

Oct. 30, 1934.

W. WHITNEY

1,979,020

TELEPHONE EXCHANGE SYSTEM

Filed Oct. 12, 1932

10 Sheets-Sheet 1

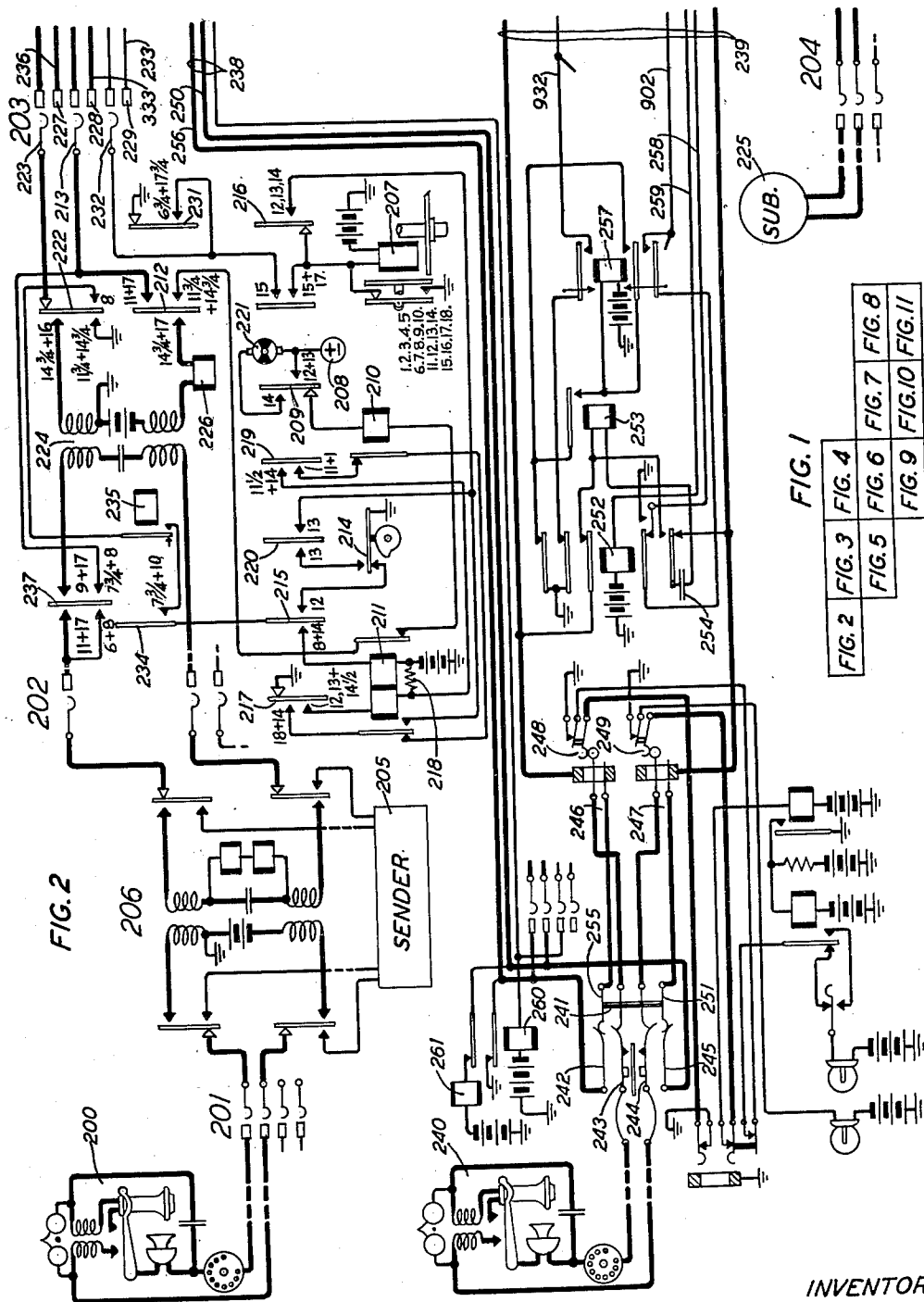


FIG. 1

FIG. 2	FIG. 3	FIG. 4	
	FIG. 5	FIG. 6	FIG. 7
			FIG. 8
			FIG. 9
			FIG. 10
			FIG. 11

INVENTOR
W. WHITNEY
BY *P. C. Smith*

ATTORNEY

Oct. 30, 1934.

W. WHITNEY

1,979,020

TELEPHONE EXCHANGE SYSTEM

Filed Oct. 12, 1932

10 Sheets-Sheet 2

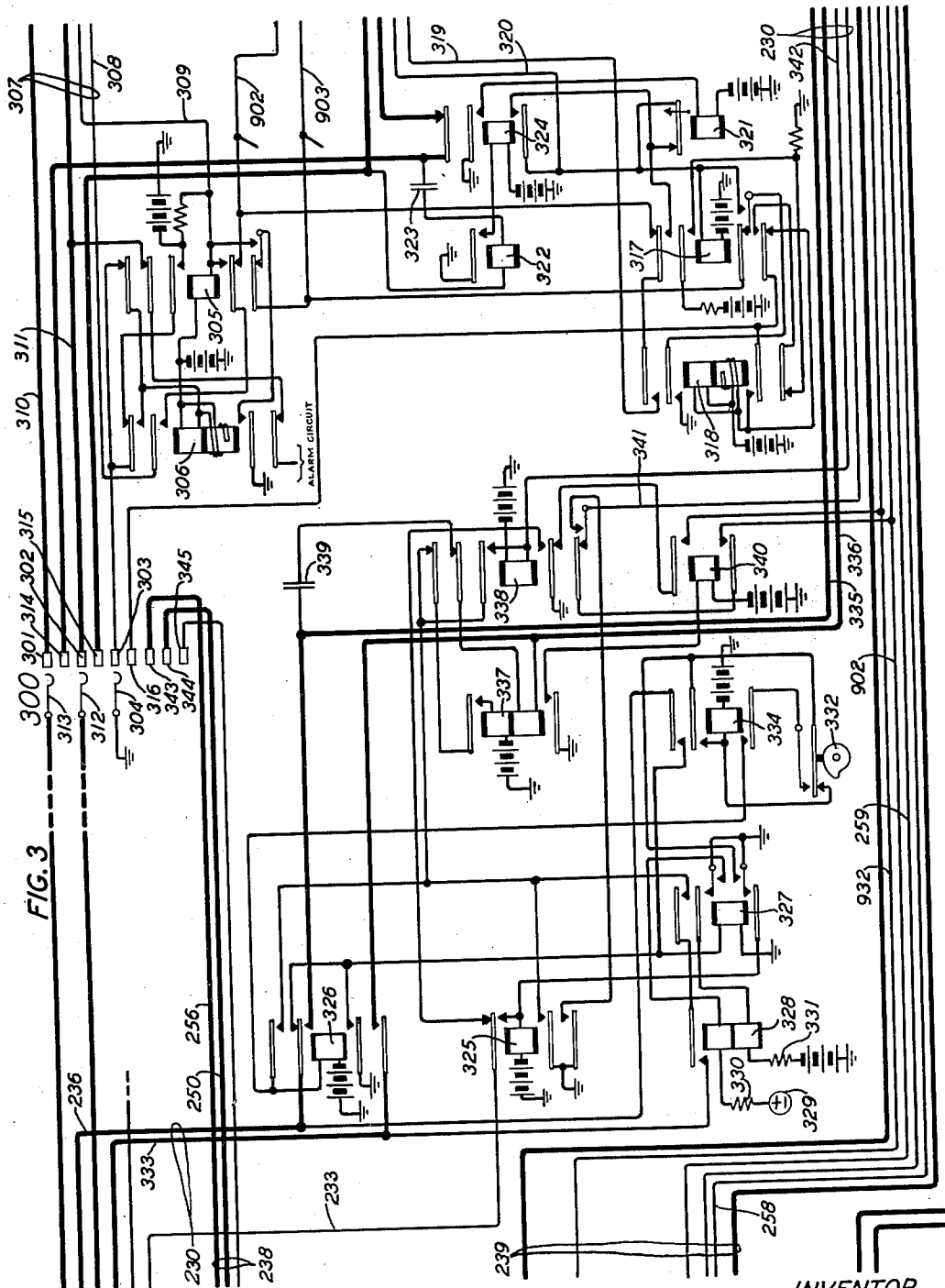


FIG. 3

INVENTOR
W. WHITNEY
BY *P. C. Smith*
ATTORNEY

Oct. 30, 1934.

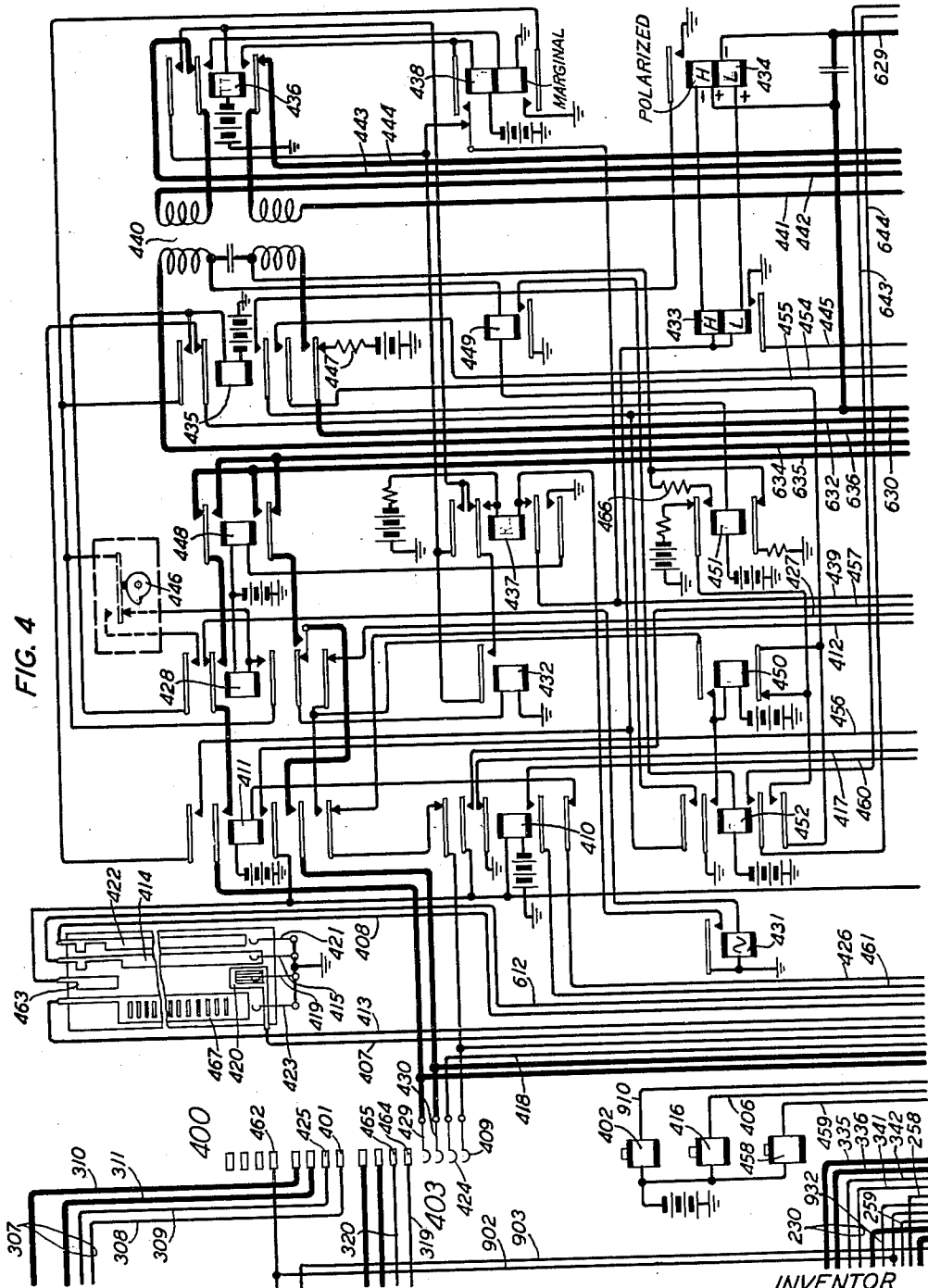
W. WHITNEY

1,979,020

TELEPHONE EXCHANGE SYSTEM

Filed Oct. 12, 1932

10 Sheets-Sheet 3



INVENTOR
W. WHITNEY

BY *P. C. Smith*

ATTORNEY

Oct. 30, 1934.

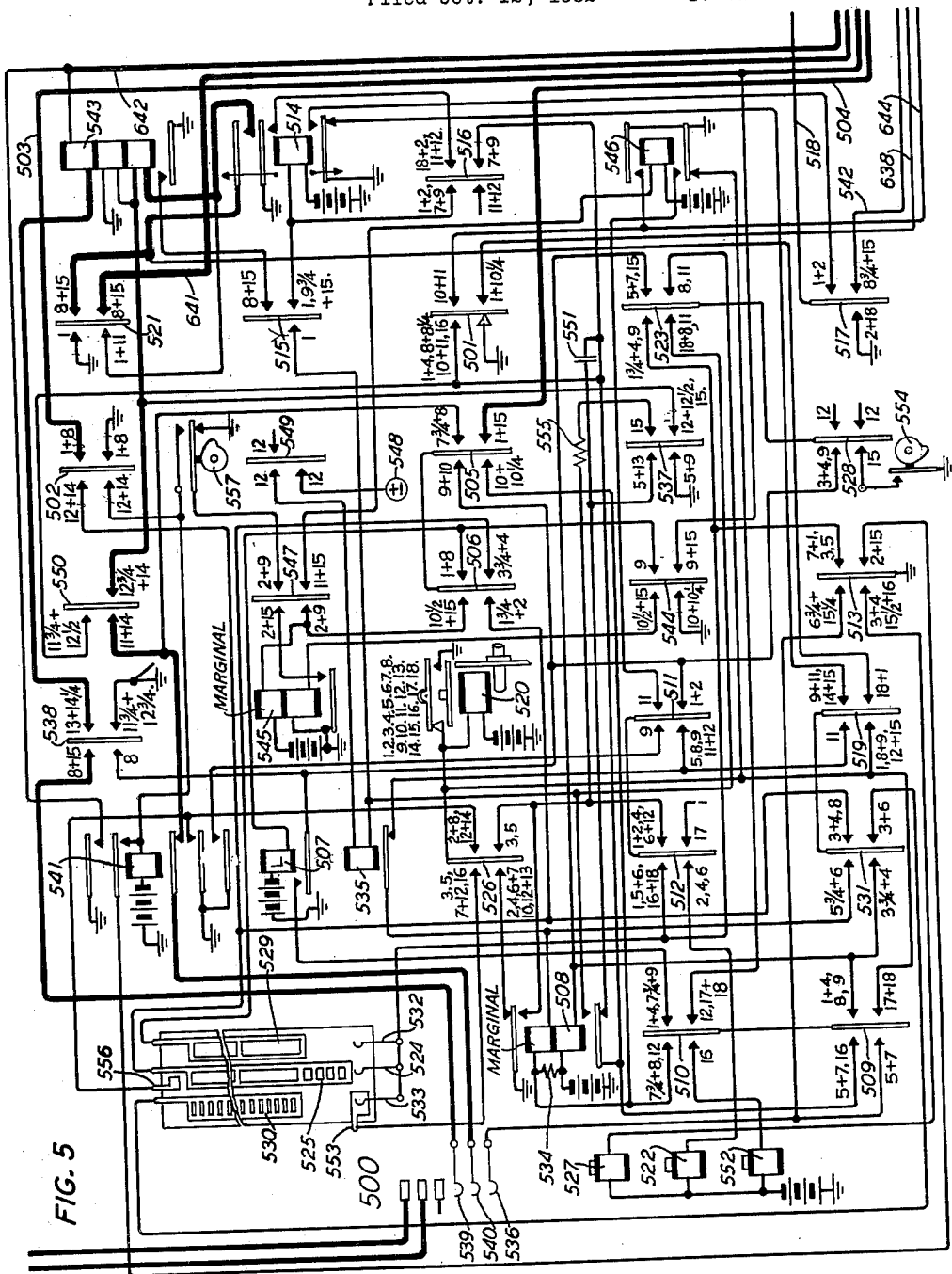
W. WHITNEY

1,979,020

TELEPHONE EXCHANGE SYSTEM

Filed Oct. 12, 1932

10 Sheets-Sheet 4



INVENTOR
W. WHITNEY

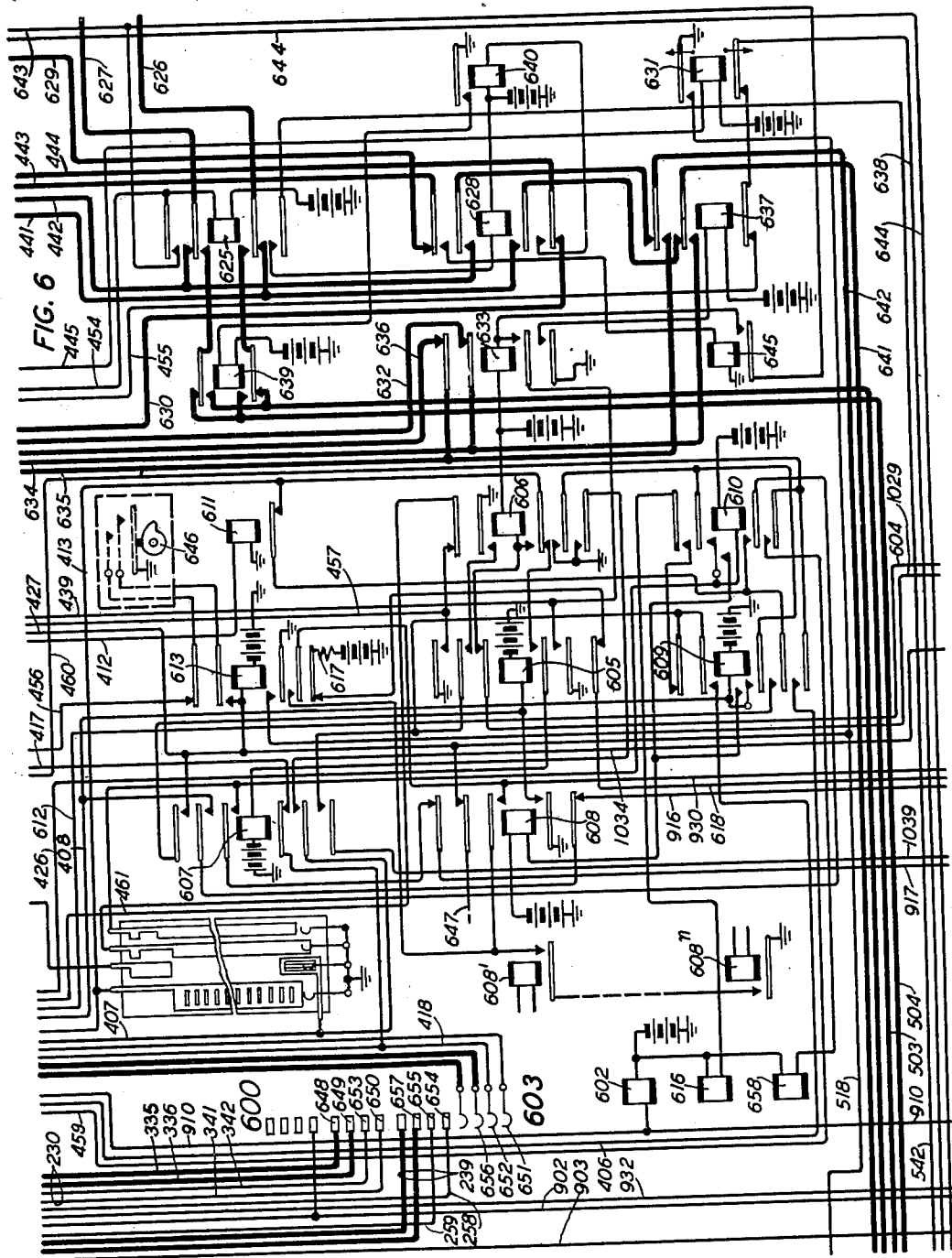
BY *P. C. Smith*

ATTORNEY

1,979,020

Filed Oct. 12, 1932

10 Sheets-Sheet 5



W. WHITNEY

BY *P. C. Smith*

ATTORNEY

Oct. 30, 1934.

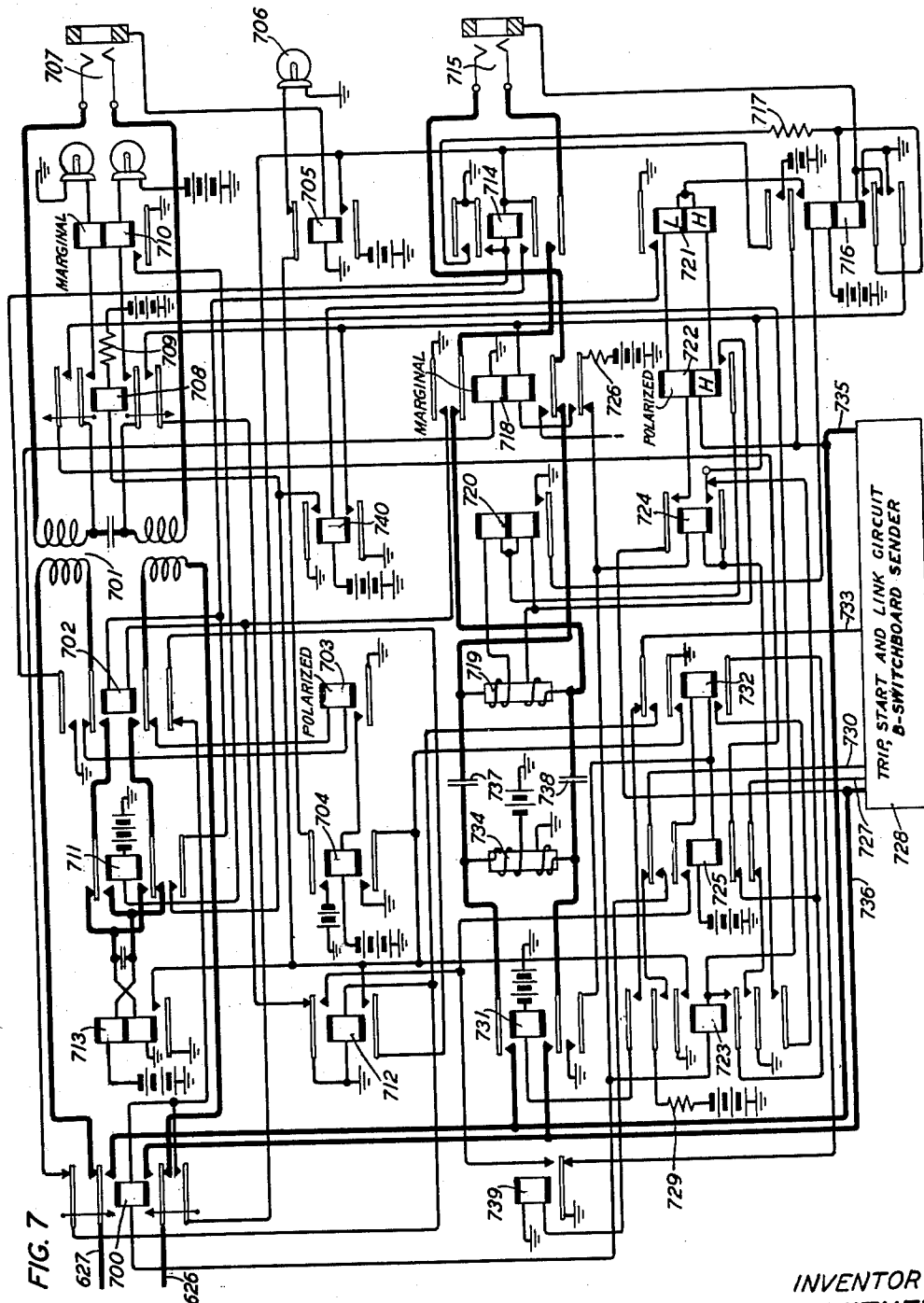
W. WHITNEY

1,979,020

TELEPHONE EXCHANGE SYSTEM

Filed Oct. 12, 1932

10 Sheets-Sheet 6



INVENTOR
W. WHITNEY
BY *P. C. Smith*

ATTORNEY

Oct. 30, 1934.

