle one of said operator positions to answer the recall upon said last-mentioned established connection, and additional means controllable over said last-mentioned established connection for governing said coin collection and refund control means.

10. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a second line, a link including an answer switch having access to said first line and a call switch having access to said second line, means for causing the answer switch of said link to seize said first line, thereby to extend a call to said link, a plurality of operator positions, switching apparatus having access to said operator positions, means for causing said switching apparatus to route a call on said link to an idle one of said operator positions to be answered, call means operative under the control of an operator at said one operator position to cause the call switch of said link to seize said second line, thereby to complete a connection between said first line and said second line including said one operator position, transfer means operative under the control of an operator at said one operator position to complete a connection between said first line and said second line excluding said one operator position, means controllable over said last-mentioned established connection for creating a recall upon said last-mentioned established connection, means responsive to the presence of a recall upon said established connection for causing said switching apparatus to route the recall on said link to an idle one of said operator positions to be answered, and additional means controllable over said last-mentioned established connection for governing said coin collection and refund control means.

11. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a second line, an operator position, means for establishing a connection independent of said operator position between said first line and said second line, means controllable over said established connection for routing a call-back upon said established connection to said operator position to be answered, and additional means controllable over said established connection for governing said coin collection and refund control means.

12. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a

first line extending to said paystation, a second line, an operator position, means for establishing a connection independent of said operator position between said first line and said second line, means controllable over said established connection for routing a call-back upon said established connection to said operator position to be answered, means under the control of an operator at said operator position for governing said coin collection and refund control means to cause coins deposited in said coin receiving means to be refunded, and additional means controllable over said established connection for governing said coin collection and refund control means to cause coins deposited in said coin receiving means to be collected.

13. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a second line, an operator position, means including a link for establishing a connection independent of said operator position between said first line and said second line, control apparatus included in said link, said control apparatus being operative in a first manner to create a call-back upon said established connection and operative in a second manner to govern said coin collection and refund control means, means controllable over said established connection for selectively governing the manner of operation of said control apparatus, and means for routing a call-back upon said established connection to said operator position to be answered.

14. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a second line, an operator position, a link, means for connecting said link to said first line, thereby to extend a call on said first line to said link, means responsive to the presence of a call on said link for connecting said link to said operator position, thereby to route the call on said link to said operator position to be answered, means operative under the control of an operator at said operator position for connecting said link to said second line, thereby to route the call on said link to said second line, means operative under the control of an operator at said operator position for disconnecting said link from said operator position, thereby to complete a connection by way of said link between said first line and said second line independent of said operator position, control apparatus included in said link, said control apparatus being operative in a first manner to create a recall upon said established connection and operative in a second manner to govern said coin collection and refund control means, means controllable over said established connection for selectively governing the manner of operation of said control apparatus, and means responsive to the presence of a recall upon said link for connecting said link to said operator position, thereby to route the recall on said link to said operator position to be answered.

15. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a second line, an operator position, means including a link for establishing a connection independent of said

operator position between said first line and said second line, control apparatus included in said link, said control apparatus being operative in a first manner to create a call-back upon said established connection and operative in a second manner to release said link, means controllable over said second line for selectively governing the manner of operation of said control apparatus, means for routing a call-back upon said established connection to said operator position to be answered, additional means operative under the control of an operator at said operator position for releasing said link, means operative under the control of an operator at said operator position for governing said coin collection and refund control means to cause coins deposited in said coin receiving means to be refunded, and additional means controlled only in response to the release of said link by said control apparatus for governing said coin collection and refund control means to cause coins deposited in said coin receiving means to be collected.

16. In a telephone system, a substation, a first line extending to said substation, a message register associated with said first line, a second line, a plurality of operator positions, means for establishing a connection independent of said operator positions between said first line and said second line, means controllable over said established connection for positively selecting an idle one of said operator positions to supervise said established connection, and additional means controllable over said established connection for operating said message register.

