

June 2, 1931.

F. J. SCUDDER

1,808,577

AUTOMATIC TELEPHONE EXCHANGE SYSTEM

Filed Jan. 11, 1930

10 Sheets-Sheet 1

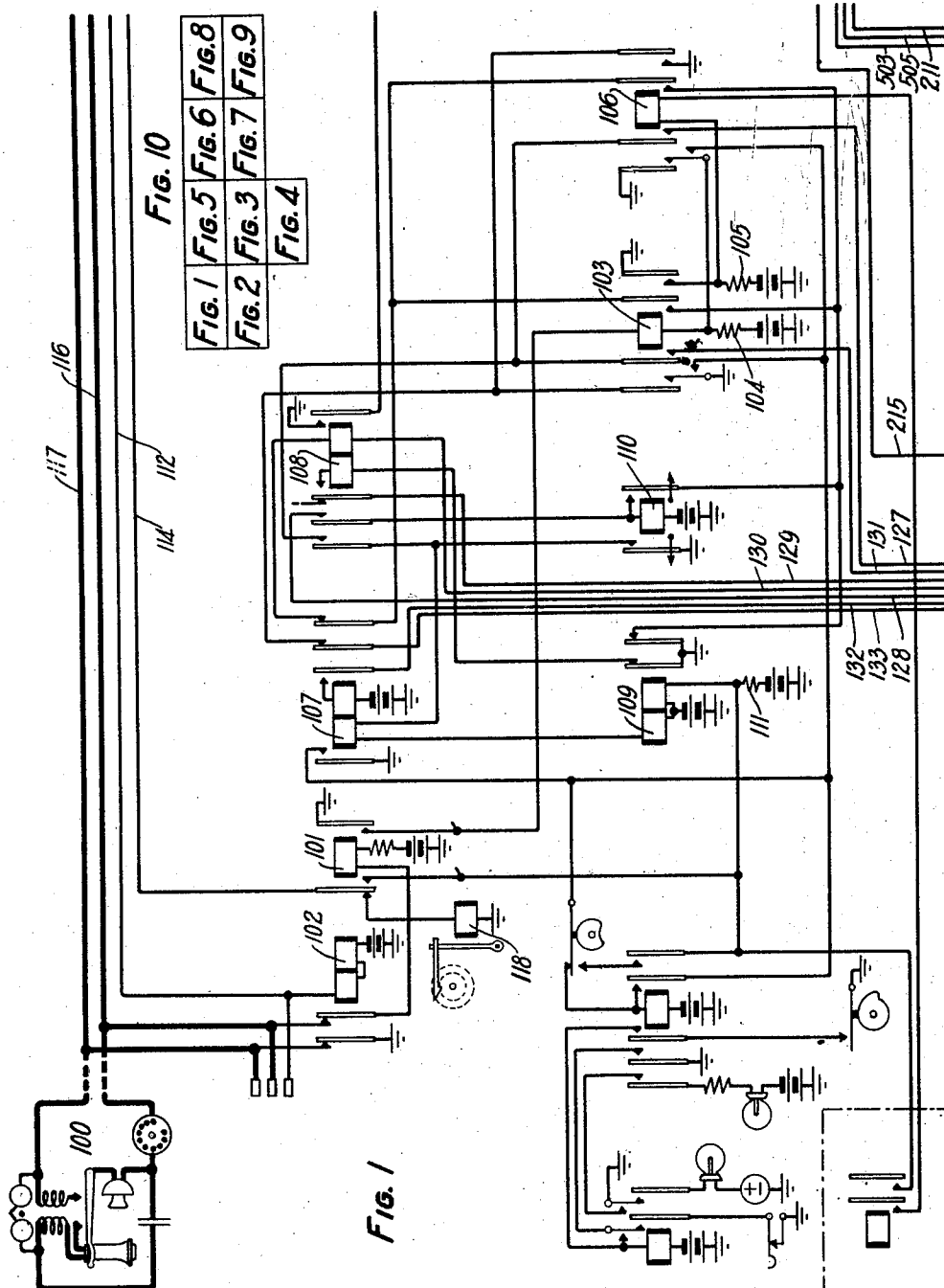