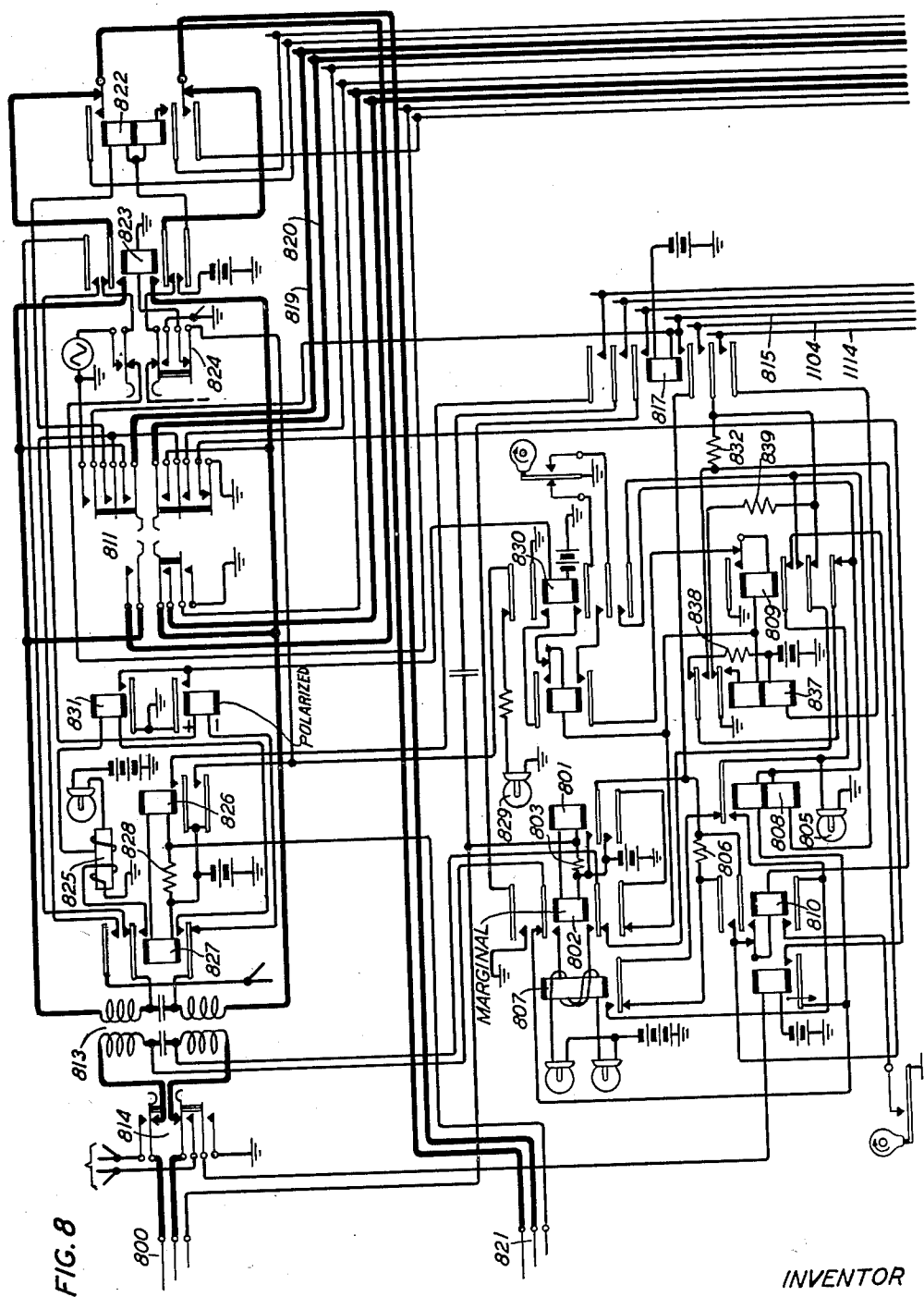
W. WHITNEY

1,979,020

TELEPHONE EXCHANGE SYSTEM

Filed Oct. 12, 1932

10 Sheets-Sheet 7



INVENTOR
W. WHITNEY
BY
P. C. Smith
ATTORNEY

Oct. 30, 1934.

W. WHITNEY

1,979,020

TELEPHONE EXCHANGE SYSTEM

Filed Oct. 12, 1932

10 Sheets-Sheet 8

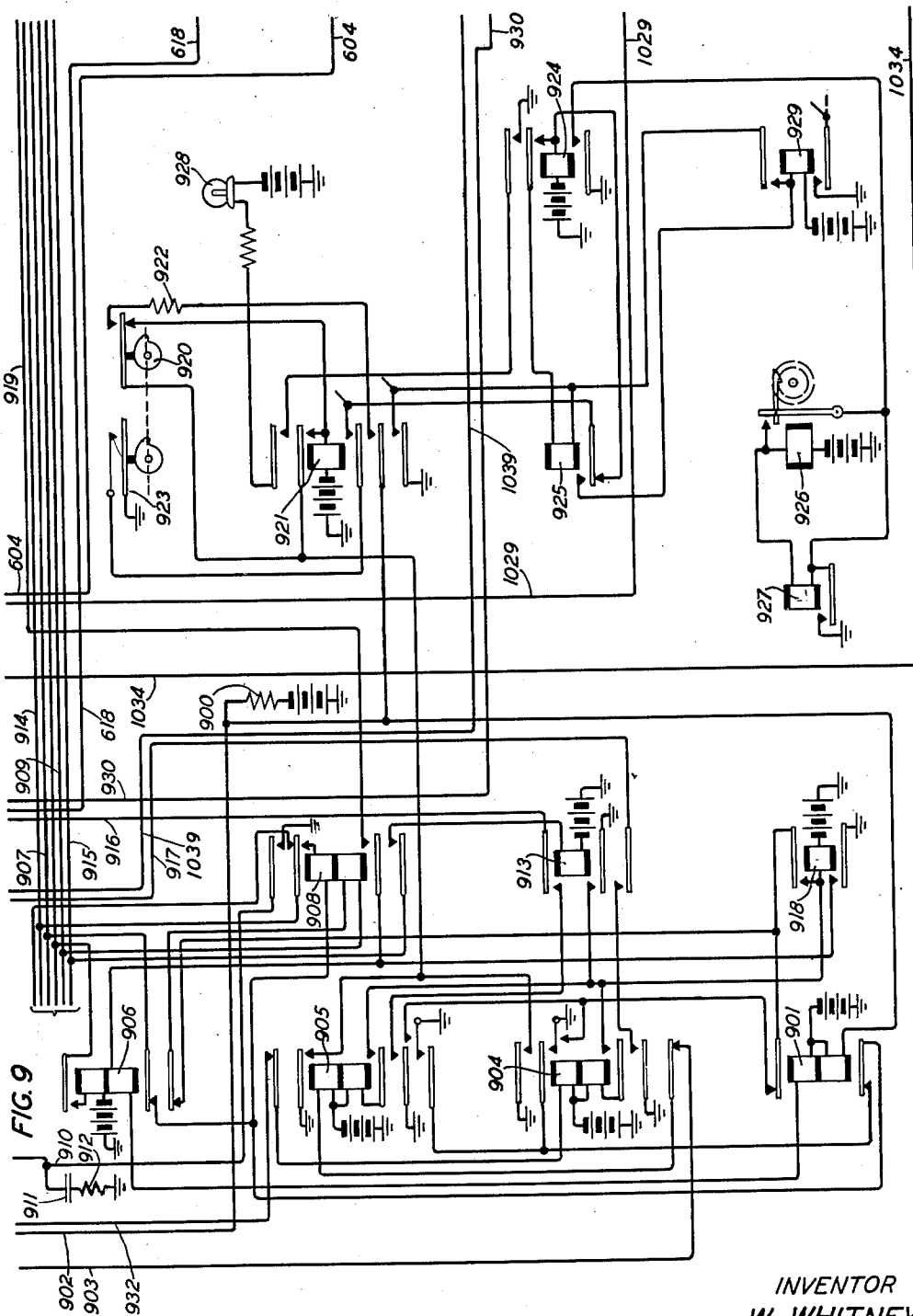


FIG. 9

INVENTOR
W. WHITNEY
BY *P. C. Smith*
ATTORNEY

Oct. 30, 1934.

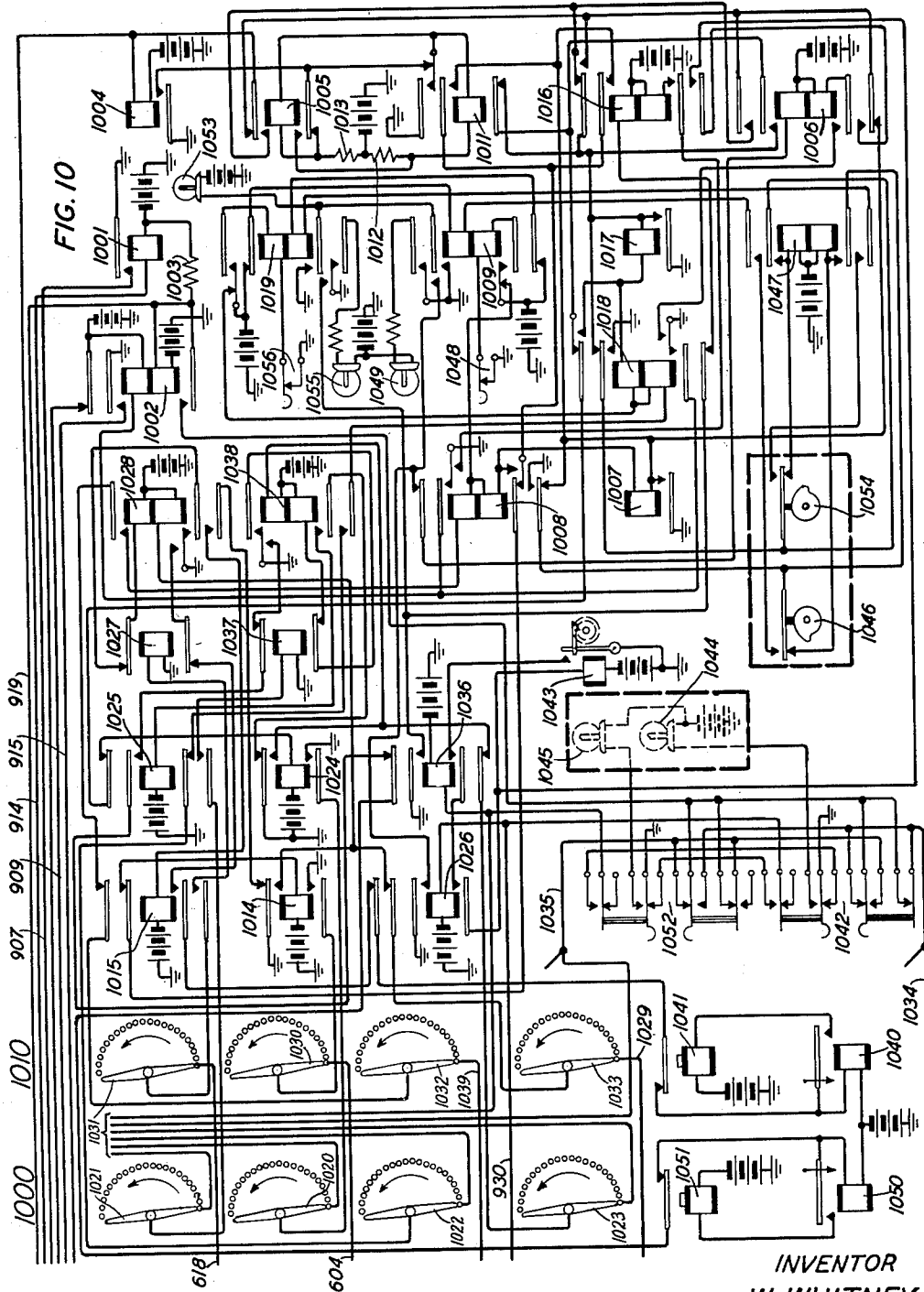
W. WHITNEY

1,979,020

TELEPHONE EXCHANGE SYSTEM

Filed Oct. 12, 1932

10 Sheets-Sheet 9



INVENTOR
W. WHITNEY

BY *P. C. Smith*

ATTORNEY

Oct. 30, 1934.

W. WHITNEY

1,979,020

TELEPHONE EXCHANGE SYSTEM

Filed Oct. 12, 1932

10 Sheets-Sheet 10

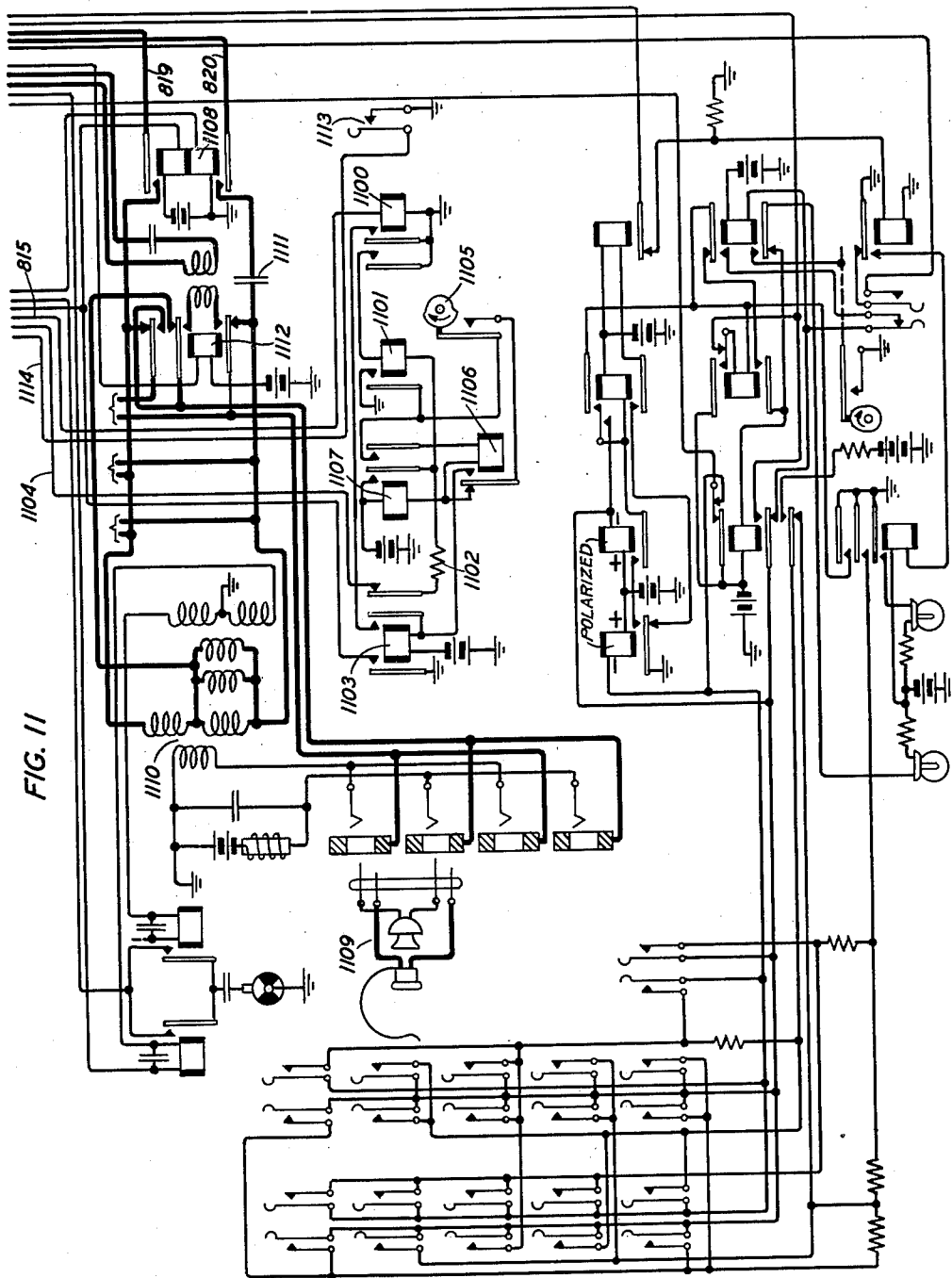


FIG. 11

INVENTOR
W. WHITNEY
BY *P. C. Smith*
ATTORNEY

UNITED STATES PATENT OFFICE

1,979,020

TELEPHONE EXCHANGE SYSTEM

Wiley Whitney, Bloomfield, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application October 12, 1932, Serial No. 637,426

23 Claims. (Cl. 179—18)

This invention relates to telephone exchange systems and more particularly to systems in which connections are established by dial switching equipment and in which an operator is enabled to intercept calls which have been extended to certain terminals of selector switches. It is desirable to enable calls to be intercepted when a connection has been extended to final selector terminals which are vacant or not in use, to terminals of lines on which the number has been changed, to terminals of lines which have been denied service for non-payment, to terminals of lines on which an error has been made in the directory listing, to terminals of lines which have been disconnected or when the final selector has been set upon a particular terminal for the purpose of obtaining verification request service. Also when a selector switch preceding the final selector or connector has been set upon a trunk terminal which is vacant or not connected to a final selector, it is desirable to enable the attempted call to be intercepted in order that the subscriber may be apprised of his dialing error and an attempt made to complete the desired connection. In addition, when a call has been made to a subscriber's line which is temporarily out of order and has been plugged out of service for inspection and repair, it is desirable that the services of an intercepting operator be secured to inform the calling subscriber of that condition.

Heretofore this intercepting service has been secured by trunking all calls on which the services of an operator are necessary, to an intercepting operator's position on the "A" switchboard of the office in which the calls originated or into which calls are incoming to lines which are temporarily out of service. This procedure requires that intercepting positions must be provided local to each office of the exchange area. It is, of course, apparent that considerable economy could be realized if the "A" switchboard could be removed from each office and a centralized "A" switchboard provided for serving all offices of the exchange area. If, however, the "A" switchboard is centralized it is most economical to also centralize intercepting operators' positions on the centralized "A" switchboard. Since it is highly desirable to provide facilities for enabling the intercepting operators to complete as many intercepted calls as possible, it therefore becomes necessary to provide means whereby when an intercepted call has then trunked to the centralized intercepting operator's position from any office of the exchange area, the operator may readily have access to completing equipment in the originating office for com-

pleting the attempted connection if the desired line terminates in the originating office. It is, therefore, the object of the present invention to provide facilities of an economical and simple character whereby the completion of intercepting calls trunked to a centralized intercepting operator's position may if the desired line terminates in the originating office, be controlled over the same circuit employed to trunk the call to the operator's position.

Although the present invention, for purposes of illustration, has been disclosed in an embodiment directed to the trunking of intercepted calls from offices of a dial switching system of the power driven or so-called panel type, it will be apparent that it is equally applicable to systems employing step-by-step type switches. In accordance with the invention the intercepting trunks from the final selector banks, incoming selector banks, or from plugged up subscribers' lines of each office are terminated in the banks of trunk finders at that office. As many trunk finders are provided at each office as are necessary to handle the intercepting traffic, an idle trunk finder being always allotted for use. When a call is initiated which becomes extended to an intercepting trunk appearing in the bank of an allotted trunk finder, the trunk finder is started to hunt for and connect with the intercepting trunk thereby extending the connection over an interoffice trunk in which the trunk finder terminates to a trunk jack at the centralized intercepting operator's position. The intercepting operator answers the call with the answering plug of a cord circuit of her position and obtains from the calling subscriber the designation of the connection which the calling subscriber has attempted to complete. If the connection can be completed in the originating office the intercepting operator then plugs the calling plug of her cord circuit into a calling jack of the interoffice trunk thereby causing the incoming end of the interoffice trunk circuit to become automatically associated with an operator's position on a "B" switchboard and then passes information for completing the connection to the "B" operator.

The "B" operator upon receiving the information, sets up on her keyboard the necessary record of the correct designation and the sender at her position is then controlled from the keyboard to control selector switches at the originating office over a control circuit extending over the interoffice trunk to extend a connection to the line to which the calling subscriber

desires connection. As soon as the connection has thus been established, a talking connection is completed from the calling line over the selector switches initially set by the calling subscriber, the intercepting trunk, trunk finder and the selector switches of the originating office set by the distant "B" operator to the correct called line. Thereupon the end of the interoffice trunk incoming to the centralized intercepting operator's position is cut off and the intercepting operator's position and the "B" operator's position equipment is freed for other service.