17. In a telephone system, a substation, a first line extending to said substation, a message register associated with said first line, a second line, a plurality of operator positions, means for establishing a connection independent of said operator positions between said first line and said second line, means controllable over said established connection for creating a call-back upon said established connection, means responsive to the presence of a call-back upon said established connection for positively selecting an idle one of said operator positions to answer the call-back upon said established connection, and additional means controllable over said established connection for operating said message register.

18. In a telephone system, a substation, a first line extending to said substation, a message register associated with said first line, a second line, a plurality of operator positions, means for establishing a connection between said first line and an idle one of said operator positions, thereby to extend a call from said first line to said one operator position to be answered, means for establishing a connection between said one operator position and said second line, thereby to extend a call from said one operator position to said second line, means for establishing a connection between said first line and said second line independent of said one operator position, thereby to extend a call from said first line to said second line, means controllable over said last-mentioned established connection for creating a recall upon said last-mentioned established connection, means responsive to the presence of a recall upon said established connection for positively selecting an idle one of said operator positions to answer the recall upon said established connection, and additional means controllable over said established connection for operating said message register.

19. In a telephone system, a substation, a first

line extending to said substation, a message register associated with said first line, a second line, a link including an answer switch having access to said first line and a call switch having access to said second line, means for causing the answer switch of said link to seize said first line, thereby to extend a call to said link, a plurality of operator positions, switching apparatus having access to said operator positions, means for causing said switching apparatus to route a call on said link to an idle one of said operator positions to be answered, call means operative under the control of an operator at said one operator position to cause the call switch of said link to seize said second line, thereby to complete a connection between said first line and said second line including said one operator position, transfer means operative under the control of an operator at said one operator position to complete a connection between said first line and said second line excluding said one operator position, means controllable over said last-mentioned established connection for creating a recall upon said last-mentioned established connection, means responsive to the presence of a recall upon said last-mentioned established connection for causing said switching apparatus to route the recall upon said link to an idle one of said operator positions to be answered, and additional means controllable over said established connection for operating said message register.

20. In a telephone system, a substation, a first line extending to said substation, a message register associated with said first line, a second line, an operator position, means for establishing a connection independent of said operator position between said first line and said second line, means controllable over said established connection for routing a call-back upon said established connection to said operator position to be answered, and additional means controllable over said established connection for operating said message register.

21. In a telephone system, a substation, a first line extending to said substation, a message register associated with said first line, a second line, an operator position, means including a link for establishing a connection independent of said operator position between said first line and said second line, control apparatus included in said link, said control apparatus being operative in a first manner to create a call-back upon said established connection and operative in a second manner to operate said message register, means controllable over said established connection for selectively governing the manner of operation of said control apparatus, and means for routing a call-back upon said established connection to said operator position to be answered.

22. In a telephone system, a substation, a first line extending to said substation, a message register associated with said first line, a second line, an operator position, a link, means for connecting said link to said first line, thereby to extend a call on said first line to said link, means responsive to the presence of a call on said link for connecting said link to said operator position, thereby to route the call on said link to said operator position to be answered, means operative under the control of an operator at said operator position for connecting said link to said second line, thereby to route the call on said link to said second line, means operative under the control of an operator at said operator position for disconnecting said link from said

operator position, thereby to complete a connection by way of said link between said first line and said second line independent of said operator position, control apparatus included in said link, said control apparatus being operative in a first manner to create a recall upon said established connection and operative in a second manner to operate said message register, means controllable over said established connection for selectively governing the manner of operation of said control apparatus, and means responsive to the presence of a recall upon said link for connecting said link to said operator position, thereby to route the recall on said link to said operator position to be answered.