Fig. 1

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10 Sheets-Sheet 2

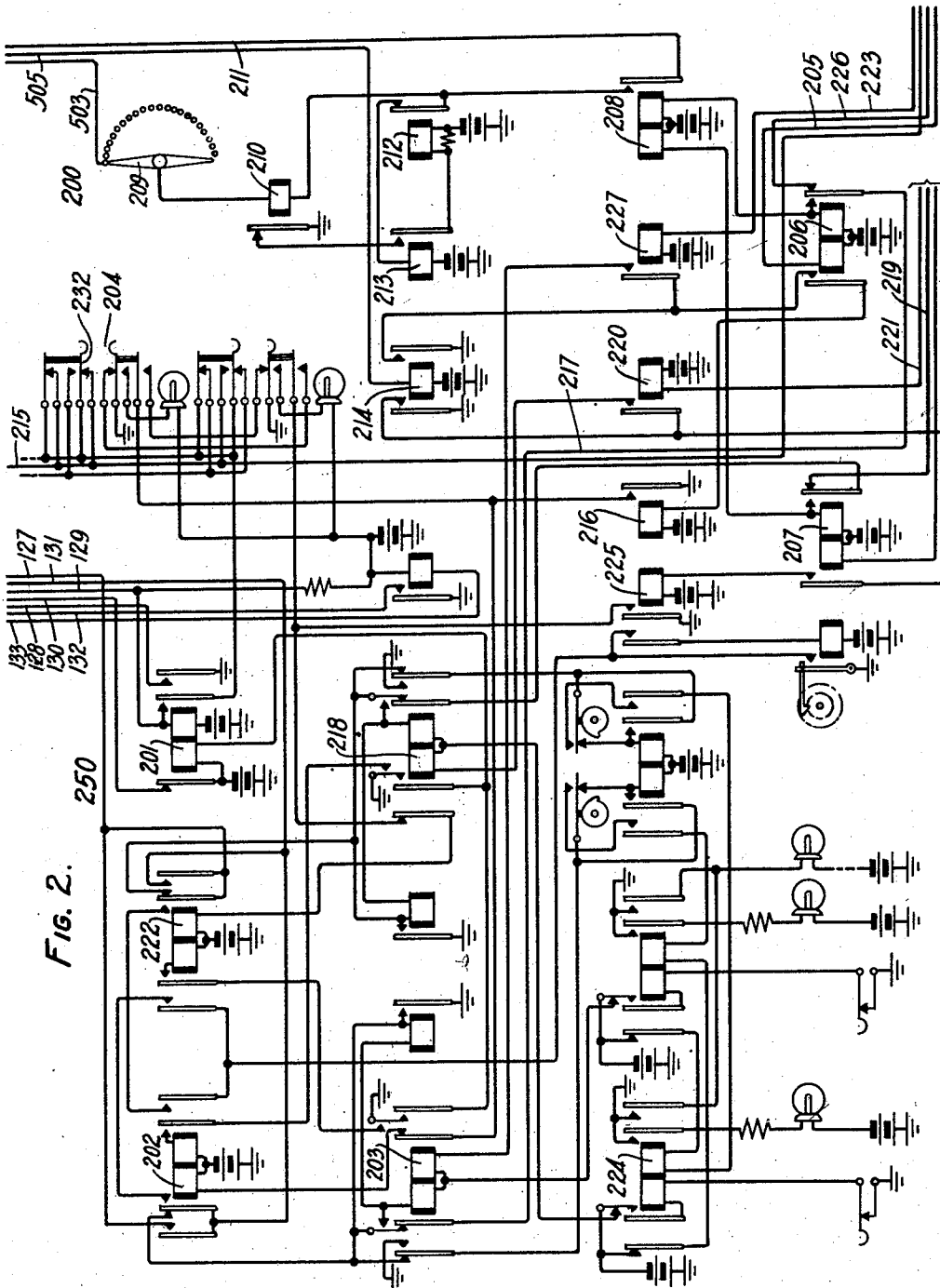


Fig. 2.