The trunk finders are arranged for access to a maximum of eight hundred trunks and since the terminal capacity of the well known panel type finder switch is four hundred, the finders are arranged for allotment in pairs, the brushes on the shaft of one finder of each pair having access to four hundred trunks appearing in the left half of the frame and the brushes of the shaft of the other finder of the pair having access to four hundred trunks appearing in the right half of the frame. Two groups of relays are provided in the trip circuits, one group being assigned to groups of intercepting trunks appearing in the right half of the frame and the other group being assigned to groups of intercepting trunks appearing in the left half of the frame, and dependent upon the operation of a relay in either group, the brush shaft of that one of a pair of allotted trunk finders will be started to hunt for the intercepting trunk upon which there is a call. The trunk finders are also divided into two groups and two allotters are provided which alternately allot an idle pair of trunk finders in each group for the purpose of equalizing the wear on the trunk finders.

For a more complete understanding of the invention, reference may be had to the following detailed description taken in connection with the attached drawings in which:

Fig. 1 is a diagram showing the manner in which the remaining figures should be arranged to completely disclose the invention;

Fig. 2 shows in the upper portion thereof a calling line, the diagrammatic disclosure of portions of a line finder, district selector, incoming selector and the sender of an originating office and in the lower portion thereof a second calling line which it will be assumed has been plugged out of service for inspection or repair and the plugging-up line and trouble intercepting trunk to which the line is connected. Fig. 2 also shows in the lower right portion thereof the diagrammatic representation of a called subscriber's line in the originating office to which the intercepting operator may extend intercepting calls and the diagrammatic representation of a final selector;

Fig. 3 shows in the upper portion thereof the diagrammatic representation of a final selector to which the incoming selector of Fig. 2 has access, which in turn has access to an intercepting trunk and a verification intercepting trunk terminating in the bank of the trunk finder of Fig. 4 and in the lower portion thereof an intercepting trunk extending from the bank of the incoming selector of Fig. 2 and terminating in a bank of the trunk finder of Fig. 6;

Figs. 4 and 6 show two trunk finders having access to the intercepting trunks of Figs. 2 and 3 and connected to the outgoing end of an interoffice intercepting trunk extending to a centralized intercepting operator's position;

Fig. 5 shows an incoming selector associable

with the outgoing end of the inter-office intercepting trunk of Fig. 6 for extending intercepting calls over the final selector diagrammatically shown in Fig. 2 to called lines in the originating office;

Fig. 7 shows the incoming end of the inter-office intercepting trunk terminating at the centralized intercepting operator's position and the diagrammatic representation of a B operator's equipment associable therewith for controlling the incoming selector of Fig. 5 and the final selector of Fig. 2;

Fig. 8 shows a cord circuit of the intercepting operator's position;

Figs. 9 and 10 taken together show a trip, start and allotter circuit for allotting and starting trunk finders such as are shown in Figs. 4 and 6;

Fig. 9 shows the trip circuit and Fig. 10 shows the start and allotter circuit; and

Fig. 11 shows the intercepting operator's telephone and key set circuits.

The line finder 201, district selector 202, incoming selector 203, final selector 204, shown diagrammatically in Fig. 2, the final selector 300, shown diagrammatically in Fig. 3, the trunk finders 400 and 600, illustrated in Figs. 4 and 6 and the incoming selector 500, shown in Fig. 5 are all of the well known panel type. For a complete disclosure of the circuits of line finder 201 and district selector 202, reference may be had to Patent No. 1,862,549, granted June 14, 1932 to R. Raymond and W. J. Scully. For a complete disclosure of the circuits of incoming selector 203 and final selectors 204 and 300, reference may be had to Patent No. 1,658,829, granted February 14, 1928 to C. H. Berry. The sender indicated by the rectangle 205 of Fig. 2 may be of the type disclosed in the patent to Raymond and Scully above referred to. The allotter switches 1000 and 1010 shown in Fig. 10 are of the well known non-restoring step-by-step type. The trip, start and link circuit and "B" switchboard sender indicated by the rectangle in the lower portion of Fig. 7 may be of the general type disclosed in Patent No. 1,753,348, granted April 8, 1930 to J. B. Newsom.

The trunk finders are divided into two groups on the trunk finder frame, the finders of one group in which finder 400 is included being located on one-half of the frame and the finders of the other group of which finder 600 is one, being located on the other half of the frame. All finders of the first group have access to the terminals of 400 trunks and all finders of the second group have access to the terminals of 400 other trunks so that a total of 800 trunks may be served. The trunk terminals of each group of 400 are further subdivided into ten banks of forty terminals each, each trunk finder having access thereto being provided with ten sets of brushes cooperating respectively with the ten banks. For tripping any brush set of any one of the finders of the first group, ten trip rods, one for each brush set extend before all finders of the group. The magnet 402, for example, serves when energized to trip the brush set 403 of finder 400 or the corresponding brush set of any other finder of the same group, the other nine trip magnets and brush sets of finder 400 being omitted for the sake of clarity. Similarly for tripping any brush set of any one of the finders of the second group, ten trip rods, one for each brush set, extend before all finders of the second group. The magnet 602, for example, serves when energized to trip the brush set 603 of finder 600 or the corresponding brush set

of any other finder of the same group. Corresponding trip magnets such as 402 and 602 are connected in parallel for simultaneous operation.

Ten trip circuits of which one is shown in Fig. 9 are provided, each trip circuit serving the two corresponding subgroups of trunks appearing in the corresponding terminal banks of the two groups of trunk finders. For example, the trip circuit of Fig. 9 serves the subgroup of forty trunks to which the brush set 403 of finder 400 has access, and the subgroup of forty trunks to which the brush set 603 of finder 600 has access. When any trunk of the first subgroup is calling, relay 905 is operated and when any trunk of the other subgroup is calling, relay 904 is operated. Either relay when operated prevents the operation of the other relay and causes the trip magnets 402 and 602 to be operated for tripping the brush set of a started trunk finder which has access to the subgroup of trunks in which the calling trunk is located. The operation of relay 904 or 905 causes the start circuit shown in Fig. 10, there being a single start circuit common to the ten trip circuits, to start an allotted trunk finder in the group of finders having access to the calling trunk.

The trunk finders of the two groups are arranged to be allotted in pairs, each pair comprising a trunk finder in each group, as for example, the pair of finders 400 and 600. For allotting the trunk finders two allotter circuits 1000 and 1010 are provided as shown at the left of Fig. 10, each allotter serving to allot one half of the pairs of trunk finders and the other allotter serving to allot the other half of the pairs of trunk finders. The two allotters are arranged to operate in conjunction with the start circuit shown at the right of Fig. 10 so that upon successive calls one of a pair of finders allotted by one allotter and then one of a pair of finders allotted by the other allotter and so on will be started. The particular finder of the pair to be started is determined in accordance with which relay 904 or 905 of the operated trip circuit is operated at the time. For example, if the allotter 1010 has allotted the pair of trunk finders 400 and 600 then if subgroup relay 905 is operated, the start circuit will cause the trunk finder 400 to be started, or if the subgroup relay 904 is operated, the start circuit will cause the trunk finder 600 to be started.

Completion of an intercepted call from a final selector terminal

It will first be assumed that the subscriber at substation 200 has initiated a call thereby causing the line finder 201 to connect with the calling line and the sender 205 to be connected with the line finder-district selector link circuit 206 and that the subscriber has then dialed a directory number causing the sender to set the district selector 202 and office selector (not shown), if necessary, the incoming selector 203 and the final selector 300 to establish a connection from the calling line to the terminals of the terminal bank of final selector 300 corresponding to the directory number dialed. It will also be assumed that that particular called line has been disconnected from the terminal bank of the final selector, either because the called line has been given a new number, or service of the called subscriber has been discontinued or a mistake in directory listing has been made, and that such terminals have been connected to an intercepting trunk 307 over which the calling subscriber may have access to a centralized intercepting operator's position. When therefore the

brushes of final selector 300 have been positioned upon the terminals of its bank corresponding to the numerical designation dialed, which terminals are indicated as 301, 302 and 303, a circuit is established from ground at the final selector over brush 304, terminal 303, upper back contact of relay 305, upper operating winding and lower non-inductive winding of relay 306 in parallel to battery.

Relay 306 operates and locks over its upper front contact to ground on terminal 303 and connects battery in parallel through resistance 900 at the lower winding of relay 901, over conductor 902, inner lower back contact of relay 305, inner upper front contact of relay 306, conductor 308, to the test terminal 401 of the intercepting trunk 307, appearing in the terminal bank of trunk finder 400, thus marking the intercepting trunk 307 as calling. Relay 306 also closes a circuit extending from ground at its lower front contact, lower normal contacts of relay 305, conductor 903, lower back contact of subgroup relay 904 to battery through the upper winding of subgroup relay 905 of the trip circuit of Fig. 9. Relay 905 operates, at its upper back contact opens the operating path of subgroup relay 904 to prevent a call in the other subgroup of trunks served by the same trip circuit from being served at this time and closes a circuit for operating relay 1001, extending from ground at its lowermost front contact, over the lower back contact of relay 901, inner lower back contact of relay 906, conductor 907, winding of relay 1001 to battery. At its lower front contacts, relay 905 also closes a circuit extending from ground, upper back contact of relay 901, lower back contact of relay 906, lower winding of relay 908, conductor 909, to battery over the upper back contact of relay 1002.

Relay 908 upon operating closes the operating circuit of trip magnets 402 and 602, extending from battery through the windings of these magnets in parallel, conductor 910 to ground at the upper front contact of relay 908, the contacts of relay 908 being protected by a parallel circuit to ground through condenser 911 and resistance 912. The operation of trip magnets 402 and 602 rotate trip rods (not shown) preparatory to tripping the corresponding brush sets of the allotted pair of trunk finders. Relay 908 also closes a locking circuit for itself extending from ground at the lowermost contact of relay 905, lower back contact of relay 901, upper winding and inner upper front contact of relay 908, back contacts of relays similar to relay 908 of succeeding trip circuits, conductor 914 to battery in parallel through the lower winding of start relay 1002 and resistance 1003. By thus wiring the locking circuit through contacts of relays 908 of other trip circuits only relay 908 of one trip circuit of the frame may be held operated at one time.

Start relay 1002 operates in the locking circuit of relay 908 and at its inner upper front contact closes a circuit from ground over conductor 915, lower contact of relay 908, to battery through the winding of relay 913. Relay 913 operates and connects ground from the intermediate lower front contact of relay 905, upper front contact of relay 913 to conductor 916 as an indication that a trunk finder of the group in which finder 400 is located should be started to hunt for the calling trunk. Had subgroup relay 904 been operated instead, then the operation of relay 913 would connect ground from the intermediate lower front contact of relay 904 over the lower front contact of relay 913 to conductor 917 as

an indication that a trunk finder of the group in which finder 600 is located should be started to hunt for the calling trunk. Relay 913 also closes an obvious circuit for relay 918 and closes a locking circuit for relay 905 extending from battery over the lower winding and inner lower front contact of relay 905, to ground at the inner lower front contact of relay 913. Relay 918 locks over its upper contact and the upper back contact of relay 901 to ground at the lower front contact of relay 905 and closes an operating circuit for relay 906 extending from ground at the lower front contact of relay 918, lower winding of relay 906 to battery through the upper winding of relay 901. Relay 901 does not receive sufficient current to operate at this time, but relay 906 operates. Relay 918 also closes a circuit extending from ground at its lower contact, over the inner lower front contact of relay 908, conductor 919 to battery through the winding of relay 1004 and in parallel therewith either over the upper back contact of relay 1005, lower back contact of relay 1006, winding of relay 1007, lower winding of relay 1008 to battery over the inner lower normal contacts of relay 1009 or over the upper front contact of relay 1005, upper normal contacts of relay 1016, winding of relay 1017, upper winding of relay 1018 to battery over the upper normal contacts of relay 1019 dependent upon whether relay 1005 is or is not operated at this time. It will be assumed that relay 1005 is not operated and that consequently relay 1007 operates in parallel with relay 1004, relay 1008 not receiving sufficient current to cause its operation, because of the high resistance of the winding of relay 1007.

Relay 1007 upon operating locks itself and relay 1004 to ground at its front contact. Relay 1004 upon operating closes a circuit from ground at its contact over the upper normal contacts and winding of relay 1011, resistance 1012 to battery and in parallel over the lower back contact of relay 1005 through resistance 1013 to battery. Relay 1011 operates and locks from ground over its upper alternate contacts and winding through resistance 1012 to battery and prepares an operating circuit for relay 1005 extending from battery through resistance 1013, winding of relay 1005 to ground at the upper alternate contacts of relay 1011, but relay 1005 being shunted by ground from the contact of relay 1004 over the lower back contact of relay 1005, does not operate until relay 1004 releases. Relay 1011, at its inner upper front contact closes a circuit for relay 1014 extending from battery, winding of relay 1014, inner upper back contact of relay 1015, inner lower normal contacts of relay 1008, inner upper front contact of relay 1011, to ground at the front contact of relay 1007. Relay 1014 closes an obvious circuit for operating relay 1028 which locks over its upper winding, and the upper back contact of relay 1027 to ground at its own inner lower front contact.

Assuming that allotter 1010 is standing in a position to allot the pair of trunk finders 400, 600, relay 1014 upon operating closes a start circuit extending from ground at its lower front contact, brush 1030 of allotter 1010, conductor 604, upper back contact of relay 605, winding of relay 606 to battery. Relay 606 operates and closes an obvious circuit for relay 607 which in turn extends conductor 916 over the lower back contact of relay 608, middle upper front contact of relay 607, to battery through the winding

of relay 609, and extends conductor 917 over the upper back contact of relay 608, inner upper front contact of relay 607, to battery through the winding of relay 610. If subgroup relay 905 has been operated, ground will have been connected to conductor 916, and relay 609 will therefore operate. However, if subgroup relay 904 has connected ground to conductor 917, relay 610 will operate. Relays 609 and 610 determine whether the shaft of trunk finder 400 or the shaft of trunk finder 600 will be started to hunt for a calling trunk. Since it has been assumed that relay 905 was operated, relay 609 will operate and lock over its inner lower front contact to ground at the middle lower front contact of relay 606. With relay 609 operated, relay 606 now locks from battery over its winding and inner lower front contact, back contact of relay 611, middle lower front contact of relay 609, conductor 612, commutator segment 414 and brush 415 of finder 400 to ground. Relay 609 also extends its locking ground through the winding of relay 608 to battery, thus operating relay 608 which opens the initial operating circuits of relays 609 and 610 and closes an obvious operating circuit for relay 605 and a circuit for relay 613 extending from battery through the winding of relay 613, upper front contact of relay 607 to ground at the inner lower front contact of relay 608. Relay 608 also closes at its inner upper front contact one point in a chain circuit through the contacts of similar relays of all trunk finders of the group normally allotted by allotter 1010 to conductor 930 for causing the start circuit of Fig. 10 to direct all calls to the other group of finders normally allotted by allotter 1000 as will be hereinafter described.

Relay 605 upon operating opens the initial operating circuit of relay 606, removes battery through resistance 617 over the lower back contact of relay 613, the lower back contact of relay 605 and conductor 618 from the terminal on which brush 1031 of allotter 1010 is sending to mark the trunk finder as busy to the allotter and closes the circuit of updrive magnet 416 of trunk finder 400 extending from battery through the winding of magnet 416, conductor 406, inner upper contact of relay 609, inner upper front contact of relay 605, to ground at the upper front contact of relay 606. With magnet 416 operated the shaft of trunk finder 400 is started upward to hunt for the terminals of the calling trunk.

At the time relay 613 operated, a circuit was closed from ground at its inner lower front contact over conductor 1029, brush 1033, middle upper back contact of relay 1026, to battery through the lower winding of relay 1028 for holding relay 1028 operated. With relays 605 and 606 operated, a circuit is closed from ground over the inner upper front contacts of relay 606 and 605, lower front contact of relay 607, conductor 1039, brush 1032 of allotter 1010, upper back contact of relay 1015, upper front contact of relay 1028, upper winding of relay 1008 to battery over the inner lower normal contacts of relay 1009. Relay 1008 now operates closing a short circuit around the winding of relay 1007 extending from the upper terminal of the winding of relay 1007, inner lower alternate contacts of relay 1008, inner upper front contact of relay 1011 to the lower terminal of the winding of relay 1007. Relay 1007 releases. Relay 1008 upon operating releases relay 1014 and locks in a circuit from battery through its lower winding and inner lower alternate contacts, inner upper front

contact of relay 1011, lower back contact of relay 1006, upper back contact of relay 1005, conductor 919, inner lower front contact of relay 908 to ground at the lower contact of relay 918. Relay 1008 at its inner upper front contact establishes a holding circuit through the upper winding of start relay 1002 for preventing another call from being served until the present call is safely handled and prepares an alarm circuit as will be described later.

Relay 1014 upon releasing removes ground from trunk finder start conductor 604 and closes a circuit from ground at its back contact over the lower front contact of relay 1028 to battery through the winding of relay 1015. Relay 1015 upon operating connects the winding of relay 1027 over its lower front contact to brush 1031 of allotter 1010 and closes a circuit from battery through the winding of stepping relay 1040 and back contact of stepping magnet 1041 of allotter 1010, upper back contact of relay 1026, inner lower front contact of relay 1015, lower back contact of relay 1027, to ground at the inner lower front contact of relay 1028. Relay 1040 operates and connects its operating ground to the winding of magnet 1041 which operates in turn opening the operating circuit of relay 1040. Relay 1040 now releases opening the circuit of magnet 1041 which releases to advance the brushes of allotter 1010 one step and to restore the operating circuit of relay 1040. In this manner allotter 1010 is advanced step-by-step until brush 1031 engages a terminal of its bank to which battery is connected through a resistance such as 617 of an idle pair of trunk finders in the allotter group. When wiper 1031 engages such a terminal, relay 1027 operates opening the circuit of stepping relay 1040 to arrest further stepping of the allotter and opens the holding circuit of relay 1028. Since the holding path previously traced for relay 1028 is also opened as soon as allotter brush 1033 moves off of the terminal connected to conductor 1029, relay 1028 releases in turn releasing relay 1015. With relay 1015 released, the circuit of relay 1014 is prepared so that it may operate on the next call directed to allotter 1010. The allotter 1010 has now preallotted another pair of trunk finders.

As soon as the shaft of trunk finder 400 has advanced through the tripping zone to trip the brush set 403, since trip magnet 402 has been operated, the commutator brush 419 engages commutator segment 420 closing a circuit from ground over brush 419 and segment 420, conductor 407, inner lower front contact of relay 607, conductor 1034, lower normal contacts of key 1042, lower front contact of relay 1002, conductor 914, to the upper winding of relay 908, thus short-circuiting this winding and causing relay 908 to release. Relay 908 upon releasing releases trip magnets 402 and 602 and releases relays 913 and 1004. Relay 1008 also releases provided that at this time the operating circuit through the upper winding of relay 1008 has been opened through the operation of relay 1015 as previously described. Relay 913 upon releasing removes ground from conductor 916 which initially caused the operation of relay 609 and opens the operating circuit of relay 918.

Relay 1004 upon releasing removes the short circuit previously traced around the winding of relay 1005 and relay 1005 now operates. As soon as brush 419 leaves the commutator segment 420, relay 1002 releases again connecting operating battery over its upper back contact for relays such as 908 of the trip circuits so that other calls may be handled in other trip

circuits. On the next incoming call from one of the trip circuits having access to the start circuit of Fig. 10, relay 1004 will be reoperated to close a shunt around the winding of relay 1011 extending from ground, contact of relay 1004, lower front contact of relay 1005, winding of relay 1011, to ground at the upper alternate contacts of relay 1011 and relay 1011 releases. With relay 1005 operated a circuit is established from ground on conductor 919, upper front contact of relay 1005, upper normal contacts of relay 1016, winding of relay 1017, upper winding of relay 1018 to battery over the upper normal contacts of relay 1019. Relay 1017 operates in this circuit closing at its contact a holding circuit for itself and for relay 1004, but relay 1018 does not receive sufficient current to operate. With relay 1011 released and relay 1017 operated, a circuit is closed from ground at the contact of relay 1017, lower back contact of relay 1011, upper normal contact of relay 1018, upper back contact of relay 1025, to battery through the winding of relay 1024. Relay 1024 closes an obvious circuit through the upper winding of relay 1038, which relay operates and locks over its lower winding, lower back contact of relay 1037 to ground at the upper front contact of relay 1038. Relay 1024 also closes a start circuit over brush 1020 of allotter 1000 for starting one of the pair of trunk finders which the allotter 1000 has preallotted. Following the starting of one of the pair of trunk finders as determined by the operated condition of subgroup relay 904 or 905 of the trip circuit, relays 1018, 1025, 1027, 1050 and stepping magnet 1051 function in the same manner as relays 1008, 1015, 1037, 1040 and magnet 1041, previously described to advance allotter 1000 to preallot another pair of trunk finders in its allotter group.

As soon as the started trunk finder has advanced its brush shaft through the tripping zone, ground is placed on conductor 1035, establishing a circuit over the lower normal contacts of key 1052 and the lower contact of relay 1002, which in the manner previously described, causes the release of relay 1004 and the release of relay 1018 if it has not at the time been released through the operation of relay 1025. Relay 1004 upon releasing opens the holding circuit of relay 1005 which following the release of relay 1011 was held operated in a circuit from ground at the contact of relay 1004, upper normal contacts of relay 1011, winding of relay 1005, resistance 1013 to battery. With both relays 1005 and 1011 released, the next incoming call is directed to a trunk finder in the group allotted by allotter 1010 in the manner previously described.

It will be recalled that the trunk finder 400 has been started and that the brush set 403 thereof has been tripped through the operation of trip magnet 402. As soon as the finder leaves normal, a holding circuit is established from ground over commutator brush 421 and segment 422, conductor 408 to battery through the winding of relay 609 and through the inner lower front contact of relay 609 through the winding of relay 608 for holding these relays operated as long as the trunk finder is off-normal. The finder shaft moves the tripped brush set 403 over the terminals of its associated bank until the test brush 409 engages terminal 401 of the calling trunk upon which terminal it will be recalled battery potential has been connected through the winding of relay 901 of the trip circuit. A circuit is thereupon completed over brush 409, upper back contact of relay

410, lower back contact of relay 411, conductor 412 to ground through the winding of relay 611. Relays 611 and 901 operate. Relay 611 opens the holding circuit of relay 606, but relay 606 remains operated over another holding circuit extending from battery through its winding and inner lower front contact, conductor 413, centering commutator segment 467, and brush 423 to ground until the brush set 403 is fully centered on the terminals of the calling trunk 307. Relay 606 then releases opening the circuit of updrive magnet 416 to arrest further movement of the shaft of trunk finder 400. Relay 606 also releases relay 607 and opens one holding circuit for relay 609, but relay 609 is locked operated as previously described as long as finder 400 remains off-normal. With relay 607 released a circuit is closed from ground at the inner upper back contact of relay 410, conductor 417, the lower back contact of relay 607, conductor 418, brush 424, terminal 425, conductor 309, winding of relay 305 of the trunk 307 to battery. Relay 305 operates, locks over its lower alternate contacts and the inner lower front contact of relay 306 to ground, connects ground to trunk terminal 401, over conductor 308, the inner upper front contact of relay 306, inner lower and lowermost alternate contacts of relay 305 to ground at the lower front contact of relay 306 thereby releasing relay 611, and opens conductors 902 and 903 extending to the trip circuit of Fig. 9. Relay 305 also at its inner upper front contact connects battery to the upper back contact of sleeve relay 306 so that should the calling subscriber restore first, the sleeve terminal 303 of the intercepting trunk 307 will be marked with busy potential. Relay 305 also opens at its upper back contact the initial operating circuit of sleeve relay 306.