23. In a telephone system, a substation, a first line extending to said substation, a message register associated with said first line, a second line, an operator position, and means including a link for establishing a connection independent of said operator position between said first line and said second line, control apparatus included in said link, said control apparatus being operative in a first manner to create a call-back upon said established connection and operative in a second manner to release said link, means controllable over said second line for selectively governing the manner of operation of said control apparatus, means for routing a call-back upon said established connection to said operator position to be answered, additional means operative under the control of an operator at said operator position for releasing said link, and means controlled only in response to the release of said link by said control apparatus for operating said message register.

24. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a substation, a second line extending to said substation, a message register associated with said second line, a third line, means selectively operative to establish a connection between said first line or said second line and said third line, a plurality of operator positions, means controllable over said established connection for positively selecting an idle one of said operator positions to supervise said established connection, and additional means controllable over said established connection for governing said coin collection and refund control means in the event said first line is included in said established connection and for operating said message register in the event said second line is included in said established connection.

25. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a substation, a second line extending to said substation, a message register associated with said second line, a third line, means selectively operative to establish a connection between said first line or said second line and said third line, a plurality of operator positions, means controllable over said established connection for creating a call-back upon said established connection, means responsive to the presence of a call-back upon said established connection for positively selecting an idle one of said operator positions to answer the call-back upon said established connection, and additional means

controllable over said established connection for governing said coin collection and refund control means in the event said first line is included in said established connection and for operating said message register in the event said second line is included in said established connection.

26. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a substation, a second line extending to said substation, a message register associated with said second line, a third line, a plurality of operator positions, means selectively operative to establish a connection between said first line or said second line and an idle one of said operator positions, thereby to extend a call from said first line or said second line to said one operator position to be answered, means for establishing a connection between said one operator position and said third line, thereby to extend a call from said one operator position to said third line, means for establishing a connection between said first line or said second line and said third line independent of said one operator position, thereby to extend a call from said first line or said second line to said third line, means controllable over said last-mentioned established connection for creating a recall upon said last-mentioned established connection, means responsive to the presence of a recall upon said last-mentioned established connection for positively selecting an idle one of said operator positions to answer the recall upon said last-mentioned established connection, and additional means controllable over said established connection for governing said coin collection and refund control means in the event said first line is included in said last-mentioned established connection and for operating said message register in the event said second line is included in said last-mentioned established connection.

27. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a substation, a second line extending to said substation, a message register associated with said second line, a third line, a link including an answer switch having access to said first line and said second line and a call switch having access to said third line, means for causing the answer switch of said link to seize said first line or said second line, thereby to extend a call to said link, a plurality of operator positions, switching apparatus having access to said operator positions, means for causing said switching apparatus to route the call on said link to an idle one of said operator positions to be answered, call means operative under the control of an operator at said one operator position to cause the call switch of said link to seize said third line, thereby to complete a connection between said first line or said second line and said third line including said one operator position, transfer means operative under the control of an operator at said one operator position to complete a connection between said first line or said second line and said third line excluding said one operator position, means controllable over said last-mentioned established connection for creating a recall upon said last-mentioned established connection, means responsive to a re-

call upon said established connection for causing said switching apparatus to route the recall on said link to an idle one of said operator positions to be answered, and additional means controllable over said last-mentioned established connection for governing said coin collection and refund control means in the event said first line is included in said last-mentioned established connection and for operating said message register in the event said second line is included in said last-mentioned established connection.

28. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a substation, a second line extending to said substation, a message register associated with said second line, a third line, an operator position, means selectively operative to establish a connection independent of said operator position between said first line or said second line and said third line, means controllable over said established connection for routing a call-back upon said established connection to said operator position to be answered, and additional means controllable over said established connection for governing said coin collection and refund control means in the event said first line is included in said established connection and for operating said message register in the event said second line is included in said established connection.

29. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a substation, a second line extending to said substation, a message register associated with said second line, a third line, an operator position, means selectively operative to establish a connection independent of said operator position between said first line or said second line and said third line, means controllable over said established connection for routing a call-back upon said established connection to said operator position to be answered, means under the control of an operator at said operator position for governing said coin collection and refund control means to cause coins deposited in said coin receiving means to be refunded in the event said first line is included in said established connection, and additional means controllable over said established connection for governing said coin collection and refund control means to cause coins deposited in said coin receiving means to be collected in the event said first line is included in said established connection and for operating said message register in the event said second line is included in said established connection.

30. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a substation, a second line extending to said substation, a message register associated with said second line, a third line, an operator position, means including a link selectively operative to establish a connection independent of said operator position between said first line or said second line and said third line, control apparatus included in said link, said control apparatus being operative in a first manner to create a call-back upon said established connection and operative in a

second manner to govern said coin collection and refund control means in the event said first line is included in said established connection and to operate said message register in the event said second line is included in said established connection, means controllable over said established connection for selectively governing the manner of operation of said control apparatus, and means for routing a call-back upon said established connection to said operator position to be answered.

31. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a substation, a second line extending to said substation, a message register associated with said second line, a third line, an operator position, a link, means for selectively connecting said link to said first line or to said second line, thereby to extend a call on said first line or said second line to said link, means responsive to the presence of a call on said link for connecting said link to said operator position, thereby to route the call on said link to said operator position to be answered, means operative under the control of an operator at said operator position for connecting said link to said third line, thereby to route the call on said link to said third line, means operative under the control of an operator at said operator position for disconnecting said link from said operator position, thereby to complete a connection by way of said link between said first line or said second line and said third line independent of said operator position, control apparatus included in said link, said control apparatus being operative in a first manner to create a recall upon said established connection and operative in a second manner to govern said coin collection and refund control means in the event said first line is included in said established connection and to operate said message register in the event said second line is included in said established connection, means controllable over said established connection for selectively governing the manner of operation of said control apparatus, and means responsive to the presence of a recall upon said link for connecting said link to said operator position, thereby to route the recall on said link to said operator position to be answered.

32. In a telephone system, a paystation including means for receiving coins or the like and means for controlling collection and refund of coins deposited in said coin receiving means, a first line extending to said paystation, a substation, a second line extending to said substation, a message register associated with said second line, a third line, an operator position, means including a link selectively operative to establish a connection independent of said operator position between said first line or said second line and said third line, control apparatus included in said link, said control apparatus being operative in a first manner to create a call-back upon said established connection and operative in a second manner to release said link, means controllable over said third line for selectively governing the manner of operation of said control apparatus, means for routing a call-back upon said established connection to said operator position to be answered, additional means operative under the control of an operator at said operator position for releasing said link, means operative under the

control of an operator at said operator position for governing said coin collection and refund control means to cause coins deposited in said coin receiving means to be refunded in the event said first line is included in said established connection, and additional means controlled only in response to the release of said link by said control apparatus for governing said coin collection and refund control means to cause coins deposited in said coin receiving means to be collected in the event said first line is included in said established connection and for operating said message register in the event said second line is included in said established connection.

33. In a telephone system, a calling line, a called line, means for establishing a connection between said calling line and said called line, a plurality of operator positions, means controllable over said called line for creating a call-back upon said established connection, means responsive to the presence of a call-back upon said established connection for positively selecting an idle one of said operator positions to answer the call-back upon said established connection, additional means controllable over said called line for con-

necting a control potential to said calling line and then for releasing said established connection, and a device associated with said calling line and operated by the control potential connected to said calling line.

34. In a telephone system, a calling line, a called line, means including a link for establishing a connection between said calling line and said called line, said link including a control relay selectively operable over said called line, a plurality of operator positions, means controlled by a first predetermined operation of said control relay for creating a call-back upon said established connection, means responsive to the presence of a call-back upon said established connection for positively selecting an idle one of said operator positions to answer the call-back upon said established connection, means controlled by a second predetermined operation of said control relay for connecting a control potential to said calling line and then for releasing said established connection, and a device associated with said calling line and operated by the control potential connected to said calling line.

THOMAS F. CROCKER.