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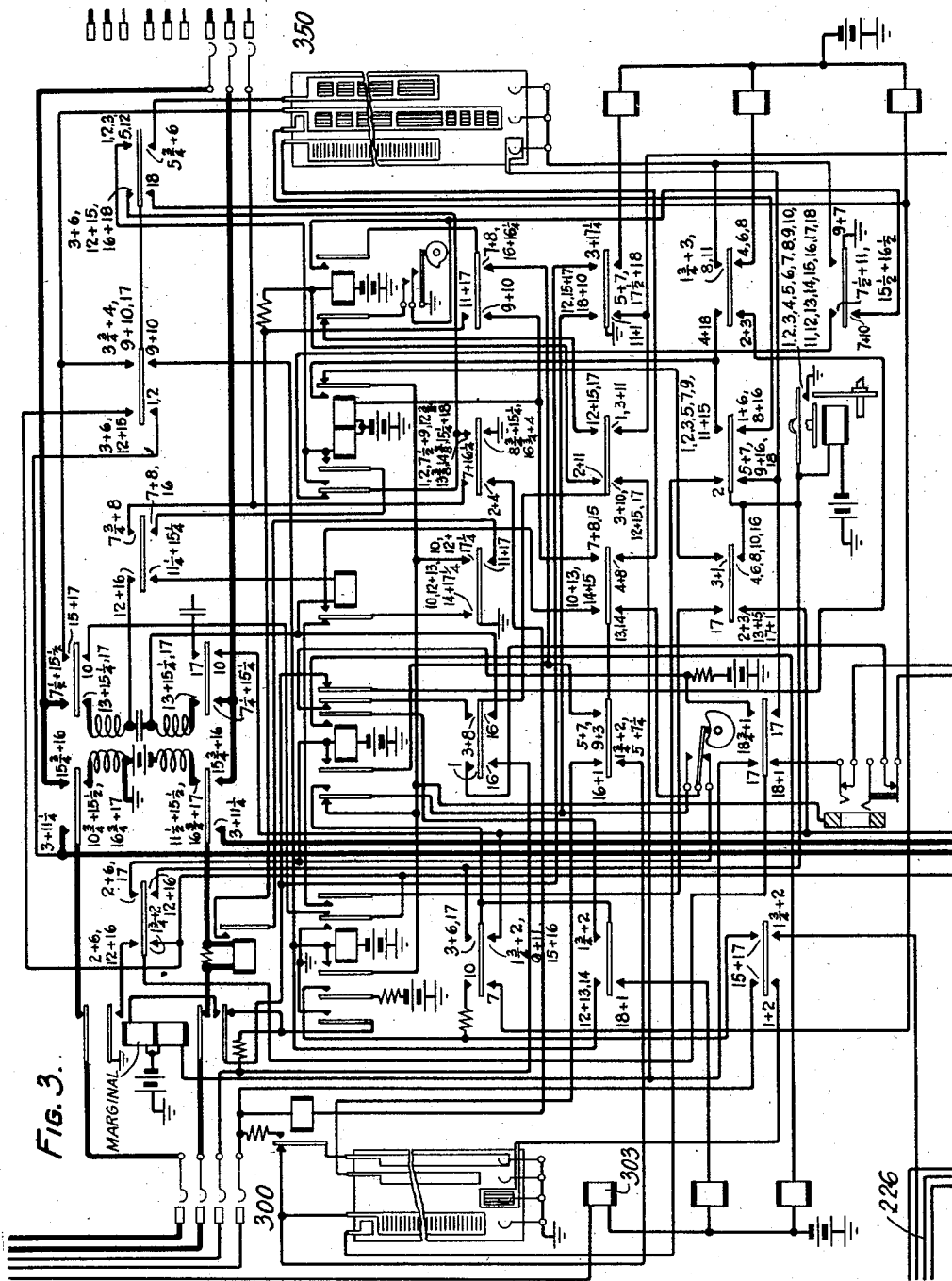
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AUTOMATIC TELEPHONE EXCHANGE SYSTEM