At the trip circuit, relay 901 operated at the time relay 611 of the trunk finder operated, opening the locking circuits of subgroup relay 905 and relay 918. Relay 901 upon operating locks over its upper winding through the lower winding of relay 906 to ground at the lower contact of relay 918 until relay 918 releases. Relay 918 releases slowly to prevent the starting of another trunk finder in case relay 901 is operated and released momentarily on the overrunning of the trunk finder before its brushes have settled back on the terminals of the calling trunk and has operated relay 305 of the trunk to open the operating circuit of relay 901 extending over conductor 902. When relay 305 of the trunk circuit operates and opens conductors 902 and 903, the operating circuit of relay 905 is opened and relay 905 releases, and the operating circuit of relay 901 is opened and this relay releases as soon as relay 918 releases to open its locking circuit. With relays 901 and 918 both released, if no other call is awaiting attention, relay 906 releases and prepares the trip circuit to handle another call. If other calls are waiting on other banks, relay 1001 of the start circuit will be operated and will hold relay 906 locked over its upper winding preventing other calls in the bank served by the trip circuit of Fig. 9 from being served until waiting trunks in all other banks have been found. The operation of relay 901 also opens the locking circuit of relay 908 which relay releases at this time in case the trunk finder has failed to close the shunt path for relay 908 by the engagement of brush 419 with commutator segment 420.

At the trunk finder the release of relay 611 also closes a circuit extending from battery, winding of relay 411, lower back contact of relay 410,

conductor 426, inner lower front contact of relay 605, inner lower back contact of relay 606, back contact of relay 611, middle lower front contact of relay 609, conductor 612, to ground over commutator strip 414 and brush 415. Relay 411 upon operating opens the operating circuit of relay 611 and closes a circuit for reoperating relay 613, if this relay has in the meantime released, extending from battery, winding of relay 613, conductor 427, lower back contact of relay 428, lower front contact of relay 411, upper back contact of relay 410, brush 409 and terminal 401 to ground as traced at the lower front contact of relay 306. Relay 411 also closes the talking conductor 310 of trunk 307 over brush 429, the inner upper front contact of relay 411, the inner upper back contact of relay 428 to ground through the winding of relay 431, and conductor 311 of trunk 307 over brush 430, the inner lower front contact of relay 411, middle lower normal contacts of relay 428, to ground through winding of relay 432. Relay 411 at its upper front contact also closes a shunt around the upper high resistance windings of relays 433 and 434 extending from the left terminals of the windings of relay 433, upper contact of relay 411, upper back contact of relay 435 to the left terminal of the upper winding of relay 434.

Following the seizure of the intercepting trunk 307 by the final selector 300, the sequence switch 207 of the incoming selector will have advanced into the ringing position 12 as described in Patent No. 1,658,329 granted to C. H. Berry above referred to, and ringing current will be connected from the source 208 over the lower contacts of cam 209, winding of ringing current cut-off relay 210, right back contact of relay 211, right contacts of cam 212, brush 213 and the terminal upon which it is resting, brush 312 of the final selector, terminal 302 to trunk conductor 311. In position 12 of sequence switch 207, a circuit is also closed over the lower contact of interrupter 214, contacts of cam 215 to battery through the right winding of relay 211 in which circuit relay 211 operates closing a circuit from battery, winding of sequence switch magnet 207, contacts of cam 216, front contact of relay 211, to ground at the upper contacts of cam 217 for advancing the sequence switch into position 13. Relay 211 releases after the sequence switch leaves position 12. In position 13 a circuit is prepared for relay 211 through its left winding and the lower left and right contacts of cam 217 but relay 211 is prevented from operating by a shunt around its left winding, extending through resistance 218, contacts of cam 219, back contact of relay 210, left back contact of relay 211, to ground at the upper contacts of cam 217. The subsequent closure of the upper contact of interrupter 214 establishes a circuit over the contacts of cam 220, contacts of cam 216 to battery through the winding of sequence switch magnet 207 for advancing the sequence switch into position 14. In position 14 ringing current is connected from source 208 through interrupter 221, the left contacts of cam 209 and thence as traced to trunk conductor 311. As soon as the trunk finder 400 has connected with the trunk 307 and relay 411 has operated the ringing current connected to trunk conductor 311 flows through the winding of relay 432 causing its operation.

Relay 432 upon operating in response to the ringing current closes a circuit for relay 436 extending from battery, winding of relay 436, upper back contact of relay 437, contact of relay 432,

upper normal contacts of relay 438, conductor 439, to ground at the lower front contact of relay 605. Relay 436 upon operating locks over its upper front contact, the upper normal contacts of relay 438, to ground on conductor 439 and establishes a circuit extending from battery through the upper winding of marginal relay 438, lower front contact of relay 436, lower right winding of repeating coil 440, conductor 441, lower back contact of relay 625, trunk conductor 626, lower back contact of relay 700, lower left winding of repeating coil 701, inner lower back contact of relay 702, winding of polarized relay 703, upper back contact of relay 702, upper left winding of repeating coil 701, inner upper back contact of relay 700, trunk conductor 627, upper back contact of relay 625, conductor 442, upper right winding of repeating coil 440, upper front contact of relay 436, to ground through the lower winding of relay 438. Relay 703 which is polarized receives current and in the proper direction to operate, but marginal relay 438 does not receive sufficient current because of the high resistance of the winding of relay 703 and does not therefore operate. Relay 703 closes an obvious circuit for relay 704 which in turn closes a circuit for lighting trunk lamp 706 which extends from battery over the upper contact of relay 704, back contact of relay 705 to ground through lamp 706. The lighting of lamp 706 is a signal to the intercepting operator that a call is incoming to her position. Relay 704 also closes a circuit extending from ground at its lower contact through the winding of relay 708 and resistance 709 to battery for operating relay 708. Relay 708 connects the windings of relay 710 through the right windings of repeating coil 701 to the tip and ring contacts of trunk jack 707.

Had the calling subscriber initiated a call to the tip party of a called party line formerly connected to the terminals 301, 302 and 303 of final selector 300 then ringing current from the source 208 would have been connected in the well known manner to trunk conductor 310 instead of to trunk conductor 311 and relay 431 in the trunk finder would be operated instead of relay 432. With relay 431 operated, an obvious circuit is closed for relay 437 which operates, locks over its inner lower front contact and conductor 439 to ground at the lower front contact of relay 605, closes the circuit of relay 436 over its upper front contact and also closes an obvious circuit for relay 448. Relay 436 causes the lighting of the trunk lamp 706 in the manner previously described. Relay 448 reverses the talking conductors at the outgoing end of the inter-office intercepting trunk so as to prevent false supervision to the incoming selector 203 from the intercepting operator's position or from the completing incoming selector 500.

The intercepting operator upon seeing the lighted lamp 706 inserts the answering plug 800 of her cord circuit into jack 707 of the trunk thereby establishing a circuit from ground through the winding of sleeve relay 705 of the trunk, sleeves of jack 707 and plug 800, windings of relays 801 and 802 in series to battery and in parallel therewith through resistance 803 to battery. Relay 705 and 801 operate but relay 802 being marginal does not operate because of the high resistance of relay 705. Relay 705 opens the circuit of lamp 706 to extinguish it. At the operator's cord circuit, relay 801 upon operating closes a circuit for lamp 805 extending from battery, inner contact of relay 801, resistance 806,

back contact of relay 807, back contact of supervisory relay 808, to ground through lamp 805. A circuit is also established in parallel with lamp 805, over the inner lower back contact of relay 809, inner normal contacts and winding of relay 810 to ground at the right normal contact of listening key 811. Relay 810 locks in a circuit from battery at the inner contact of relay 801, inner upper alternate contacts and winding of relay 810 to ground at key 811. A circuit is now closed from ground through the upper winding of marginal relay 710, inner upper front contact of relay 708, upper right winding of repeating coil 701, tips of jack 707 and plug 800, upper normal contact of key 814, upper left winding of repeating coil 813, upper back contact of relay 802, upper winding of relay 808, lower back contact of relay 809, upper back contact of relay 837, resistance 838 to battery, and from 48 volt battery through the lower winding of relay 710, inner lower front contact of relay 708, lower right winding of repeating coil 701, rings of jack 707 and plug 800, lower normal contact of key 814, lower left winding of repeating coil 813, inner lower back contact of relay 802, middle lower back contact of relay 809, resistance 839 to ground at the inner upper back contact of relay 837. Supervisory relay 808 operates, but relay 710 being marginal does not receive sufficient current to operate at this time. Relay 808 upon operating extinguishes cord supervisory lamp 805.

When the operator throws her listening key 811, to the right or talking position, relay 810 releases and a circuit is established from ground at the upper alternate contact of key 811 for relay 817 which operates and establishes a circuit from battery at the inner contact of relay 801, inner lower contact of relay 817, conductor 815, winding of relay 1100 to ground. Relay 1100 operates and establishes a circuit from ground at its outer contact through the winding of relay 1101, resistance 1102, back contact of relay 1103, conductor 1104, next to the lower front contact of relay 817, middle lower back contact of relay 809, thence as traced to battery through the lower winding of relay 710. Relay 1101 operates closing a circuit from ground at its contact through the contacts of interrupter 1105, back contact of relay 1106, winding of relay 1107 to battery. Relay 1107 operates and locks through its winding and the winding of relay 1106, the outer contact of relay 1107 to ground at the contact of relay 1101, but relay 1106 being shunted does not operate until interrupter 1105 opens its contact. Relay 1107 at its inner contact closes an obvious circuit for holding relay 1101 and connects 24-volt battery through resistance 1102 over the circuit previously traced through the lower winding of relay 710, thereby causing the operation of relay 710. As soon as interrupter 1105 opens its contact, relay 1106 operates and on the next closure of the interrupter contacts, relay 1103 operates, locks to the inner contact of relay 1100, opens the operating circuit of relay 710 and closes a circuit extending from ground at its front contact through the upper winding of relay 1108 for connecting the operator's headset 1109 to the cord circuit.

Relay 1108 upon operating establishes a talking path from the upper right winding of repeating coil 813, inner upper right contact of key 811, conductor 819, upper contact of relay 1108, right winding of repeating coil 1110, condenser 1111, lower contact of relay 1108, conductor 820, inner lower right contact of key 811, to the lower

right winding of coil 813. Assuming that the operator's telephone set 1109 is plugged up, the talking path just traced is inductively associated with the operator's transmitter through the left winding of repeating coil 1110 and is connected with her receiver over the back contacts of relay 1112.

When relay 710 in the incoming end of the inter-office trunk operates momentarily, it closes an obvious circuit for reversing relay 711 which in turn completes the circuit of relay 702 extending from battery at the front contact of relay 705, lower front contact of relay 711, winding of relay 702 to ground at the inner upper back contact of relay 712. Relay 702 upon operating disconnects the winding of relay 703 from the trunk circuit thereby releasing relay 703 and with relay 711 operated, it establishes a circuit from battery through the upper winding of relay 713, inner upper front contacts of relays 711 and 702, upper left winding of repeating coil 701, upper back contact of relay 700, thence as traced to ground through the lower winding of relay 438 and establishes a second circuit from ground through the lower winding of relay 713, lower front contacts of relays 711 and 702, lower left winding of repeating coil 701, lower back contact of relay 700, thence as traced to battery through the upper winding of relay 438. Relays 438 and 713 operate, relay 713 closing a holding circuit for relay 708 to hold relay 708 operated following the release of relay 704 which releases when relay 703 releases. In order to insure that relay 708 will not release following the release of relay 704 and before relay 713 closes its holding circuit, it is made slightly slow to release. Relay 702 upon operating also closes a circuit extending from battery at the lower contact of relay 705, through the winding of relay 714 to ground at the upper contact of relay 702, thus operating relay 714 which locks over its inner upper front contact under the control of relay 705 and at its lower contact makes the contacts of completing jack 715 effective as will be later described. When relay 710 releases at the end of the tripping cycle as previously described, it opens the circuit of reversing relay 711 which reverses the connection of battery and ground to trunk conductors 626 and 627.

Relay 438 upon operating as previously described locks over its upper winding and upper alternate contacts to ground over conductor 439 and opens the locking circuit of relay 436 which relay releases, disconnects the windings of relay 438 from the circuit previously traced over trunk conductors 627 through the windings of relays 713, and connects a low resistance holding bridge across the trunk conductors, extending from trunk conductor 627, upper back contact of relay 625, conductor 442, upper right winding of repeating coil 440, upper back contact of relay 436, conductor 443, upper back contact of relay 628, conductor 629, low resistance windings of relays 434 and 433, upper front contact of relay 411, upper back contact of relay 435, conductor 630, lower back contact of relay 628, conductor 444, lower back contact of relay 436, lower right winding of repeating coil 440, conductor 441, lower back contact of relay 625, to trunk conductor 626, thus providing a holding circuit for supervisory relay 713 at the incoming end of the inter-office intercepting trunk circuit. Relay 433 operates in this circuit and relay 434 may operate, but without function at this time. Relay 433 upon operating closes a circuit from ground at its contact over

conductor 445 to battery through the winding of relay 631 which operates and provides another holding circuit for relay 613.

Relay 438 upon operating also closes a circuit from ground at its lower contact as soon as interrupter 446 closes its lower contact through the winding of relay 428 which operates, locks over its inner lower front contact to ground at the lower contact of relay 438, opens at its lower back contact one holding circuit of relay 613, opens the circuits previously traced through the windings of relays 431 and 432, and closes a circuit from battery through resistance 447, lower back contact of relay 435, conductor 632, inner upper back contact of relay 633, conductor 634, lower back contact of relay 448, lower alternate contacts of relay 428, middle lower front contact of relay 411, brush 430, trunk conductor 311, terminal 302, brush 312, brush 213, right contacts of cam 212, right back contact of relay 211, winding of relay 210, contacts of cam 209 to ringing generator 208. Relay 210 in the incoming selector operates, removing the shunt from the left winding of relay 211 which operates to open the ringing circuit at its right contact and to close a circuit from ground at the upper contacts of cam 217, left front contact of relay 211, contacts of cam 216, to battery through the magnet winding of sequence switch 207 thereby advancing the sequence switch out of the ringing position 14 into the talking position.

At its inner upper front contact, relay 428 also closes a circuit extending from ground at the contacts of cam 222 in the incoming selector over brush 223, brush 313, terminal 301, conductor 310, trunk finder brush 429, inner upper contact of relay 411, inner upper front contact of relay 428, upper back contact of relay 448, conductor 635, upper back contact of relay 633, conductor 636, upper left winding of repeating coil 440, winding of relay 449, lower back contact of relay 450 to battery over the upper back contact of relay 451. Relay 449 operates in this circuit and closes an obvious circuit for relay 452 which operates closing a holding path for relay 449 over its lower contact, independent of the lower contacts of relay 450, closing an obvious circuit for relay 450 and closing a new short-circuit around the upper windings of relays 433 and 434, over its upper contact. Relay 450 upon operating locks over its upper front contact, lower front contact of relay 411, upper back contact of relay 410, brush 409, terminal 401, conductor 308, inner upper front contact of relay 306, lower front contacts of relay 305 to ground at the lower front contact of relay 306, and opens the initial operating circuit of relay 449.

At its upper front contact relay 428 prepares a circuit for relay 435 which is closed as soon as interrupter 446 makes its upper contact extending from battery, winding of relay 435, upper contact of relay 428, upper contact of interrupter 446, to ground at the lower front contact of relay 438. Relay 435 upon operating locks over its upper front contact to ground at the lower contact of relay 438, disconnects tripping battery through resistance 447 at its lower contact, connects the left windings of repeating coil 440 through to the repeating coil 224 in the incoming selector 203, and at its upper back contact opens one short-circuit from around the upper windings of relays 433 and 434. A talking circuit is now established between the calling subscriber's line and the operator's position telephone set over which the

operator may receive information concerning the call which the subscriber desires to make.

It will be assumed that the call is one which the operator can complete and is for a line 225 which terminates in the same office in which the calling line terminates. The operator will therefore insert the calling plug 821 of the cord circuit which she has used to answer the call, into the completing-intercepting jack 715 of the intercepting trunk circuit thereby establishing a circuit from battery, windings of relay 827 and 826 in series and in parallel therewith through resistance 828, thence over the sleeves of plug 821 and jack 715, lower back contact of relay 716, resistance 717 to ground at the upper front contact of relay 714. Relays 826 and 827 will both operate, relay 826 closing a circuit from battery over its lower front contact, upper back contact of relay 830 to ground through lamp 829 for lighting the lamp and also closing a circuit from battery over its lower front contact, normal contact of key 824 to ground through the winding of relay 823. With relays 823 and 827 both operated a circuit is now established from battery right winding of retard coil 825, winding of supervisory relay 831, lower front contact of relay 827, lower right winding of repeating coil 813, inner lower front contact of relay 823, lower normal contacts of relay 822, rings of plug 821 and jack 715, lower front contact of relay 714, upper back contact of relay 718, lower winding of retard coil 719, both windings of relay 720 in series, upper winding of retard coil 719, lower back contact of relay 718, tips of jack 715 and plug 821, upper normal contacts of relay 822, inner upper front contact of relay 823, upper right winding of repeating coil 813, inner upper front contact of relay 827 to ground through the left winding of retard coil 825. Since relay 714 is operated, relay 720 operates in this circuit, but due to the high resistance of relay 720, the cord supervisory relay 831 does not operate. Relay 714 is provided so that the relay 720 will not operate in case the operator plugs into the completing jack 715 in error instead of answer jack 707 when answering a call. Relay 720 upon operating closes an obvious circuit through the upper winding of relay 716 and this relay operates locking from ground over its inner lower front contact and lower winding to battery over the sleeve of jack 715 and short-circuiting resistance 717. Relay 716 also establishes another holding circuit for relay 714 extending from battery at its upper front contact and the winding and inner upper front contact of relay 714 to ground, short-circuits the lower high resistance windings of relays 721 and 722 at its inner upper front contact and at its lower front contact establishes a circuit for relay 723 extending from ground at the lower front contact of relay 716, lower normal contacts of relay 724, inner lower back contacts of relay 725, upper front contact of relay 708, winding of relay 723, lower back contact of relay 718, resistance 726, to battery.

Relay 723 operates and locks in a circuit from battery as traced through its winding and inner lower front contact, lower normal contacts of relay 724 to ground at the lower front contact of relay 715 so that it is held operated after 725 operates as later described. Relay 723 connects ground at its middle lower front contact over the lower back contact of relay 725 and start conductor 727 leading to the trip, start and link circuit indicated by the rectangle 728, connects battery through resistance 729 over its middle upper

front contact and the upper back contact of relay 725 to conductor 730, connects battery through the winding of relay 731 over its upper front contact and the upper back contact of relay 732, to hunting conductor 733, establishes at its inner upper front contact a new holding path for relay 708 and at its lower front contact prepares a future operating path for relay 724.

The connection of ground to the start conductor 727 causes the trip, start and link circuit 728 to start hunting for the trunk circuit of Fig. 7. When the terminals of the trunk circuit are connected with, battery on conductor 730 causes the trip, start and link circuit to cease hunting and the circuit over conductor 733 is then closed, thereby operating relay 731. Relay 731 connects battery and ground through the windings of retard coil 734 to the tip conductor 735 and ring conductor 736, respectively and closes an obvious circuit for operating relay 725. The trip, start and link circuit 728 proceeds to associate the central "B" operator's position circuit therewith and, with battery and ground on conductors 735 and 736 causes the associated operator's position circuit to function to transmit a double order tone to the intercepting operator over conductors 735 and 736, front contacts of relay 731, condensers 737 and 738, thence over the talking connection previously traced to the intercepting operator's cord circuit thence over the inner contacts of talking key 811 which is still operated to the right, to the intercepting operator's headset 1109. The intercepting operator hearing the order tone passes the required number for completing the desired connection to the "B" operator.

The operation of relay 725 as previously described disconnects battery from conductor 730 and connects ground thereto over its upper front contact through the winding of relay 739, removes ground over its lower back contact from start conductor 727, opens at its inner lower back contact the operating circuit of relay 723, which relay is now held operated under the control of relays 724 and 716 and, with relay 739 now operated closes a holding circuit for itself extending from ground at the front contact of relay 739, inner upper front contact of relay 725, winding of relay 732 to battery through the winding of relay 725. Relay 732 does not operate in this holding circuit since its winding is shunted by ground applied over the lower front contact of relay 731.

After the "B" operator has completely registered the number passed to her by the intercepting operator on the registers of the sender indicated in the rectangle 728, high resistance battery is connected at the sender to conductor 733 in place of ground, thus causing relay 731 to release. Relay 731 upon releasing opens the talking circuit from the "B" operator's position to the intercepting operator's position, disconnects battery and ground through the windings of retard coil 734 from talking conductor 735 and 736, and opens the short-circuit from the winding of relay 732 which now operates in the holding circuit of relay 725. With relay 732 operated a new holding path is established from ground at its inner upper front contact for holding relay 708 operated after relay 723 releases as later described, and conductor 733 is disconnected from the winding of relay 731 and is connected over the upper front contact of relay 732 to ground through the winding of relay 712 and over the upper back contact of relay 700 to ground through the upper winding of relay 718. Relay 712 operates pro-

viding over its upper front contact a new holding ground for relays 725 and 732 for holding these relays operated after relay 739 releases. At its upper back contact relay 712 opens the circuit of relay 702 which now releases and at its lower contact closes a circuit extending from ground at the inner upper front contact of relay 723, lower contact of relay 712, lower back contact of relay 702, winding of relay 700, lower back contact of relay 718, resistance 726 to battery, relay 718 not having operated at the time the circuit previously traced through its upper winding was closed because of its marginal characteristic.

Relay 700 which is slow to operate, operates in the circuit just traced after a sufficient interval to allow the capacity on trunk conductors 626 and 627 to be discharged in a circuit extending from conductor 626 over the lower back contact of relay 700, the lower left winding of repeating coil 701, the inner lower back contact of relay 702, winding of relay 703, upper back contact of relay 702, upper left winding of repeating coil 701, upper back contact of relay 700 to conductor 627 before the trunk conductors are connected over the inner front contacts of relay 700 and conductors 735 and 736 through the trip, start and link circuit to the stepping relay of the associated sender. Relay 700 locks over its lower front contact, lower front contact of relay 708 to ground at the lower front contact of relay 716 and at its upper back contact opens the operating circuit previously traced for relay 718. Relay 702 upon releasing also disconnects battery and ground through the windings of relay 713, but relay 713 upon releasing performs no useful function at this time since relay 708 which was formerly held operated over the contacts of relay 713 is now held operated over the inner upper front contact of relay 723.

When relay 702 releases disconnecting battery and ground through the windings of relay 713 from trunk conductors 626 and 627, the circuit previously traced through the winding of relay 433 is opened and relay 433 releases in turn releasing relay 631. Relay 631 upon releasing opens at its upper contact the operating circuit of relay 613 and at its lower back contact closes a circuit over which relay 625 operates which may be traced from battery, winding of relay 625, conductor 454, middle lower front contact of relay 435, conductor 455, lower back contact of relay 637, back contact of relay 631, conductor 638, to ground over the lower contacts of cam 501 at the completing incoming selector 500. Relay 625 upon operating disconnects trunk conductors 626 and 627 from the windings of relays 433 and 434 and with relay 700 operated establishes a fundamental circuit extending from ground over the right contacts of cam 502, conductor 503, lower back contact of relay 639, inner lower front contact of relay 625, conductor 626, inner lower front contact of relay 700, conductor 736 through the winding of the stepping relay (not shown) of the sender 728 returning over conductor 735, upper front contact of relay 700, conductor 627, inner upper front contact of relay 625, upper back contact of relay 639, conductor 504, lower right contact of cam 505, upper right contact of cam 506 to battery through the winding of relay 507.

The stepping relay of the sender and relay 507 operate, relay 507 closing a circuit from battery through the lower winding of relay 508, upper right contact of cam 509, upper right contact of

cam 510, front contact of relay 507, lower right contact of cam 511, upper left contact of cam 512, to ground over the upper right contact of cam 513. Relay 508 operates and locks through its lower winding, upper right contact of cams 509 and 510, front contact of relay 507, lower right contact of cam 511, upper right contact of cam 512, upper front contact of relay 508 to ground until the sequence switch 520 leaves position 2. Relay 508 also closes a circuit extending from battery, winding of relay 514, lower contacts of cam 515, lower front contact of relay 508 to ground over the left contacts of cam 501, relay 514 locking over the upper contacts of cam 516 to ground at its inner upper front contact and closing a circuit from ground at its lower front contact and the upper contact of cam 517, conductor 518 to battery through the winding of relay 613 of the trunk finder to hold the trunk finder and outgoing trunk circuit. Relay 514 also closes a circuit for advancing sequence switch 520 of the incoming selector into position 2 which circuit extends from battery, winding of the sequence switch magnet, lower contacts of cam 519, upper front contacts of relay 514, left contact of cam 521 to ground. As soon as the sequence switch reaches position 2 holding ground is connected to conductor 518 over the left contact of cam 517 as long as the incoming selector circuit is off-normal.

With the sequence switch in position 2, the circuit of the updrive magnet 522 is closed from battery through the winding of magnet 522, lower left and upper right contacts of cam 512, to ground at the upper front contact of relay 508. During the upward travel of the brush shaft, ground is intermittently connected from the left contacts of cam 501, over the lower front contact of relay 508, left contacts of cam 523, brush 524 and commutator segment 525, lower left and upper right contacts of cam 506 to battery through the winding of relay 507 holding relay 507 operated and intermittently shunting down the stepping relay (not shown) of the sender. When the sender has received sufficient shunting impulses to satisfy it with respect to the incoming brush registration, the fundamental circuit is opened at the sender and relay 507 releases as soon thereafter as brush 524 engages the next insulating portion of the commutator segment 525, in turn releasing relay 508. Relay 508 opens the circuit of updrive magnet 522 to stop the further upward movement of the switch shaft. At its upper back contact relay 508 closes a circuit extending from ground over the lower left contact of cam 526 to the magnet winding of sequence switch 520 for advancing the sequence switch into position 3. When the sequence switch leaves position 2 relay 514 releases.

With the sequence switch in position 3 a circuit is closed from battery through the winding of trip magnet 527 to ground at the lower left contact of cam 513 and magnet 527 operates in order to be ready to trip the selected brush set of selector 500 on the next upward movement of the brush shaft. The fundamental circuit is again closed in the sender and relay 507 reoperates operating relay 508 in a circuit from battery through the lower winding of relay 508, upper right contacts of cams 509 and 510, front contact of relay 507, upper left contact of cam 528, upper left contact of cam 523, to ground at the upper right contact of cam 513 and locks in the circuit just traced through its lower winding to the front contact of relay 507 thence over the upper left

contact of cam 528, lower left contact of cam 523, lower front contact of relay 508 to ground over the left contacts of cam 501. Relay 508 also establishes a circuit from ground at its upper front contact over the lower right contact of cam 526 for advancing sequence switch 520 into position 4.

In position 4 commutator segment 529 is connected over the lower right contact of cam 506 to the tip side of the fundamental circuit and commutator segments 525 and 530 are connected over the right and lower left contacts of cam 531 to the lower winding of relay 508. The updrive magnet 522 is again energized in the circuit previously traced over the upper front contact of relay 508 to advance the switch shaft in a group selection movement. During the initial portion of this movement with trip magnet 527 operated, the selected brush set is tripped and thereafter intermittent impulses are transmitted from ground at the left contacts of cam 501, lower front contact of relay 508, left contacts of cam 523, brush 532, commutator segment 529, right contacts of cam 506 to battery through the winding of relay 507, holding relay 507 operated and intermittently shunting down the stepping relay of the sender. When the sender has received sufficient shunting impulses to satisfy it with respect to the incoming group registration, the fundamental circuit is opened at the sender and relay 507 releases as soon as brush 532 engages the next insulating portion of segment 529. Upon releasing, it opens the operating circuit of relay 508. Ground on commutator segment 530 over brush 533, the left contacts of cam 523, the lower front contact of relay 508 and the left contacts of cam 501 overlapped by ground over brush 524 and commutator segment 525, however, prevents the release of relay 508 until the switch shaft has advanced high enough for the usual locking pawl to engage when the updrive magnet 522 releases. When the locking circuit of relay 508 is opened when brush 533 engages the next insulating portion of commutator segment 530 which it does just after brush 524 leaves a conducting portion of segment 525, relay 508 releases opening the circuit of updrive magnet 522 and closing the previously traced circuit for advancing sequence switch 520 into position 5.

With the sequence switch in position 5 a circuit is established for operating relay 508 from battery, through resistance 534, upper winding of relay 508, back contact of relay 535, lower left contact of cam 511, upper left contact of cam 512 to ground at the upper right contact of cam 513. With relay 508 operated its lower winding is connected in a circuit from battery over the upper right and lower left contacts of cam 523, lower front contact of relay 508, left contacts of cam 509, to sleeve brush 536, and a circuit is established from ground over its upper front contact and the lower right contact of cam 526 for advancing the sequence switch 520 into position 6. If the first trunk upon which the tripped set of brushes is now standing is idle, the circuit over the test brush 536 through the lower winding of relay 508 will not be completed to ground and since the circuit through the upper winding of relay 508 was opened as soon as the sequence switch left position 5, relay 508 will release and connect busy ground to the test terminal of the trunk over brush 536, the left contacts of cam 509, the lower back contacts of relay 508, and the left contacts of cam 537. With relay 508 released the sequence switch is driven

into position 8 over its upper back contact and the lower left contact of cam 523, busy ground being then supplied to brush 536 over the upper left contact of cam 513 until the sequence switch leaves position 15 1/4.

If the first trunk of the group is found to be busy, however, brush 536 will find ground on the test terminal thereof and relay 508 will not release as the sequence switch moves out of position 5. With the sequence switch in position 6 the circuit of updrive magnet 522 is again closed over the lower left and upper right contacts of cam 512 to ground at the upper front contact of relay 508 and the switch shaft travels upward until an idle trunk terminal is reached. When an idle terminal is reached upon which the test brush 536 finds no ground, the circuit through the lower winding of relay 508 is opened and relay 508 releases as soon thereafter as the holding circuit through its upper winding, the upper left and lower right contacts of cam 531, commutator segment 530, brush 533, the upper contacts of cam 512 to ground at the upper front contact of relay 508 is opened at commutator segment 530, when the brush set is properly centered on the terminals of the idle trunk. Relay 508 upon releasing opens the circuit of updrive magnet 522 and closes the previously traced circuit for advancing the sequence switch into position 8. It will be assumed that the trunk terminating in final selector 204 has been selected.

With sequence switch 520 in position 8 and the sender ready to make final selections, the fundamental circuit previously traced is again closed and relay 507 operates, connecting battery through the lower winding of relay 508 and upper right contact of cam 509, and through resistance 534 and the upper left contact of cam 510 in parallel, thence over the upper right contact of cam 510, front contact of relay 507, left contacts of cam 533, tip brush 539, for operating a control relay in the final selector. As previously stated, the final selector 204 may be of the type disclosed in Patent 1,658,829 granted to C. H. Berry. Relay 508 does not operate in this circuit due to high resistance in series with it, but the final selector relay operates to start the final selector in its brush selection movement during which shunting ground impulses are transmitted back to the incoming selector over the ring brush 540, the lower back contact of relay 541, the upper right contact of cam 505 and the upper right contact of cam 506 for holding relay 507 operated and for intermittently shunting down the stepping relay of the sender.

When the sender is satisfied with respect to its final brush registration, the fundamental circuit is opened at the sender and relay 507 releases as soon as the holding circuit thereof is opened at the commutator of the final selector, opening the previously traced circuit through relay 508 and the control relay of the final selector. The sequence switch of the final selector is now advanced to the final tens selection position and the sender advances for controlling final tens selection, again operating relay 507 which in turn reestablishes the previously traced circuit for relay 508 and the control relay of the final selector. The control relay of the final selector advances the final selector in its tens selection movement, tripping the selected brush set and transmitting shunting ground impulses back to the incoming selector for holding relay 507 operated and for intermittently shunting down the stepping relay of the sender.

When the sender is satisfied with respect to its final tens registration, the fundamental circuit is opened at the sender and relay 507 releases as soon as the holding circuit thereof is opened at the commutator of the final selector, and upon releasing opens the previously traced circuit through relay 508 and the control relay of the final selector. The sequence switch of the final selector is then advanced to the final units selection position and the sender advances for controlling units selection. Final units selection is made in the same manner, after which relay 507 releases and advances the sequence switch of the final selector to a position in which ground is connected to both the tip and ring conductors of the circuit extending to the incoming selector. Ground connected over the tip brush 539 thence as previously traced to battery in parallel through resistance 534 and the lower winding of relay 508 operates relay 508, and ground connected over the ring brush 540, thence as traced through the winding of relay 507, operates relay 507. Relay 508 upon operating locks from battery through its upper winding, back contact of relay 535, lower left contact of cam 511, upper right contact of cam 512 to ground at the upper front contact of relay 508, and advances sequence switch 520 into position 9 over a circuit extending from battery, winding of magnet 520, lower contacts of cam 523, lower front contact of relay 508, to ground at the left contacts of cam 501.

With the sequence switch in position 8, relay 514 operates in a circuit through its winding, upper left and lower right contacts of cam 516 to ground at the left contacts of cam 501, and upon the release of relay 508 following the advance of the sequence switch out of position 8, the slow-to-release relay 514 is held in a circuit extending through its winding, the upper left and lower right contacts of cam 516, the lower back contact of relay 508 to ground at the left contacts of cam 537. As the sequence switch enters position 8¾, ground is connected over the lower contacts of cam 517, conductor 542, lower contact of relay 625, winding of relay 628 to battery. Relay 628 upon operating connects battery through the winding of relay 640, lower front contact of relay 628, conductor 444, lower back contact of relay 436, lower right winding of repeating coil 440, conductor 441, inner lower front contact of relay 628, inner upper back contact of relay 637, conductor 641, lower contacts of cam 521, lower and middle windings of relay 543 to ground, and ground through the winding of relay 645, upper front contact of relay 628, conductor 443, upper back contact of relay 436, upper right winding of repeating coil 440, conductor 442, inner upper front contact of relay 628, upper back contact of relay 637 to conductor 642. Relay 543 of the incoming selector operates but due to the high resistance of its middle winding relay 640 of the trunk finder does not operate at this time.

In position 9 of sequence switch 520, battery through the winding of relay 507 is connected over the right contacts of cam 544 to conductor 503 of the fundamental circuit extending to the sender, and ground is connected over the upper right contact of cam 513, the upper left contact of cam 523, the upper left contact of cam 528, the upper left and lower right contacts of cam 505 to conductor 504 of the fundamental circuit. When the sender closes the fundamental circuit following units selection, relay 507 operates closing a circuit for relay 508 extending from battery

through the lower winding of relay 508, upper right contacts of cams 509 and 510, front contact of relay 507, upper left contact of cam 528, upper left contact of cam 523 to ground at the upper right contact of cam 513. Relay 508 upon operating releases relay 514 and closes a circuit for advancing sequence switch 520 out of position 9 into position 10, which circuit extends from battery, winding of magnet 520, lower left and upper right contacts of cam 519 to ground at the back contact of relay 514. Relays 507 and 508 release when the sequence switch leaves position 9.

The fundamental circuit conductors 503 and 504 extend as previously traced over conductors 735 and 736 to the trip, start and link circuit 728 where they become bridged as this circuit advances to normal. As circuit 728 advances to normal ground is removed from conductor 730 to release relay 739. Relay 739 opens one operating circuit for relays 725 and 732 which are now held operated under the control of relay 712 and closes the circuit of relay 724 which may be traced from battery, resistance 726, lower back contact of relay 718, winding of relay 724, lower front contact of relay 723, lower front contact of relay 732, back contact of relay 739 to ground. Relay 724 operates and locks over its lower contact to ground at the lower contact of relay 716, releases relay 723 and overlaps the trunk closure bridge at the trip, start and link circuit 728, in a circuit from the conductor 736 over the upper contact of relay 724, upper low resistance windings of relays 722 and 721, inner upper front contact of relay 716 to conductor 735. As the trip, start and link circuit 728 continues to advance to normal battery is removed from conductor 733, releasing relay 712 which in turn releases relays 725 and 732. The trunk closure bridge at the trip, start and link circuit 728 is now opened and the effective bridge extends through the windings of relay 545 at the completing incoming selector and the upper windings of relays 721 and 722.

With relay 508 released when sequence switch 520 reaches position 10, the sequence switch is advanced to position 11 over the upper back contact of relay 508 and the lower left contact of cam 526. In passing through position 10 battery is connected through resistance 534 and the lower contacts of cam 505 to fundamental circuit conductor 504 and ground is connected to fundamental circuit conductor 503 over the lower contacts of cam 544 to charge the capacity of the fundamental circuit before the windings of relay 545 are connected thereto in order that a false operation of relay 545 will not be caused when the windings of this relay are connected for trunk closure test when the sequence switch reaches position 10½. In position 10½ the upper winding of relay 545 is connected from battery over the upper left contact of cam 506 and the lower right contact of cam 505 to conductor 504 and the lower winding of relay 545 is connected from ground over the upper left and lower right contacts of cam 544 to conductor 503, awaiting trunk closure at the distant end of conductors 503 and 504.

In positions 10 and 11 relay 625 of the trunk circuit is held operated in a circuit traced from battery through the winding and upper front contact of relay 625, conductor 643, inner lower front contact of relay 452, conductor 644 to ground at the upper right contact of cam 501, the initial operating circuit of relay 625 being opened at 150

the lower right contact of cam 501 as soon as the sequence switch leaves position 10 $\frac{1}{4}$.

With the trunk closure bridge closed, relay 545 operates and establishes a circuit for relay 546 extending from ground at the contact of relay 545, upper left and lower right contacts of cam 547 to battery through the winding of relay 546. With relay 546 operated ground for holding relay 625 of the outgoing end of the intercepting trunk circuit is connected over its upper front contact to conductor 644 in parallel with the upper right contact of cam 501 and a circuit is closed from battery through resistance 534, upper winding of relay 508, back contact of relay 535, lower left and upper right contacts of cam 511 to ground at the lower front contact of relay 546, for operating relay 508 which locks through its upper winding, the back contact of relay 535, lower left contact of cam 511, upper right contact of cam 512, to ground at the upper front contact of relay 508 and closes a circuit extending from battery through the winding of the sequence switch magnet 520, lower contacts of cam 523, lower front contact of relay 508, to ground at the left contacts of cam 501 in which circuit the sequence switch is advanced into position 12. In position 12 relay 508 is held operated under the control of relay 535.

With the sequence switch in position 12, ringing current is connected from the source of ringing current 548 over the left contacts of cam 549, winding of relay 535, lower front contact of relay 508, left contacts of cam 550, lower back contacts of relay 541, brush 540, thence over the ring brush of final selector 204 through the substation ringer of subscriber's line 225, tip brush of final selector 204, brush 539, upper left and lower right contacts of cam 538 to ground. Ringing tone is transmitted to the right windings of repeating coil 440 of the trunk over the circuit previously traced through the lower winding of relay 543, the lower right and upper left contacts of cam 537, condenser 551, lower front contact of relay 508, thence as traced through the source of ringing current 548. The ringing tone is transmitted inductively through the left windings of repeating coil 440 to the calling subscriber's line so that the calling subscriber may hear it and know that the called subscriber is being signaled.

When the called subscriber answers, relay 535 operates releasing relay 508 which opens the circuit over which ringing current was applied to the called line, releasing relay 535 and advancing sequence switch 520 into position 14 in a circuit which extends from ground at the upper back contact of relay 508 over the lower left contact of cam 526. A circuit is now established from ground through the winding of relay 645 thence as traced to conductor 642, upper winding of relay 543, upper contacts of cam 538, brush 539 thence over the called subscriber's line loop returning over brush 540, lower back contact of relay 541, lower contacts of cam 550, lower winding of relay 543, upper front contact of relay 514, right contacts of cam 521, conductor 641, thence as traced to battery through the winding of relay 640. Relay 543 is held operated in this circuit and relays 640 and 645 both operate. Relay 645 upon operating closes a circuit for relay 633 extending from battery, winding of relay 633, contact of relay 645, conductor 643, inner lower front contact of relay 452, conductor 644 to ground at the upper front contact of relay 546. Relay 633 operates and locks over its inner lower front contact to ground at the middle lower front contact of relay 605, opens the talking circuit from the

calling subscriber's line to the left windings of repeating coil 440 thereby releasing relay 449 and closes an obvious operating circuit for relay 637. Relay 449 upon releasing releases relay 452 which in turn releases relay 625 and opens the short circuit from around the upper high resistance windings of relays 433 and 434.

A talking circuit is now established from battery at the originating incoming selector 203, lower right winding of the repeating coil 224 thereof, winding of supervisory relay 226, left and upper right contacts of cam 212, brush 213, brush 312, conductor 311, brush 430, middle lower front contact of relay 411, lower alternate contacts of relay 428, lower back contact of relay 448, conductor 634, inner upper front contact of relay 637, conductor 641, thence as traced through the lower winding of relay 543 over the called subscriber's line loop, thence through the upper winding of relay 543, conductor 642, upper front contact of relay 637, conductor 635, upper back contact of relay 448, inner upper front contact of relay 428, inner upper front contact of relay 411, brush 429, conductor 310, brush 313, brush 223, upper contacts of cam 222, upper right winding of repeating coil 224 at the originating incoming selector 203 to ground. Relay 543 is held operated in this circuit and supervisory relay 226 in the originating incoming selector operates for giving charge supervision on the calling line. Relay 625 upon releasing opens the previously traced circuit for relay 545 in the completing incoming selector whereupon relay 545 releases in turn releasing relay 546.

At the time the trunk closure bridge was closed through the windings of relays 721 and 722, relay 721 operated, but polarized relay 722 did not receive current in the proper direction to cause its operation. Relay 721 upon operating closes an obvious circuit for relay 740 which establishes a new holding circuit for relay 708 to hold relay 708 operated following the release of relay 712 as previously described and at its lower front contact establishes a new holding circuit for relays 724 and 700 paralleling the holding circuit of these relays previously traced to ground at the lower front contact of relay 716. Following the response of the called subscriber it will be recalled that relay 625 released in turn releasing relay 628. With relays 625 and 628 released, the trunk closure circuit previously traced from battery and ground through the windings of relay 545 at the incoming selector 500 is opened and relay 721 releases in turn releasing relay 740. Relay 740 in turn releases relays 708, 700 and 724. With relay 708 released the supervisory circuit previously traced from battery and ground through the windings of relay 710 and the upper winding of the supervisory relay 808 is opened and relay 808 releases closing the circuit of answering supervisory cord lamp 805. This circuit may be traced from battery, inner front contact of relay 801, resistance 806, back contact of relay 807, back contact of relay 808 to ground through lamp 805. The lighting of lamp 805 is a signal to the intercepting operator that the call has been completed and that she should disconnect her cord circuit from jacks 708 and 715.

Until the operator removes the cord plugs, relay 702 is operated in a circuit from ground at the upper back contact of relay 712, winding of relay 702, inner lower front contact of relay 714, to battery at the lower front contact of relay 705, and with relays 700, 625 and 628 released, a

circuit is established from battery, upper winding of relay 713, lower back contact of relay 711, lower front contact of relay 702, lower left winding of repeating coil 701, lower back contact of relay 700, conductor 626, lower back contact of relay 625, conductor 441, lower right winding of repeating coil 440, lower back contact of relay 436, conductor 444, lower back contact of relay 628, conductor 630, upper and lower windings of relays 434 and 433, conductor 629, upper back contact of relay 628, conductor 443, upper back contact of relay 436, upper right winding of repeating coil 440, conductor 442, upper back contact of relay 625, conductor 627, inner upper back contact of relay 700, upper left winding of repeating coil 701, inner upper front contact of relay 702, upper back contact of relay 711, lower winding of relay 713, to ground. Relay 433 operates in this circuit, but due to the high resistance of relays 433 and 434, relay 713 does not operate. Relay 433 causes relay 631 to operate which closes a circuit holding circuit for relay 613, so that the trunk finder is held jointly under the control of the intercepting operator and the completing incoming selector 500.