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10 Sheets-Sheet 3



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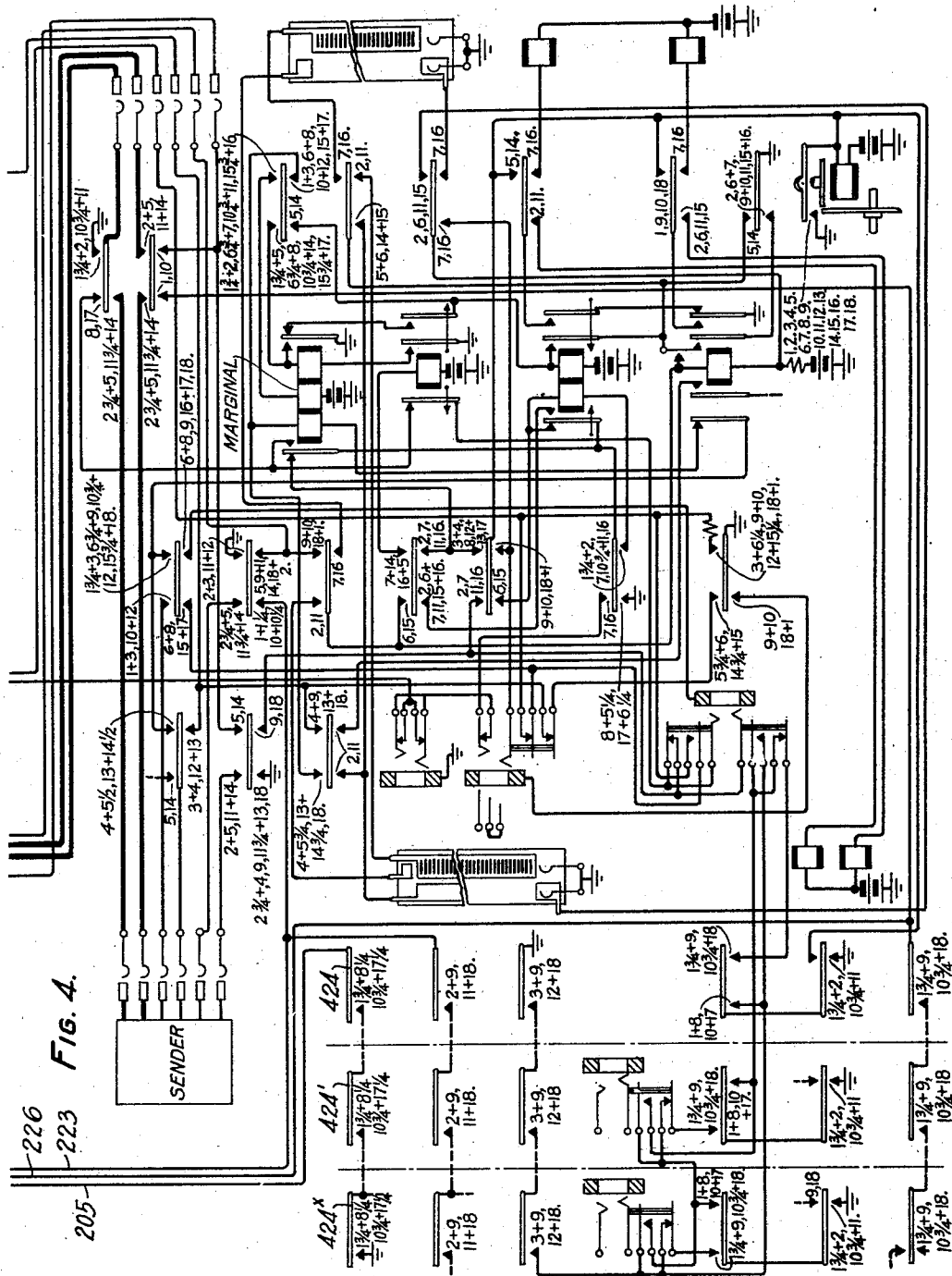
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10 Sheets-Sheet 4