When the operator disconnects her cord circuit all operated relays associated with her cord circuit release and relays 705 and 720 of the incoming end of the interoffice trunk circuit also release in turn releasing relays 714, 716 and 702. All apparatus of the incoming end of the interoffice intercepting trunk is now in normal condition and the circuit of relay 433 is opened causing it to release and in turn release relay 631. The trunk finder 400 is now held entirely under the control of the completing incoming selector 500.

Release of the connection

When the calling subscriber 200 hangs up, the district selector 202, incoming selector 203, and final selector 300 release. The incoming selector upon releasing opens the previously traced circuit from battery and ground thereat through the windings of relay 543 at the completing incoming selector 500. Relay 543 upon releasing in turn releases relay 514 which closes a circuit from ground at its back contact over the upper right and lower left contacts of cam 519, to battery through the winding of sequence switch magnet 520 for advancing the sequence switch into position 16. In position 16 the circuit of downdrive magnet 552 is closed from battery, winding of magnet 552, lower left contact of cam 510, upper left contact of cam 509, to ground at the left contacts of cam 501 and the shaft of selector 500 is driven down into normal position. Upon reaching normal a circuit is closed from battery, winding of sequence switch magnet 520, upper left contact of cam 526, normal commutator segment 553, brush 533 to ground at the upper right contact of cam 513 for advancing the sequence switch into position 17. From position 17 the sequence switch is advanced into normal position over a circuit from battery, winding of magnet 520, lower right contact of cam 509, lower right contact of cam 510, to ground at the back contact of relay 546. Upon leaving position 15 1/4 ground is removed from the sleeve brush 536 at the upper left contact of cam 513, thus causing the release of the final selector 204. Upon leaving position 18 ground is removed from conductor 518 at the left contact of cam 517 thus opening the holding circuit of relay 613. Since the intercepting operator has taken down her cord circuit at

this time, no other holding circuit for relay 613 exists and relay 613 releases as soon as interrupter 646 opens its lower contacts.

As soon thereafter as the interrupter circuit 646 again closes its contacts, the circuit of relay 410 is closed from battery, winding of relay 410, inner lower front contact of relay 411, conductor 456, upper back contact of relay 613, to ground at the contacts of interrupter 646. Relay 410 operates and locks over its inner upper front contact, conductor 457, to ground at the upper front contact of relay 605 and closes the circuit of downdrive magnet 458 extending from battery, winding of magnet 458, conductor 459, lower front contact of relay 609, conductor 460, lower front contact of relay 410, conductor 461, upper back contact of relay 606, to ground at the upper contact of relay 605. Relay 410 also opens the connections to trunk finder brushes 409 and 424 to prevent interference with other trunk circuits during the downdrive and releases relay 411 and relay 450, if operated. Relay 411 opens the operating circuit of relay 410 and disconnects the tip and ring brushes 429 and 430 of the trunk finder during the downdrive. When the magnet 458 has caused the brush shaft of trunk finder 400 to be driven into normal position, the brush 421 leaves the commutator segment 422, opening the holding circuit of relays 608 and 609 which release. Relay 608 in turn releases relay 605. Relay 605 opens the circuits of downdrive magnet 458 and relays 410, 438 and 633. Relay 438 upon releasing in turn releases relays 428 and 435. Relay 633 releases relay 637. All apparatus used in completing the intercepted call has now been restored to normal.

Premature disconnection by the calling subscriber

If the calling subscriber disconnects before the called subscriber has answered, the release of the originating incoming selector 203 opens the circuit of relay 449 which releases in turn releasing relay 452. Relay 452 releases relay 625, opens the operating circuit of relay 450, and removes the short circuit from the upper high resistance windings of relays 433 and 434. If the completing incoming or final selector has not been completely set, relay 625 is still held operated by ground connected to conductor 638 at the lower right contact of cam 501 until sequence switch 520 of the incoming selector reaches position 11 awaiting trunk closure at which time all selections will have been completed. Relay 625 will then release in turn releasing relay 628. With relays 625 and 628 both released the circuit previously traced over which relays 545 and 543 of the completing incoming selector were operated, will be opened and these relays will release. Relay 545 in turn releases relay 546 and relay 543 in turn releases relay 514. Relay 514 upon releasing establishes a circuit extending from ground at its back contact, upper contacts of cam 519, back contact of relay 535, to battery through the upper winding of relay 508 and resistance 534 to battery. Relay 508 operates, locks over its upper winding, back contact of relay 535, lower left contact of cam 511, upper right contact of cam 512, to ground at the upper front contact of relay 508 and closes a circuit for advancing sequence switch 520 into position 12 which circuit may be traced from battery, winding of sequence switch magnet 520, lower contacts of cam 523, lower front contact of relay 508, to ground at the left contacts of cam 501. In position 12, relay 508 releases since its upper winding is short-circuited

over the upper left and lower right contacts of cam 510 to ground at the back contact of relay 546. With relay 508 released, ringing current can not be applied from source 548 to the called line and the sequence switch is advanced into position 14 over the upper back contact of relay 508 and the lower left contact of cam 526. From position 14 the sequence switch is advanced into position 16 in a circuit from ground at the back contact of relay 514, upper right and lower left contacts of cam 519, to battery through the sequence switch magnet 520. From this point the incoming selector proceeds to restore to normal causing the restoration of the final selector 204 in the manner previously described.

Should the calling subscriber disconnect while the incoming selector sequence switch is in the ringing position 12, at which time relays 543, 514, 545, 546 and 508 are operated, relays 543 and 545 will be released as previously described because of the release of relays 625 and 628 in the outgoing trunk circuit and they will in turn release relays 514 and 546. With relay 546 released, the upper winding of relay 508 is short-circuited as just described and relay 508 will then release to stop the transmission of ringing current. From this point restoration of the incoming selector 500 and final selector 204 takes place as just described.

No circuit changes take place at the incoming end of the inter-office intercepting trunk shown in Fig. 7 until selections have been completed at the completing incoming and final selectors and trunk closure has taken place. At that time when the trip, start and link circuit 728 advances to normal, relays 739, 712, 725, 732 and 723 release as previously described and relay 724 operates connecting the low resistance windings of relays 721 and 722 to the trunk conductors 626 and 627. If, however, the disconnection by the calling subscriber has caused the release of relays 625 and 628, the trunk conductors 626 and 627 are not connected at the outgoing end of the inter-office intercepting trunk through the windings of relays 454 and 433 and consequently relay 721 can not operate or if operated remain operated and relay 740 is not therefore operated. With relay 723 now released, relay 708 has no holding circuit and releases, opening the circuit of the cord supervisory relay 808 which in turn releases to light the cord lamp 805 as a disconnect signal. When the operator takes down her cord circuit in response to the disconnect signal, the remaining apparatus employed in the establishment of the connection releases in the manner previously described.

Premature disconnection by the intercepting operator

Should the intercepting operator disconnect before selections are completed, relays 705 and 720 which were operated over plugs of the connected cord circuit will release in turn releasing relay 716 and 723. Relays 725, 732, 739 and 712 will, however, remain operated until after the incoming selector 500 has been advanced to the trunk closure position when they will release and since relay 716 is already released, relay 724 will not operate and therefore the overlapping bridge through the upper windings of relays 721 and 722 will not be effective after the restoration of the trip, start and link circuit 728 to hold relays 545 and 546 in the incoming selector 500 operated. Upon the release of these relays, relay 546 will release, causing the release of relays 625

and 628. The circuit of relay 543 is now opened at the contacts of relay 628 and relay 543 releases in turn releasing relay 514. From this point the completing incoming selector proceeds to restore to normal in the manner previously described in connection with a premature disconnection by the calling subscriber in turn causing the restoration of the final selector 204.

Called line busy

If the called line 225 is busy or if the "B" operator has directed the final selector 204 to a reorder trunk circuit, the final selector will transmit intermittent ground impulses from the busy back interrupter or from the reorder trunk in the manner described in Patent No. 1,658,829, granted to C. H. Berry and with the sequence switch of the incoming selector 500 in the ringing position 12, relay 535 will operate to release relay 508 which then advances the sequence switch into position 14. In position 14 the intermittent ground over ring brush 540, the lower back contact of relay 541, lower contacts of cam 550, lower winding of relay 543, upper contact of relay 514, right contacts of cam 521, conductor 641, inner upper back contact of relay 637, inner lower front contact of relay 628, conductor 441, lower right winding of repeating coil 440, lower back contact of relay 436, conductor 444, lower front contact of relay 628, to battery through the winding of relay 640 which will cause the intermittent operation of relay 640. Relay 640 will in turn cause the intermittent operation of relay 639 which will intermittently reverse the circuit extending as traced from battery and ground through the windings of relay 545 and the upper windings of relays 721 and 722. Polarized relay 722 and relay 721 will follow these reversals, intermittently closing a shunt around the lower high resistance winding of relay 720 which will in turn cause the intermittent release and operation of cord supervisory relay 831. The intermittent operation of relay 831 will in turn cause the intermittent operation of relay 830 to flash the calling supervisory lamp 329. At the same time a busy tone will be transmitted over the circuit traced through the lower right winding of repeating coil 440, which will be heard by the calling subscriber.

If the operator disconnects plug 821 of her cord circuit from jack 715 in response to this flashing signal, relays 729 and 716 will release, relay 716 removing the short circuit from the lower windings of relays 721 and 722, thus introducing sufficient resistance into the circuit through the windings of relay 545 at the completing incoming selector to cause this relay to release and in turn release relay 546. Relay 546 upon releasing opens the holding circuit of relay 625 which releases in turn releasing relay 628. With relay 628 released, the previously traced circuit from battery through the winding of relay 640 and the lower and middle windings of relay 543 is opened and relays 543, 640 and 639 will release. Relay 543 in turn releases relay 514. With relays 514 and 546 both released the incoming selector 500 and final selector are restored to normal as previously described. With relay 625 released the circuit previously traced from battery and ground through the windings of relay 545 at the incoming selector through the windings of relays 721 and 722 is opened, thus releasing relay 721 which in turn releases relay 740. Relay 740 releases relays 724 and 700 and opens the operating circuit of relay 708. Relay 150

700 upon releasing now closes an operating circuit for relay 713, extending as formerly traced over the back contacts of relays 625 and 628 through the low resistance, lower windings of relays 433 and 434, thus reoperating relays 713 and 434. Relay 713 establishes a new holding circuit for relay 708 so that the answering supervisory relay 808 of the operator's cord circuit is maintained operated to prevent a disconnect signal on the answering cord lamp 805. Relay 434 reoperates relay 631 which in turn connects holding ground to the circuit of relay 613 before the incoming selector has restored to normal and removed holding ground therefor over conductor 518, so that the trunk finder is maintained operated under the control of the intercepting operator in the condition in which it was prior to the attempt to complete the connection. The operator may talk with the calling subscriber and make another attempt to complete the call if desired.

Completing incoming selector goes to overflow during trunk hunting

If during trunk hunting the incoming selector 500 finds all trunks extending to the selected group of final selectors busy, at which time sequence switch 520 will be in position 6, the brush shaft of the incoming selector will advance the tripped brush set to the top terminal set of its bank, which set of terminals are the overflow terminals. The test brush 536 will in this case encounter no ground potential and relay 508 which is maintained operated during trunk hunting will release, opening the circuit of updrive magnet 522 and closing a circuit from ground at its upper back contact over the lower left contact of cam 526 for advancing sequence switch 520 into position 8. Relay 514 now operates in a circuit from battery through its winding, the upper left and lower right contacts of cam 516 to ground at the left contacts of cam 501. The sequence switch is now advanced into position 9 over a circuit extending from battery, winding of sequence switch magnet 520, lower left contact of cam 519, upper right contact of cam 531, commutator segment 525, brush 524 to ground at the upper right contact of cam 513. As sequence switch 520 leaves position 8, relay 508 releases closing a holding circuit for slow releasing relay 514 extending through the winding of relay 514, the upper left and lower right contacts of cam 516, lower back contact of relay 508 to ground at the left contacts of cam 537. In position 9 reversed battery is transmitted over the fundamental circuit to the "B" operator's sender by the connection of battery through the winding of relay 507, right contacts of cam 544, to fundamental circuit conductor 503 and by the connection of ground from the upper right contact of cam 513, the upper left contact of cam 523, the upper left contact of cam 528, the upper left and lower right contacts of cam 505, to the fundamental circuit conductor 504. Since the sender has not yet completed the control of selections it recognizes this as an overflow condition and at once advances the trip, start and link circuit 728 to normal.

Relay 507 operates over the fundamental circuit closing a circuit for relay 508 which may be traced from battery through the lower winding of relay 508, upper right contacts of cams 509 and 510, front contact of relay 507, upper left contact of cam 528, upper left contact of cam 523 to ground at the upper right contact of cam

513. Relay 508 upon operating releases relay 514 and closes a circuit for advancing sequence switch 520 into position 10 which circuit extends from battery, winding of magnet 520, lower left and upper right contacts of cam 519, to ground at the back contact of relay 514. Relays 507 and 508 release when the sequence switch leaves position 9. As the sequence switch enters position 9 $\frac{3}{4}$ with relay 543 operated a circuit is closed extending from battery through the winding of relay 514, right contacts of cam 515 to ground at the contact of relay 543 for reoperating relay 514. With relay 508 released, when the sequence switch reaches position 10, it is advanced to position 11 over the upper back contact of relay 508 and the lower left contact of cam 526.

With the sequence switch in position 11 when the trip, start and link circuit 728 advances to normal, relay 545 operates over the circuit previously traced in turn operating relay 546. Relay 546 closes a circuit for operating relay 508 which may be traced from ground at the lower front contact of relay 546, upper right and lower left contacts of cam 511, back contact of relay 535 to battery through the upper winding of relay 508 and resistance 534. Relay 508 upon operating locks over its upper winding, back contact of relay 535, lower left contact of cam 511, upper right contact of cam 512, to ground at its upper front contact and closes a circuit from battery through the winding of sequence switch magnet 520, lower contacts of cam 523, lower front contact of relay 508 to ground at the left contacts of cam 501 for advancing the sequence switch into position 12. In position 12, relay 541 operates in a circuit from battery through its winding, the left contacts of cam 502, commutator segment 525, brush 524 to ground at the upper right contact of cam 513, locks over its inner upper front contact to ground at the lower right contact of cam 513, and at its inner lower front contact closes a circuit from ground over the upper right contact of cam 526 for advancing the sequence switch into position 15. At its upper front contact, relay 541 also connects ground to conductor 642 extending over the upper back contact of relay 637, inner upper front contact of relay 628, conductor 442, upper right winding of repeating coil 440, upper back contact of relay 436, conductor 443, upper front contact of relay 628 to the winding of relay 645 to ground to prevent the operations of relay 645 at this time from battery applied from the overflow register which is connected over tip brush 539 from the tip overflow terminal. Ground from the upper front contact of relay 541 through the upper winding of relay 543 and the upper contacts of cam 538 operates the overflow register (not shown).

When the sequence switch leaves position 12, relay 508 releases and upon reaching position 15 it is intermittently operated in a circuit from battery through its lower winding, the upper right contact of cam 523, the lower left contact of cam 528, to ground at the contacts of interrupter 554. As relay 508 operates and releases, ground is intermittently applied over its upper front contact through resistance 555, the right contacts of cam 537, in shunt of the middle high resistance winding of relay 543 thus causing relay 640 to be operated and released at a reorder rate in the same manner as previously described in connection with a busy line condition. Relay 640 causes the calling supervisory cord lamp 829 to flash at the reorder rate in the manner previously described. When the operator removes the call-

ing cord plug 821 from the completing trunk jack 715, in response to the flashing of lamp 829, relay 545 is caused to release in the manner previously described in turn releasing relay 546.

From this point the restoration of the incoming selector 500 proceeds in the manner previously described.

Should the incoming selector advance to the tell-tale position in any of its updrive movements, that is with sequence switch 520 in positions 2, 4 or 6, brush 524 will encounter the tell-tale segment 556 and a circuit will be closed for advancing sequence switch 520 into position 9 which may be traced from battery through magnet 520, the upper right contact of cam 526, segment 556, brush 524, to ground over the left contacts of cam 523, the lower front contact of relay 508, and the left contacts of cam 501 in positions 2 and 4 or to ground over the upper contacts of cam 512 and the upper front contact of relay 508 in position 6. The sequence switch is then advanced to position 12 in the same manner as described in connection with the overflow condition and is advanced to position 15 over the upper right contact of cam 526, tell-tale commutator segment 556, brush 524, to ground at the upper right contact of cam 513. In position 15 the operator's calling cord lamp 829 is flashed at the reorder rate as described in connection with the overflow condition.

Incoming selector times out

If during the time that selections are being made at the incoming selector 500 or at the final selector 204 with sequence switch 520 in any position between 2 and 9, the timing interrupter 557 closes its lower contacts, relay 545 will operate in a circuit from battery over its upper winding, lower left and upper right contacts of cam 547 to ground at the interrupter and will lock over the left contacts of cam 547 and the front contact of relay 545. If the sequence switch fails to advance out of position 9 by the time the interrupter closes its upper contact, that is, from 14 to 15 seconds after relay 545 operates, a circuit is established for relay 541 extending from battery through the winding of relay 541, upper contact of interrupter 557, upper contacts of cam 547, to ground at the front contact of relay 545. Relay 541 locks over its inner upper front contact to ground at the lower right contact of cam 513, opens the ring talking conductor to prevent the application of ringing current as the sequence switch passes through position 12 and closes a circuit extending from ground at its inner lower front contact, upper right contact of cam 526 to battery through sequence switch magnet 520 for advancing the sequence switch into position 9 if it has not already reached that position. In position 9, a circuit for operating relay 508 is closed extending from ground at the lower front contact of relay 541, left contacts of cam 511, back contact of relay 535, upper winding of relay 508, resistance 534 to battery. With the sequence switch in position 9 reversed battery is transmitted to the sender and if the sender has not already timed out and given trunk closure, it does so at this time. With relay 508 operated, the sequence switch 520 is now advanced to position 15 in the manner previously described in connection with the overflow condition except that relay 541 is already operated. The intercepting operator is given a flashing signal if a satisfactory trunk closure is provided at the inter office intercepting trunk and the return to normal of the

incoming selector 500 and final selector 204 if operated off-normal is accomplished as on the overflow condition, otherwise the incoming selector restores to normal immediately.

Abandonment of connection before the intercepting operator answers

On all intercepting calls except from trouble intercepting trunks, if the calling subscriber abandons the call before the operator answers, thus releasing the originating selector switches 202, 203 and 300, relay 432 which was operated from ringing current applied from the incoming selector 203 will release and sleeve relay 306 of the intercepting trunk 307 will also release. The release of relay 306 opens the circuit of relay 613 previously traced over conductor 427, the lower back contact of relay 428, the lower front contact of relay 411, upper back contact of relay 410, brush 409, terminal 401, conductor 308, inner upper front contact of relay 306, lower front contacts of relay 305 to ground at the lower front contact of relay 306 and relay 613 releases. With relay 613 released, when interrupter 646 closes its contacts the circuit of relay 410 is closed from battery over the inner lower front contact of relay 411, conductor 456, upper back contact of relay 613, to ground at the contacts of interrupter 646. Relay 410 operates and locks over its inner upper front contact, conductor 457 to ground at the upper front contact of relay 605 and closes the circuit of downdrive magnet 458 from battery, winding of magnet 458, conductor 459, lower front contact of relay 609, conductor 460, lower front contact of relay 410, conductor 461, upper back contact of relay 606, to ground at the upper contact of relay 605. Relay 410 also opens the connection to trunk finder brushes 409 and 424 to prevent interference with other trunk circuits during the down-drive and releases relay 411 and relay 450, if operated. Relay 411 opens the operating circuit of relay 410 and disconnects the tip and ring brushes 429 and 430 during the down-drive. When the magnet 458 has caused the brush shaft to be driven into normal position, brush 421 leaves the commutator segment 422 opening the holding circuits of relay 608 and 609 which release. Relay 608 in turn releases relay 605. Relay 605 opens the circuits of magnet 458 and relays 410 and 436, thus restoring the outgoing trunk circuit to normal.

The release of relay 436 opens the circuit previously traced through the windings of relay 703 at the incoming end of the interoffice intercepting trunk. Relay 703 releases in turn releasing relays 704 and 708. Relay 704 upon releasing also extinguishes the trunk lamp 706. All apparatus has now been restored.

Trunk finder goes to overflow or tell-tale

If the trunk finder 400 goes to the overflow position when hunting for a calling trunk, battery which is connected through resistance 900 in the trip circuit of Fig. 9, over conductor 902 to the overflow terminal 462 of the bank of terminals in which the trunk finder is hunting, will be connected over trunk finder brush 409, upper back contact of relay 410, lower back contact of relay 411, conductor 412 to ground through the winding of relay 611, operating relay 611 which in turn releases relays 606 and 607. Relay 606 upon releasing opens the circuit of updrive magnet 416 and closes the circuit of relay 411 as previously described. Relay 411 upon operating re-

leases relay 611. Since brush 409 has found battery potential on terminal 462, the previously traced operating circuit for relay 613 extending over the upper back contact of relay 410, the lower front contact of relay 411, the lower back contact of relay 428, conductor 427, through the winding of relay 613 to battery does not maintain relay 613 operated after relay 607 releases and consequently, relay 410 is operated by interrupter 646 for causing the trunk finder to restore to normal in the manner previously described.

Should the trunk finder shaft advance to the tell-tale position, the holding circuit of relay 606 formerly traced to ground over commutator segment 414 and brush 415 will be opened and relay 606 will release in turn releasing relay 607. Relay 410 is now operated in a circuit through its winding, tell-tale segment 463 to ground on brush 419 for causing the trunk finder to restore to normal in the manner previously described.

Trip circuit time alarm

If for any reason either relay 905 or 904 of the trip circuit of Fig. 9 remains operated for a longer period than is necessary to complete its function in starting an allotted trunk finder to hunt for and select a calling trunk in the subgroup allocated to the trip circuit, an alarm will be given and a peg-count resistor will be operated in the following manner: With relay 905 operated, for example, when the timing interrupter 920 closes its lower contact, relay 921 operates in a circuit from battery through its winding, the lower contact of interrupter 920, the upper front contact of relay 905 to ground and locks over its inner upper front contact directly under the control of relay 905. If relay 905 remains operated until interrupter 923 closes its contact, relay 924 operates in a circuit from battery through its winding, the back contact of relay 925, the inner lower front contact of relay 921 to ground at the contact of interrupter 923 and locks in a circuit from battery through its winding and inner upper front contact, winding of relay 925 to ground at the lower front contact of relay 921. At its lower contact, relay 924 closes an obvious circuit in series through the winding of relay 927 and the winding of register magnet 926. Relay 927 upon operating closes a locking circuit for itself and register magnet 926 until the register magnet 926 operates. When magnet 926 operates it closes a holding circuit for itself and short-circuits the winding of relay 927 which then releases. At its upper front contact, relay 924 also closes a circuit over the upper contact of relay 921 for pilot lamp 928.

When the contacts of interrupter 923 open, relay 925 which was shunted operates in the locking circuit of relay 924 opening the initial operating circuit of relay 924. If the delay is due to the failure of the trip magnets 402 and 602 to operate or any other condition which may prevent the calling trunk from being found, relay 901 will not at this time be operated, but will operate upon the next closure of the upper contact of interrupter 920 in a circuit from battery through the lower winding of relay 901, middle lower front contact of relay 921, resistance 922, upper contact of interrupter 920 to ground at the upper front contact of relay 905. Relay 901 upon operating releases the trip circuit by releasing relays 918 and 906 thus permitting another trunk finder to start if relay 905 remains

operated. If the trouble is only temporary, then relays 905 and 921 will be released as soon as the trunk is found extinguishing lamp 928 and releasing relays 924 and 925 and register magnet 926. If the trouble condition is not cleared and relays 905 and 921 are not released before interrupter 923 again closes its contact, relay 929 operates over the front contact of relay 925, the inner lower front contact of relay 921, to ground at the contact of interrupter 923, locking over its upper contact to ground at the lower contact of relay 921 and closing an alarm and pilot lamp circuit over its lower contact. When relay 905 finally releases, relays 921, 924, 925 and 929 will release, stopping the alarm.

All trunk finders busy in either allotter group

If all trunk finders of an allotter group, for example, the trunk finders served by allotter 1010, are busy, relays 608, 608' to 608ⁿ of these trunk finders will be operated and a chain circuit will be established from ground over the contacts of these relays, conductor 930 through the winding of relay 1026 to battery. Relay 1026 upon operating closes an operating circuit for relay 1006 extending from battery, upper winding of relay 1006, upper back contact of relay 1008, to ground at the inner upper front contact of relay 1026 as soon as relay 1008 restores to normal. It will be assumed that relays 1005 and 1011 are normal in which condition ground from a trip circuit over conductor 919 would normally extend over the upper back contact of relay 1005, the lower back contact of relay 1006, winding of relay 1007, lower winding of relay 1008 to battery for starting an allotted trunk finder served by allotter 1010. However, with relay 1006 operated, this circuit will not be completed through the windings of relays 1007 and 1008, but will be completed over the upper front contact of relay 1006, upper normal contacts of relay 1016, winding of relay 1017, upper winding of relay 1018 to battery. Relay 1017 will therefore operate on the next incoming call and close a circuit from ground at its front contact, inner upper front contact of relay 1006, upper back contact of relay 1018, upper back contact of relay 1025, to battery through the winding of relay 1024, thus starting a trunk finder allotted by allotter 1000. As soon as relay 1018 operates as previously described, it closes a locking circuit for relay 1006, extending from battery through the lower winding and inner lower front contact of relay 1006 to ground at the inner lower front contacts of relay 1018 to insure that relay 1006 will remain operated until the call has been safely started. If after the call has been started and the allotter 1000 has been advanced to allot another trunk finder in its group, relay 1026 is still operated indicating that all finders in the group served by allotter 1010 are still busy, relay 1006 will be maintained operated and on the next incoming call with relay 1005 now operated, ground on conductor 919 will again operate relay 1017 for starting another finder in the group served by allotter 1000. The operation of relay 1018 also opens the operating circuit of relay 1016 so that should relay 1036 be operated due to all trunk finders in the group served by allotter 1000 being busy, relay 1016 could not operate before the call being handled has been safely started. Relays 1036 and 1016 function in the same manner as relays 1026 and 1006 in case all trunk finders served by allotter 1000 become busy for causing all incoming calls

to start allotted trunk finders served by allotter 1010.

Should all trunk finders in both allotter groups become busy, relays 1026, 1036, 1006 and 1016 will operate and on the next incoming call, ground on conductor 919 will be extended either over the upper front or back contacts of relay 1005, upper front contacts of relays 1006 and 1013, lower front contacts of relays 1006 and 1016 to battery through the winding of overflow register 1043 for operating the register which locks through its winding, the lower front contacts of relay 1026 and 1036 to ground at the front contact of register 1043, as long as both allotter groups remain busy.

A trunk finder cannot be started under this condition as neither relay 1014 nor 1024 can operate since the circuits of relays 1007 and 1017 are both opened at contacts of relays 1006 and 1016.

Throw-over keys 1042 and 1052 are provided for removing either allotter group of trunk finders from service. The operation of key 1042 lights a floor alarm pilot lamp 1044 indicating that the trunk finders served by allotter 1010 have been removed from service, disconnects conductor 1034 and closes a circuit for relay 1026 extending through the upper alternate contacts of key 1042 to ground at the inner upper normal contacts of key 1052. Relay 1026 operates relay 1006 and these two relays then function to cause all incoming calls to start allotted trunk finders served by allotter 1000 in the manner previously described. If key 1052 is operated, the lamp 1045 is lighted to indicate that trunk finders served by allotter 1000 have been removed from service. Conductor 1035 is opened and relays 1036 and 1016 are operated to cause all incoming calls to start allotted trunk finders served by allotter 1010.

If a trunk finder fails to start for any reason or if it starts and relay 1008, for example, fails to operate, assuming the call is directed to a trunk finder served by allotter 1010, ground from the trip circuit over conductor 919, the upper back contact of relay 1005, the lower back contact of relay 1006, or ground over the contact of relay 1007, thence over the lower back contact of relay 1008, the lower contact of interrupter 1046 will be connected through the lower winding of relay 1047. Relay 1047 will operate and then lock over its inner lower front contact to the operating ground independently of the contacts of interrupter 1046. After two seconds interrupter 1046 will close its upper contact and with relay 1047 operated will close a circuit extending from battery, inner upper back contact of relay 1019, upper winding of relay 1009, upper front contact of relay 1047, upper contact of interrupter 1046, to ground as traced on conductor 919 or to ground at the front contact of relay 1007. Relay 1009 upon operating locks from battery over its lower alternate contacts and lower winding to ground at the contacts of key 1048, lights lamp 1049 to identify the allotter group in which the failure has occurred, lights the aisle pilot lamp 1053, closes a circuit for operating relay 1006, which may be traced from battery through the upper winding of relay 1006, the upper back contact of relay 1008, to ground at the upper front contact of relay 1009 for transferring all incoming calls to the other allotter group of trunk finders served by allotter 1000 and opens the operating circuits of relays 1008 and 1019. This feature functions in a similar manner if the trunk finder starts but fails to remove ground from the upper winding of relay 1008 in which case relay 1008 operates short-circuiting and releasing relay 1007. In

this case ground for operating relay 1047, when the interrupter 1046 closes its upper contact, is obtained from the lower front contact of relay 1008. When relay 1009 operates as previously described, battery is removed from relay 1008 and it releases placing relay 1006 under the control of relay 1009 to transfer calls as previously described. When the trouble is cleared, the operation of key 1048 releases relay 1009 and restores the circuit to normal. If similar trouble arises in connection with a trunk finder served by the allotter 1000 and relay 1018 fails to operate, relay 1047 is operated by interrupter 1054 and relay 1019 functions in the same manner as relay 1009 locking under the control of key 1056, lighting lamp 1055, the aisle pilot lamp 1053 and operating relay 1016 for transferring all incoming calls to the allotter group served by allotter 1010, and opening the operating circuit of relays 1018 and 1009.

Allotter advance on motor stop or make busy

If the motor which drives the switch shaft of an allotted trunk finder stops or if the trunk finder is made busy, ground will be applied from conductor 647 over the back contact of relay 608 of the allotted trunk finder to battery through the winding of relay 613, operating relay 613 which will close a circuit from ground at its inner lower front contact, over conductor 1029, brush 1033 of allotter 1010 which serves this trunk finder, inner upper back contact of relay 1026 to battery through the lower winding of relay 1028. Relay 1028 operates and functions as previously described to advance the allotter 1010 to allot another trunk finder. Relay 1038 functions in a similar manner in connection with trunk finders of the other allotter group.

Intercepting call from a verification intercepting trunk

In the foregoing description the manner in which an intercepted call from a final selector multiple is completed and the manner in which the circuits function in case operating failures are encountered has been discussed. It will now be assumed that a toll operator for the purpose of checking a number has set a toll incoming selector of the type shown for example in the application of E. L. Getz, Serial No. 599,732, filed March 18, 1932, and the final selector 300 upon the set of terminals 314, 315 and 316 connected to a verification intercepting trunk which terminates in a terminal bank to which the trunk finder 400 has access. For simplification it will also be assumed that this trunk terminates in the brush group to which the brush set 403 has access.

When this trunk circuit is seized by the final selector 300, ground over the sleeve brush 304 and terminal 316 is extended over the lower back contact of relay 317, through the operating winding and non-inductive winding of relay 318 in parallel to battery, operating relay 318 which then locks over its upper winding and lower front contact to ground at brush 304 and connects battery in parallel through resistance 900 and the lower winding of relay 901 of the trip circuit which serves the subgroup of trunks in which the trunk is located, conductor 902, the upper back contact of relay 317, the upper front contact of relay 318, conductor 319, to terminal 464, multiplied in the brush bank to which the trunk finders of the group in which finder 400 is located have access. Relay 318 also closes a start

circuit extending from ground at its inner upper front contact, over the inner lower normal contacts of relay 317, conductor 903, lower back contact of relay 904 to battery through the upper winding of the subgroup relay 905 of the trip circuit.

In the manner previously described, the trunk finder 400 is started to hunt for the calling trunk and when the brush set 403 engages the terminals of this trunk, a circuit is closed over brush 424 of the trunk finder, terminal 465, conductor 320, winding of relay 317 to battery. Relay 317 operates locking over its inner lower alternate contacts to ground at the inner upper front contact of relay 318, connecting ground to trunk terminal 464 over conductor 319, the upper front contact of relay 318, the upper front contact of relay 317, back contact of relay 321, inner lower alternate contacts of relay 317 to ground at the inner upper front contact of relay 318 to hold the trunk finder and opening conductors 902 and 903 extending to the trip circuit of Fig. 9. Relay 317 also at its inner upper front contacts connects battery to the lower back contact of sleeve relay 318 so that should the calling subscriber restore first, the sleeve terminal 316 of the intercepting trunk will be marked with busy potential. Relay 317 also opens at its lower back contact, the initial operating circuit of sleeve relay 318.

Until the operator answers, machine ringing current is applied from the incoming selector 203, over the talking conductors of the trunk for operating relay 432 in the trunk finder. Part of this ringing current passes through the winding of relay 322 and condenser 323. Relay 322 will follow the intermittent application of ringing current in turn operating relay 324 which in turn operates slow to release relay 321. The operation of these relays at this time, however, is without function. When the connection has been extended to the intercepting operator's position and the intercepting operator has answered in the manner previously described, the ringing current is tripped and a talking circuit is established from the toll operator's position to the intercepting operator's position. No supervision at the incoming selector will be given however, but as described in the application of E. L. Getz hereinbefore referred to, a relay in the toll incoming selector will be operated in series with supervisory relay 449 in the outgoing end of the interoffice intercepting trunk which will cause the transmission of a tone signal to the intercepting operator over the established talking circuit. The intercepting operator hearing this tone will know that the call is from a toll operator's position and that she should not attempt to complete it.

She will then operate key 1113 closing a circuit from ground over conductor 1114, the lower front contact of relay 317 to battery through the lower winding of relay 337. Relay 337 operates and locks to ground over its inner upper front contact and upper winding, lower back contact of relay 802 to battery at the lower front contact of relay 801, removes battery through resistance 838 from the circuit previously traced to ground through the upper winding of relay 710, removes ground through resistance 839 from the circuit previously traced to battery through the lower winding of relay 710 and establishes a supervisory bridge over its upper front contact through resistance 832. Supervisory relay 808 at the cord circuit remains operated in this supervisory circuit and relay 710 now operates in turn operating reversing relay

711. Relay 711 upon operating reverses the direction of current flowing through the windings of relays 713 and the windings of relays 433 and 434 so that polarized relay 434 now operates closing a circuit from ground at its front contact, inner lower front contact of relay 435 to battery through the winding of relay 451. Relay 451 now operates disconnecting battery and ground at its back contacts from the supervisory circuit extending as traced through the winding of relay 449 to the toll incoming selector and closes a supervisory bridge extending from the upper left winding of repeating coil 440 through the winding of relay 449, the lower front contact of relay 452, the upper front contact of relay 451, resistance 466, to the lower left winding of repeating coil 440. Relay 449 operates in this new supervisory circuit and the supervisory relay at the incoming selector also operates to disconnect the tone current. The talking path between the toll operator's position and the intercepting operator's position is now established and the toll operator may make the desired verification request of the intercepting operator.

Should the toll operator desire to rerer after the intercepting operator has answered, relay 322 will respond to the reapplication of ringing current operating relay 324 which will open the tip conductor of the intercepting trunk circuit releasing relay 449 at the trunk finder which is at the time operated over the talking circuit from the incoming selector as previously described. Relay 449 in turn releases relay 452 which at its upper contact opens the short circuit from the upper high resistance windings of relays 433 and 434. All of the windings of relays 433 and 434 are now included in the supervisory circuit previously traced through the windings of relay 713 and due to the resistance of the windings of relays 433 and 434, relay 713 will release opening the circuit of relay 708 which in turn will cause the release of the answering supervisory relay 808 at the intercepting operator's cord circuit to light the answering supervisory lamp 805.

Relay 324 in operating at the time the toll operator rerings also causes relay 321 to operate and being slow to release relay 321 remains operated momentarily after relay 324 releases, when the toll operator releases her ringing key. With relay 321 operated and relay 324 released, the ground applied through the previous operation of relay 317 over conductor 319, terminal 464, brush 409, upper back contact of relay 410, lower front contact of relay 411, through the upper front contact and winding of relay 450 to battery which has been holding relay 450, is removed and relay 450 releases closing its back contact so that upon the release of relay 324 when the toll operator releases her ringing key, supervisory relay 449 can reoperate in turn reoperating relays 452 and 450. The reoperation of relay 452 again short-circuits the upper windings of relays 433 and 434 permitting relay 713 to reoperate. Relay 708 now operates again completing the circuit through the cord supervisory relay 808 to extinguish lamp 805. In this manner upon each depression and release of the toll operator's ringing key, the cord lamp 805 is lighted and extinguished to give the toll operator a flashing recall signal.

If the toll operator is the first to disconnect the toll incoming selector and final selector 300 will release, thus releasing sleeve relay 318, which with relay 317 operated will connect busy battery potential to the sleeve terminal 316 to hold the intercepting trunk circuit busy. Relay 318 also

opens the locking circuit of relay 317 which is now held operated from the trunk finder 400 and disconnects ground at its inner upper front contact from terminal 464 thus releasing relay 613 if the intercepting operator has not answered. The trunk finder is then restored in the manner previously described releasing relay 317 and all operated apparatus is then in normal condition. If, however, the intercepting operator has answered the removal of ground from terminal 464 does not release relay 613 since it is held operated from ground at the front contact of relay 631 until the intercepting operator pulls down her cord circuit. If the intercepting operator is the first to release the circuit of relay 613 is opened and the trunk finder releases opening the operating circuit of relay 317. Relay 317, however, remains operated under the control of sleeve relay 318 until the toll operator disconnects.

Intercepted call from a blank terminal of an incoming selector

It will now be assumed that in the establishment of a connection the calling subscriber has caused the incoming selector 203 to be set upon a set of terminals 227, 228, 229 which are not connected to a working final selector and that such terminals are connected to an intercepting trunk 230 terminating in a bank to which the brush set 603 of trunk finder 600 has access. When this trunk is seized by the incoming selector ground over the contacts of cam 231 and sleeve brush 232 marks the trunk busy to other hunting selectors. When the incoming selector sequence switch 207 reaches the selection beyond position 8 a circuit is established from battery, right winding of relay 211, left contact of cam 215, contact of cam 234, front contact of relay 235 which is at the time operated from the sender 205, right contacts of cam 222, brush 223, terminal 227, conductor 236, upper back contact of relay 326, winding of relay 327 to ground. Relay 327 operates connecting the upper winding of relay 328 from the source of ringing current 329 through resistance 330 to ground at the inner upper front contact of relay 327, connecting the lower winding of relay 328 from battery through resistance 331 to ground at the next to inner upper front contact of relay 327, closing an obvious circuit for operating relay 325 and connecting ground to the middle contact of interrupter 332. Relay 325 locks over its upper front contact and conductor 233 to ground at cam 231 in the incoming selector and connects ground over the upper front contact of relay 327 to the armature of relay 328.

With relay 327 operated relay 328 operates and releases from the intermittent current from ringing source 329 thus connecting ground intermittently over its front contact, conductor 333, terminal 228, brush 213 to the lower contacts of cam 237. As fully disclosed in Patent No. 1,658,829 hereinbefore referred to, this ground holds relay 235 operated and intermittently shunts the stepping relay of sender 205. When sufficient impulses have been transmitted to the sender to satisfy it as to its final brush registration the fundamental circuit extending therefrom through the winding of relay 235 is opened and relay 235 releases in turn opening the previously traced circuit through the winding of relay 327. When the fundamental circuit is again closed at sender 205 for controlling final tens selection, relays 235 and 327 again operate functioning as before to cause relay 328 to transmit intermittent ground impulses for shunting

the sender stepping relay until the sender is satisfied as to its final tens registration. In a similar manner impulses are transmitted through the operation of relay 328 to satisfy the sender as to its final units registration, when the fundamental circuit will be opened releasing 235, in turn releasing relay 327 which opens the circuit of relay 328 to stop the further transmission of ground impulses.

When the sender recloses the fundamental circuit to the incoming selector for incoming advance, relay 235 again operates again closing the previously traced circuit through the right winding of relay 211 and the winding of relay 327. At this time when interrupter 332 closes its lower contact a circuit will be closed from ground at the inner lower front contact of relay 327, lower contact of interrupter 332, winding of relay 334 to battery and relay 334 will operate and lock over its inner upper front contact to ground at the inner lower front contact of relay 327. When the interrupter 332 closes its upper contact a circuit will now be closed from ground at the inner lower front contact of relay 327, upper contact of interrupter 332, lower front contact of relay 334, winding of relay 326 to battery. Relay 326 operates and locks over its upper front contact to ground at the inner lower front contact of relay 325, disconnects the winding of relay 327 from the tip conductor 236 of trunk 230, connecting direct ground thereto over the upper front contact of relay 334 and the inner lower front contact of relay 326 for operating relay 211 at the incoming selector 203 and connects the trunk conductors 236 and 333 over conductors 335 and 336 to terminals 648 and 649 in the bank of trunk finder 600. With relay 326 operated relay 211 of the incoming selector 203 remains operated until interrupter 332 opens its upper contact. The operation of relay 211 at the incoming selector at this time causes the incoming selector to return an advance signal to the sender 205 after which the sequence switch of the incoming selector moves into the ringing position 12 as fully described in Patent No. 1,658,829.

With the sequence switch 207 of the incoming selector in position 12, at which time relay 211 is not operated, a ringing circuit is established from the source of ringing current 208, lower contacts of cam 209, winding of relay 210, right back contact of relay 211, right contacts of cam 212, brush 213, terminal 228, conductor 333, lower front contact of relay 326, lower winding of relay 337, middle upper back contact of relay 338, condenser 339, inner upper front contact of relay 326, conductor 236, terminal 227, brush 223, upper right and lower left contacts of cam 222 to ground. Relay 337 operates in this circuit but relay 210 does not and relay 337 upon operating locks over its upper front contact, upper back contact of relay 338 to ground at the inner lower front contact of relay 325. Relay 337 also closes an obvious circuit for relay 340 which upon operating closes a circuit from battery, winding of relay 904 in the trip circuit of Fig. 9, upper back contact of relay 905, conductor 932, upper front contact of relay 340 to ground at the inner lower front contact of relay 338, thus operating relay 904 in the trip circuit and closes a circuit from battery through resistance 900 and the lower winding of relay 901 in parallel over conductor 902, the lower front contact of relay 340, the lower normal contacts of relay 338, conductor 341, to test terminal 650

in the bank of trunk finder 600 for marking the trunk 230 as calling.

Relay 904 in the manner previously described closes a start circuit for starting one of a preallotted pair of trunk finders to hunt for the calling trunk and in the present case assuming that the pair of trunk finders 400 and 600 have been preallotted for use relays 606 and 607 will be operated. With relay 904 operated indicating that the calling trunk appears in the bank accessible to the brush set 603 of trunk finder 600, relay 610 will be operated in a circuit from ground at the lower front contact of relay 904, lower front contact of relay 913, conductor 917, upper back contact of relay 608, inner upper front contact of relay 607, winding of relay 610 to battery. With relay 610 operated relays 608 and 605 operate as before but the circuit of updrive magnet 616 of trunk finder 600 is now closed from battery, winding of magnet 616, upper front contact of relay 610, upper back contact of relay 609, inner upper front contacts of relays 605 and 606 to ground. Magnet 616 now advances the trunk finder 600 in search of the calling trunk, the brush set 603 being tripped by magnet 602 as the brush shaft passes through the tripping zone.

When the test brush 651 encounters the test terminal 650 of the calling trunk 230 battery potential on terminal 650 causes the operation of relay 611 as previously described to arrest the brush set 603 on the terminals of trunk 230, relays 606 and 607 releasing. A circuit is now closed from ground at the inner upper back contact of relay 410, conductor 417, lower back contact of relay 607, brush 652, terminal 653, conductor 342 to battery through the winding of relay 338. Relay 338 operates and locks over its inner upper front contact to ground at the inner lower front contact of relay 325, removes ground from conductor 932, connects ground from the lower front contact of relay 325 over the lower alternate contacts of relay 338 and conductor 341 to terminal 650, disconnects the lower winding of relay 337 from the ringing bridge through condenser 339 from across talking conductors 335 and 336, releases relay 337, opens the circuit previously traced over conductors 902 and 932 and connects ground to the upper back contact of relay 325. From this point the circuits function as previously described in connection with the call first discussed, ringing current applied from the incoming selector being tripped when the intercepting operator answers, a talking circuit being established from the calling line to the intercepting operator's position and in accordance with the instructions given by the calling subscriber to the operator, the call being completed to a desired line.

If the calling subscriber disconnects first, the incoming selector restores opening the circuit of relay 325 which releases. With relay 338 still operated ground is applied from the inner lower front contact of relay 338, upper back contact of relay 335, conductor 233, to terminal 229 for marking the trunk 230 busy to other incoming selectors. Relay 325 upon releasing also releases relay 326 and opens the locking circuit of relay 338. If the intercepting operator has not as yet answered, the release of relay 325 by removing ground from conductor 341 causes the release of relay 613, which in turn, as previously described, causes the operation of relay 410. Relay 410 upon operating then closes the circuit of downdrive magnet 658 which may be traced from battery through the winding of this magnet, the lower front contact of relay 610, conductor 460, the inner lower front

contact of relay 410, conductor 461, upper back contact of relay 606 to ground at the upper front contact of relay 605. Magnet 658 restores the shaft of trunk finder 600 to normal. Relay 410 upon operating also releases relay 338. From this point the restoration of all other apparatus which has been operated takes place as previously described. If the operator has answered the call the removal of ground from conductor 341 through the release of relay 325 is without effect.

If the operator releases first thus releasing the trunk finder 600 and opening the operating circuit of relay 338, relay 338 remains locked to the front contact of relay 325 until the calling subscriber restores when relays 325 and 338 will release thus restoring the intercepting trunk circuit to normal.

Calls to a subscriber's line which is out of service and has been plugged up to a plugging up trouble intercepting trunk

It will now be assumed that the calling subscriber has dialed a number which has caused the incoming selector 203 and final selector 300 to connect the calling line to the terminals of a called line 240 on which there is trouble and which line has been plugged up to a trouble intercepting trunk 239 appearing in the bank of trunk finder 600 to which the brush set 603 thereof has access. This line 240 is illustrated in Fig. 2 as plugged out of service by the insertion of shoe 241 into contact with the distributing frame terminals of the line and the removal of the usual heat coils from between the terminals 242 and 243 and 244 and 245. The shoe 241 is connected to plugs 246 and 247 which are plugged into jacks 248 and 249 associated with the trouble intercepting trunk 239.

When the final selector 300 engages the terminals 343, 344, 345 of the inside line 238 of the called line 240 and ringing current is transmitted from the incoming selector 203, the ringing current flows in a path extending from the source 208, lower contacts of cam 209, winding of relay 210, right back contact of relay 211, right contacts of cam 212, brush 213, brush 312, terminal 344, conductor 250, terminal 245, contact 251 of shoe 241, rings of plug 247 and jack 249, lower back contact of relay 252, condenser 254, winding of relay 253, inner upper back contact of relay 252, rings of jack 248 and plug 246, contact 255 of shoe 241, terminal 242, conductor 256, terminal 343, brush 313, brush 223 to ground at the lower left contact of cam 222. Relay 253 operates in this circuit but relay 210 does not. Relay 253 upon operating closes an obvious circuit for relay 257 which locks over its inner lower front contact to ground at the upper back contact of relay 252. With relay 257 operated ground is connected from the middle upper back contact of relay 252, over the upper front contact of relay 257 and conductor 932 for operating relay 904 in the trip circuit of Fig. 9 and battery is connected from the trip circuit over conductor 902, the lower front contact of relay 257, the inner lower normal contacts of relay 252, conductor 258, to test terminal 654, in the terminal bank of trunk finder 600 to which brush set 603 thereof has access for marking the trouble intercepting trunk 239 as calling.

Assuming that the pair of trunk finders 400 and 600 has been allotted for use, relay 904 upon operating causes the trunk finder 600 to be started hunting for the calling trunk, tripping the brush set 603 as it advances through the tripping

zone. As soon as the calling trunk is found relay 611 operates from battery placed on terminal 654 through the operation of relay 257, relay 611 in turn releasing relays 606 and 607 to arrest the hunting movement of trunk finder 600. A circuit is now closed from ground at the inner upper back contact of relay 410, conductor 417, inner lower back contact of relay 607, brush 652, terminal 655, conductor 259, winding of relay 252 to battery. Relay 252 operates, connects ground over its inner lower alternate contacts, conductor 258, to terminal 654, disconnects the condenser bridge through condenser 254 and the winding of relay 253 and opens the circuits previously traced over conductors 902 and 932. Relay 252 also closes a discharge path for condenser 254 through the winding of relay 253 and the lower front contact of relay 252 so that relay 253 will not operate falsely due to the discharge of this condenser following disconnection.

With the trunk finder 600 engaging the terminals of the trouble intercepting trunk, ringing current from the incoming selector causes the intercepting operator to be signaled and the ringing current is then tripped upon the response of the operator in the manner previously described. The operator is then enabled to talk with the calling subscriber to inform him that the called line is removed from service because of trouble.

If the calling subscriber disconnects first, thus releasing selector switches 203 and 300 no change occurs in the trouble intercepting trunk, relay 252 being held operated from the trunk finder until the trunk finder is restored when the intercepting operator disconnects. Since the trouble intercepting trunk is not restored to normal when the calling subscriber disconnects the abandonment of a call by the calling subscriber prior to the response of the operator does not cause the trunk lamp 706 to become extinguished until the operator responds. If the call has been made for the tip party on the plugged-up line then should the calling subscriber abandon the call relay 431 will release but relay 432 will operate in a circuit from ground through its winding, inner lower normal contacts of relay 428, middle lower front contact of relay 411, brush 656, terminal 657, ring conductor of trunk 239, rings of jack 249 and plug 247, contact 251 of shoe 241, terminal 245, upper back contact of cut-off relay 260, which released upon the abandonment of the call, to battery through the winding of line relay 261. Relay 432 operates, short-circuiting relay 437 which operated and locked when relay 431 operated. Relay 437 now releases, in turn releasing relay 448 which restores the connections from the left windings of repeating coil 440 to normal. This is done so that should the trouble intercepting trunk 239 be resealed on call to the ring party of the plugged up line connected thereto before the intercepting operator answers, incorrect supervision will not be given. As the present invention is not concerned with the manner in which a subscriber whose line has been plugged out of service may receive the attention of a repairman on calls initiated by such subscriber, no description of the other apparatus associated with the trouble intercepting trunk of Fig. 2 will be described herein.

If a call initiated by calling subscriber 200 is extended over an intercepting trunk, to the intercepting operator's position, and can be completed in some other office of the exchange area, the intercepting operator will plug the calling plug 821 of the cord circuit which she has used to

answer the call into the jack of a trunk over which the call may be extended to the office in which the desired line terminates and will then proceed to establish the connection in the manner disclosed and described in the Patent No. 1,897,083 granted to W. B. Strickler on February 14, 1933.

What is claimed is:

1. In a telephone exchange system, an originating office, subscribers' lines terminating therein, a second office having an intercepting operator's position, a two-way trunk circuit extending between said offices and terminating at said operator's position in answering and calling jacks, means controlled by a calling subscriber in said originating office to extend a connection over said trunk circuit to said second office, a cord circuit at said position for connection to said jacks, an operator's telephone set associable with said cord circuit for enabling said operator to obtain information from the calling subscriber for completing the desired connection, selector switches in said originating office controllable over said trunk circuit, and means controlled from said second office following the connection of said cord circuit with the calling jack of said trunk circuit for controlling said switches to complete a connection from said calling line to a called line terminating in said originating office.

2. In a telephone exchange system, an originating office, subscribers' lines terminating therein, a second office having an intercepting operator's position, a two-way trunk circuit extending between said offices and terminating at said operator's position in answering and calling jacks, means controlled by a calling subscriber in said originating office to extend a connection over said trunk circuit to said second office, a cord circuit at said position for connection to said jacks, an operator's telephone set associable with said cord circuit for enabling said operator to obtain information from the calling subscriber for completing the desired connection, a second operator's position at said second office having apparatus for controlling selector switches, selector switches at said first office controllable over said trunk circuit, means operative upon the connection of said cord circuit with the calling jack of said trunk circuit for enabling said intercepting operator to communicate with an idle operator at said second position, and means controllable by the apparatus at said second position for setting said switches to complete a connection from said calling line to a called line terminating in said originating office.

3. In a telephone exchange system, an originating office, subscribers' lines terminating therein, a second office having an intercepting operator's position, a two-way trunk circuit extending between said offices and terminating at said operator's position in answering and calling jacks, means controlled by a calling subscriber in said originating office to extend a connection over said trunk circuit to said second office, a calling lamp associated with said answering jack, means at said originating office for applying ringing current to said trunk circuit for lighting said lamp, a cord circuit at said position for connection to said jacks, means in said trunk circuit operable from said cord circuit following its connection with the answering jack of said trunk circuit for extinguishing said lamp, for tripping said ringing current and for establishing a talking circuit from said operator's telephone set to said calling line for enabling said operator to obtain information from the calling subscriber for completing

the desired connection, selector switches in said originating office controllable over said trunk circuit, and means controlled from said second office following the connection of said cord circuit with the calling jack of said trunk circuit for controlling said switches to complete a connection from said calling line to a called line terminating in said originating office.

4. In a telephone exchange system, an originating office, subscribers' lines terminating therein, a second office having an intercepting operator's position, a two-way trunk circuit extending between said offices and terminating at said operator's position in answering and calling jacks, means controlled by a calling subscriber in said originating office to extend a connection over said trunk circuit to said second office, a cord circuit at said position for connection to said jacks, an answering supervisory signal in said cord circuit, an operator's telephone set associable with said cord circuit for enabling said operator to obtain information from the calling subscriber for completing the desired connection, selector switches in said originating office controllable over said trunk circuit, means controlled from said second office following the connection of said cord circuit with the calling jack of said trunk circuit for controlling said switches to complete a connection from said calling line to a called line terminating in said originating office, and means controlled over said trunk circuit from the originating office for operating said supervisory signal should the calling subscriber abandon the call prior to the response of the called subscriber.

5. In a telephone exchange system, an originating office, subscribers' lines terminating therein, a second office having an intercepting operator's position, a two-way trunk circuit extending between said offices and terminating at said operator's position in answering and calling jacks, means controlled by a calling subscriber in said originating office to extend a connection over said trunk circuit to said second office, a cord circuit at said position for connection to said jacks, a calling supervisory signal in said cord circuit, an operator's telephone set associable with said cord circuit for enabling said operator to obtain information from the calling subscriber for completing the desired connection, selector switches in said originating office controllable over said trunk circuit, means controlled from said second office following the connection of said cord circuit with the calling jack of said trunk circuit for controlling said switches to complete a connection from said calling line to said called line terminating in said originating office, and means controlled over said trunk circuit from said switches for flashing said supervisory signal should the called line be found to be busy.

6. In a telephone exchange system, an originating office, subscribers' lines terminating therein, a second office having an intercepting operator's position, a two-way trunk circuit extending between said offices and terminating at said operator's position in answering and calling jacks, means controlled by a calling subscriber in said originating office to extend a connection over said trunk circuit to said second office, a cord circuit at said position for connection to said jacks, a calling supervisory signal in said cord circuit, an operator's telephone set associable with said cord circuit for enabling said operator to obtain information from the calling subscriber for completing the desired connection, selector switches in said originating office controllable over said

trunk circuit, means controlled from said second office following the connection of said cord circuit with the calling jack of said trunk circuit for controlling said switches to complete a connection from said calling line to said called line terminating in said originating office, and means controlled over said trunk circuit from said switches for flashing said supervisory signal at a reorder rate should one of said switches be advanced to its overflow position while trunk hunting or overrun in any of its selective or trunk hunting movements.

7. In a telephone exchange system, an originating office, subscribers' lines terminating therein, a second office having an intercepting operator's position, a two-way trunk circuit extending between said offices and terminating at said operator's position in answering and calling jacks, means controlled by a calling subscriber in said originating office to extend a connection over said trunk circuit to said second office, a cord circuit at said position for connection to said jacks, a calling supervisory signal in said cord circuit, an operator's telephone set associable with said cord circuit for enabling said operator to obtain information from the calling subscriber for completing the desired connection, selector switches in said originating office controllable over said trunk circuit, means controlled from said second office following the connection of said cord circuit with the calling jack of said trunk circuit for controlling said switches to complete a connection from said calling line to said called line terminating in said originating office, and means controlled over said trunk circuit from said switches for flashing said supervisory signal at a reorder rate should said switches fail to complete selections within a predetermined interval.

8. In a telephone exchange system, an originating office, subscribers' lines terminating therein, a second office having an intercepting operator's position, a two-way trunk circuit extending between said offices having an outgoing section and an incoming section, said incoming section terminating at said operator's position in answering and calling jacks, means controlled by a calling subscriber in said originating office to extend a connection over said trunk circuit to said second office, a cord circuit at said position for connection to said jacks, an operator's telephone set associable with said cord circuit for enabling said operator to obtain information from the calling subscriber for completing the desired connection, a second operator's position at said second office associable with the incoming section of said trunk circuit, selector switches at said originating office controllable over said trunk circuit, means operative upon the connection of said cord circuit to said calling jack for enabling said intercepting operator to communicate with an idle operator at said second position, means controllable from said second operator's position for setting said switches to complete a connection to a called line in said originating office, and means operative following the completion of said connection to said called line for disconnecting the outgoing and incoming sections of said trunk circuit and for completing a connection from said calling line over the outgoing section of said trunk circuit and said switches to said called line.

9. In a telephone exchange system, an originating office, subscribers' lines terminating therein, a second office having an intercepting operator's position, a two-way trunk circuit extending between said offices having an outgoing section

and an incoming section, said incoming section terminating at said operator's position in answering and calling jacks, means controlled by a calling subscriber in said originating office to extend a connection over said trunk circuit to said second office, a cord circuit at said position for connection to said jacks, an operator's telephone set associable with said cord circuit for enabling said operator to obtain information from the calling subscriber for completing the desired connection, a second operator's position at said second office associable with the incoming section of said trunk circuit, selector switches at said originating office controllable over said trunk circuit, means operative upon the connection of said cord circuit to said calling jack for enabling said intercepting operator to communicate with an idle operator at said second position, means controllable from said second operator's position for setting said switches to complete a connection to a called line in said originating office, and means operative following the completion of said connection to said called line for dismissing said second operator's position, for disconnecting the outgoing and incoming sections of said trunk circuit thereby dismissing said first operator's position and for completing a connection from said calling line over the outgoing section of said trunk circuit and said switches to said called line.

10. In a telephone exchange system, a plurality of lines divided into groups, a plurality of pairs of finder switches having access to said lines, means for preallocating a pair of idle finder switches for use, and means controlled in accordance with the group in which the line is located for determining which of a pair of allotted finder switches will be started in search of the line.

11. In a telephone exchange system, a plurality of lines divided into a plurality of main groups, each main group being further divided into an A and a B subgroup, a plurality of pairs of finder switches, each finder switch having a plurality of brush sets, one finder switch of each pair having access respectively to the A subgroups of the main groups and the other finder switch of each pair having access respectively to the B subgroups of the main groups, means for preallocating a pair of idle finder switches for use, a plurality of A subgroup relays individual respectively to the A subgroups of lines, a plurality of B subgroup relays individual respectively to the B subgroups of lines, means operative when a call is present on a line of any subgroup to operate the respective subgroup relay, and means dependent upon whether an A or a B subgroup relay is operated to start that one of the allotted pair of finder switches which has a brush set having access to the subgroup of lines in which the calling line is located.

12. In a telephone exchange system, a plurality of lines divided into a plurality of groups, each main group being further divided into an A and a B subgroup, a plurality of pairs of finder switches, each finder switch having a plurality of brush sets, one finder switch of each pair having access respectively to the A subgroups of the main groups, and the other finder switch of each pair having access respectively to the B subgroups of the main groups, means for preallocating a pair of idle finder switches for use, a plurality of A subgroup relays individual respectively to the A subgroups of lines, a plurality of B subgroup relays individual respectively to the B subgroups of lines, means operative when a call is present on a line of any subgroup to operate the respective

subgroup relay, a pair of relays associated with each pair of finder switches for controlling the operating and restoring circuits of the finder switches of the pair respectively, and means dependent upon whether an A or a B subgroup relay is operated to operate that one of said pair of relays to start the finder switch which has a brush set having access to the subgroup of lines in which the calling line is located.

13. In a telephone exchange system, an originating office, subscribers' lines terminating therein, a plurality of groups of local trunk circuits terminating in said office, means controlled by a calling subscriber to extend a connection to one of said trunk circuits, a distant office, a plurality of interoffice trunk circuits extending between said offices and each terminating at said originating office in a pair of trunk finders, means operative upon the seizure of a local trunk circuit for preparing the start circuit of a pair of idle trunk finders, and means dependent upon the group in which the calling local trunk circuit is located for determining which one of the pair of trunk finders shall be started to hunt for the calling local trunk circuit.

14. In a telephone exchange system, a plurality of lines, a plurality of finder switches each having access to said lines, said finder switches being divided into two groups, means for preallocating an idle finder switch from each group, means responsive to a call on any one of said lines for starting the preallocated finder switch of one group in search of the calling line, and means thereupon effective for preparing a start circuit for an allotted finder switch of the other group for use on the next call.

15. In a telephone exchange system, a plurality of lines, a plurality of finder switches each having access to said lines, said finder switches being divided into two groups, a separate allotter for preallocating an idle finder switch from each group, means responsive to a call on any one of said lines for starting an allotted finder switch of one group in search of the calling line, means thereupon effective for preparing a start circuit for an allotted finder switch of the other group for use on the next call, and means for advancing each allotter to allot another finder switch in its group following the starting of the finder switch of its group, finder switches of the two groups being started in alternation in response to successive calls.

16. In a telephone exchange system, a plurality of lines, a plurality of finder switches each having access to said lines, said finder switches being divided into two groups, a separate allotter for preallocating an idle finder switch from each group, means responsive to a call on any one of said lines for starting an allotted finder switch of one group in search of the calling line, means thereupon effective for preparing a start circuit for an allotted finder switch of the other group for use on the next call, means for advancing each allotter to allot another finder switch in its group following the starting of a finder switch in its group, finder switches of the two groups being thus started in alternation in response to successive calls, and means operative when all finder switches of one group are busy for causing successive calls to successively start finder switches of the other group.

17. In a telephone exchange system, a plurality of lines, a plurality of finder switches each having access to said lines, said finder switches being divided into two groups, a separate allot-

ter for preallotting an idle finder switch from each group, means responsive to a call on any one of said lines for starting an allotted finder switch of one group in search of the calling line, means thereupon effective for preparing a start circuit for an allotted finder switch of the other group for use on the next call, means for advancing each allotter to allot another finder switch in its group following the starting of a finder switch in its group, finder switches of the two groups being thus started in alternation in response to successive calls, and means operative when all finders of one group have been removed from service for preventing the advancement of the allotter serving that group of finders and for causing successive calls to successively start finder switches of the other group.

18. In a telephone exchange system, a plurality of lines, a plurality of finder switches each having access to said lines, said finder switches being divided into two groups, a separate allotter for preallotting an idle finder switch from each group, means responsive to a call on any one of said lines for starting an allotted finder switch of one group in search of the calling line, means thereupon effective for preparing a start circuit for an allotted finder switch of the other group for use on the next call, means for advancing each allotter to allot another finder switch in its group following the starting of a finder switch in its group, finder switches of the two groups being thus started in alternation in response to successive calls, a timing mechanism associated with each allotter, and means controlled by each timing mechanism if a finder switch allotted by its associated allotter fails to start, or if started, fails to find the calling line within a predetermined interval to cause succeeding calls to start finder switches of the other group served by the other allotter until the trouble condition is removed.

19. In a telephone exchange system, a plurality of lines, a plurality of finder switches each having access to said lines, said finder switches being divided into two groups, a separate allotter for preallotting an idle finder switch from each group, means responsive to a call on any one of said lines for starting an allotted finder switch of one group in search of the calling line, means thereupon effective for preparing a start circuit for an allotted finder switch of the other group for use on the next call, means for advancing each allotter to allot another finder switch in its group following the starting of a finder switch in its group, finder switches of the two groups being thus started in alternation in response to successive calls, a timing mechanism associated with each allotter, means controlled by each timing mechanism if a finder switch allotted by its associated allotter fails to start, or if started, fails to find the calling line within a predetermined time interval to cause succeeding calls to start finder switches of the other group served by the other allotter, a lamp associated with each timing mechanism and when lighted indicating the trouble condition, and a key associated with each timing mechanism for restoring the allotter circuits to normal upon the removal of the trouble condition.

20. In a telephone exchange system, an origi-

inating office, subscribers' lines terminating therein, selector switches in said office, a distant office, a two-way trunk circuit extending between said offices, means controllable by a calling subscriber for setting selector switches of said originating office to establish a local connection with any one of said lines or to extend a connection over said trunk circuit to said distant office, and means at said distant office for controlling switches of said originating office over said trunk circuit to complete a connection from said calling line to any one of said lines.

21. In a telephone exchange system, an originating office, subscribers' lines terminating therein, selector switches in said office, a distant office, a two-way trunk circuit extending between said offices, means controllable by a calling subscriber for setting selector switches of said originating office to establish a local connection with any one of said lines or to extend a connection over said trunk circuit to said distant office, means at said distant office for controlling switches of said originating office over said trunk circuit to complete a connection from said calling line to any one of said lines, and means operative following the completion of said last connection for disassociating said distant office from said trunk circuit and for maintaining the connection between said calling and called lines over circuits local to the originating office.

22. In a telephone exchange system, an originating office, subscribers' lines terminating therein, selector switches in said office, a distant office, a two-way trunk circuit extending between said offices having an outgoing and an incoming section, means controllable by a calling subscriber for setting selector switches of said originating office to establish a local connection with any one of said lines or to extend a connection over said trunk circuit to said distant office, means at said distant office for controlling switches of said originating office over said trunk circuit to complete a connection from said calling line to any one of said lines, and means operative following the completion of said last connection for disconnecting the outgoing and incoming sections of said trunk circuit and for completing a connection from said calling line over the outgoing section of said trunk circuit and said switches to said called line.

23. In a telephone exchange system, a plurality of originating offices, subscribers' lines terminating therein, selector switches in each of said offices, a distant office, two-way trunk circuits extending from each of said originating offices to said distant office, means controllable by a calling subscriber in any of said originating offices for setting selector switches of said originating office to establish a local connection with any line of said office or to extend a connection over one of said trunk circuits to said distant office, and means at said distant office for controlling switches of the originating office over the trunk circuit by which the calling line of that office has become connected to said distant office to complete a connection from said calling line to any line of the originating office.

WILEY WHITNEY.