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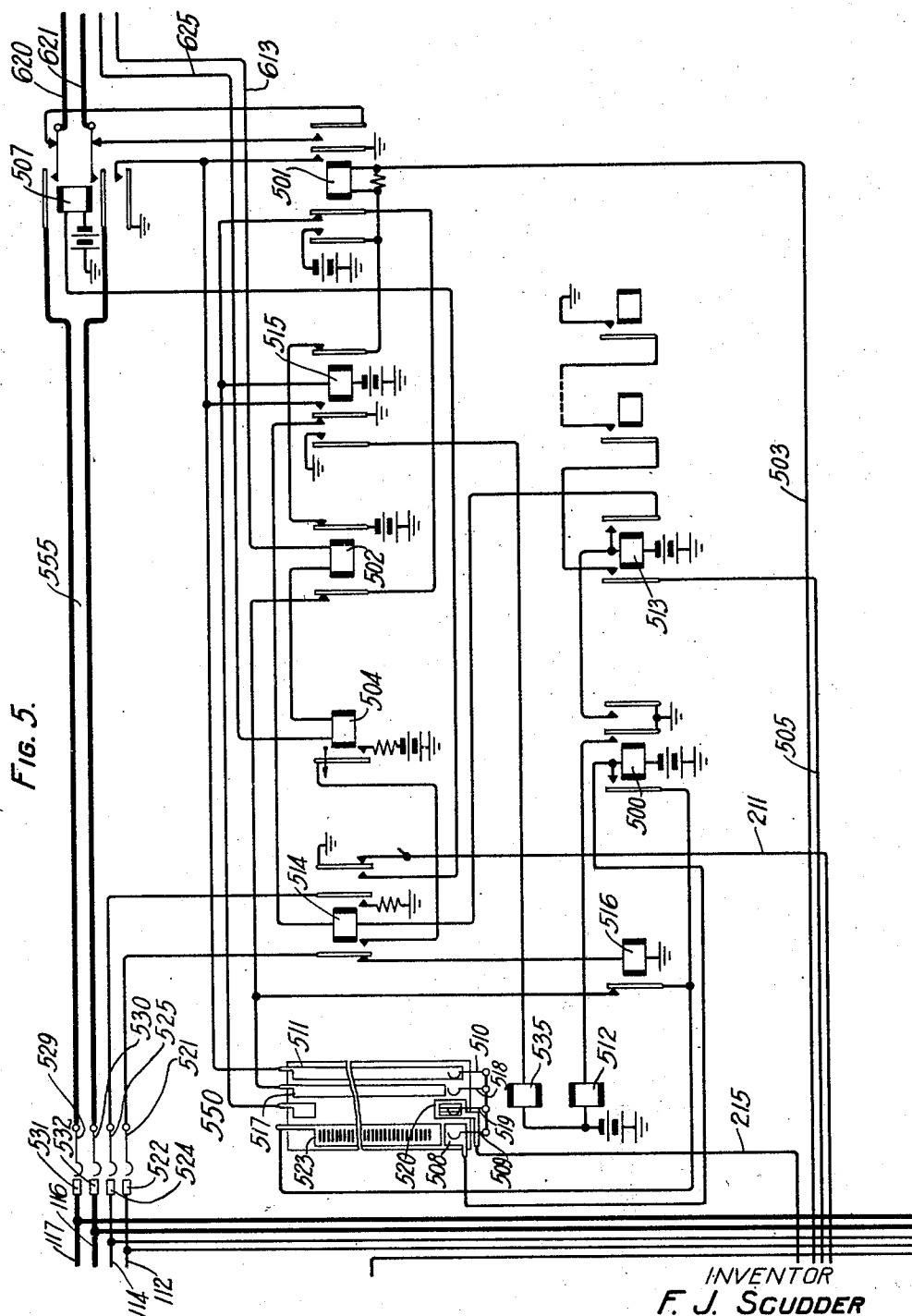
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AUTOMATIC TELEPHONE EXCHANGE SYSTEM

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10 Sheets-Sheet 5



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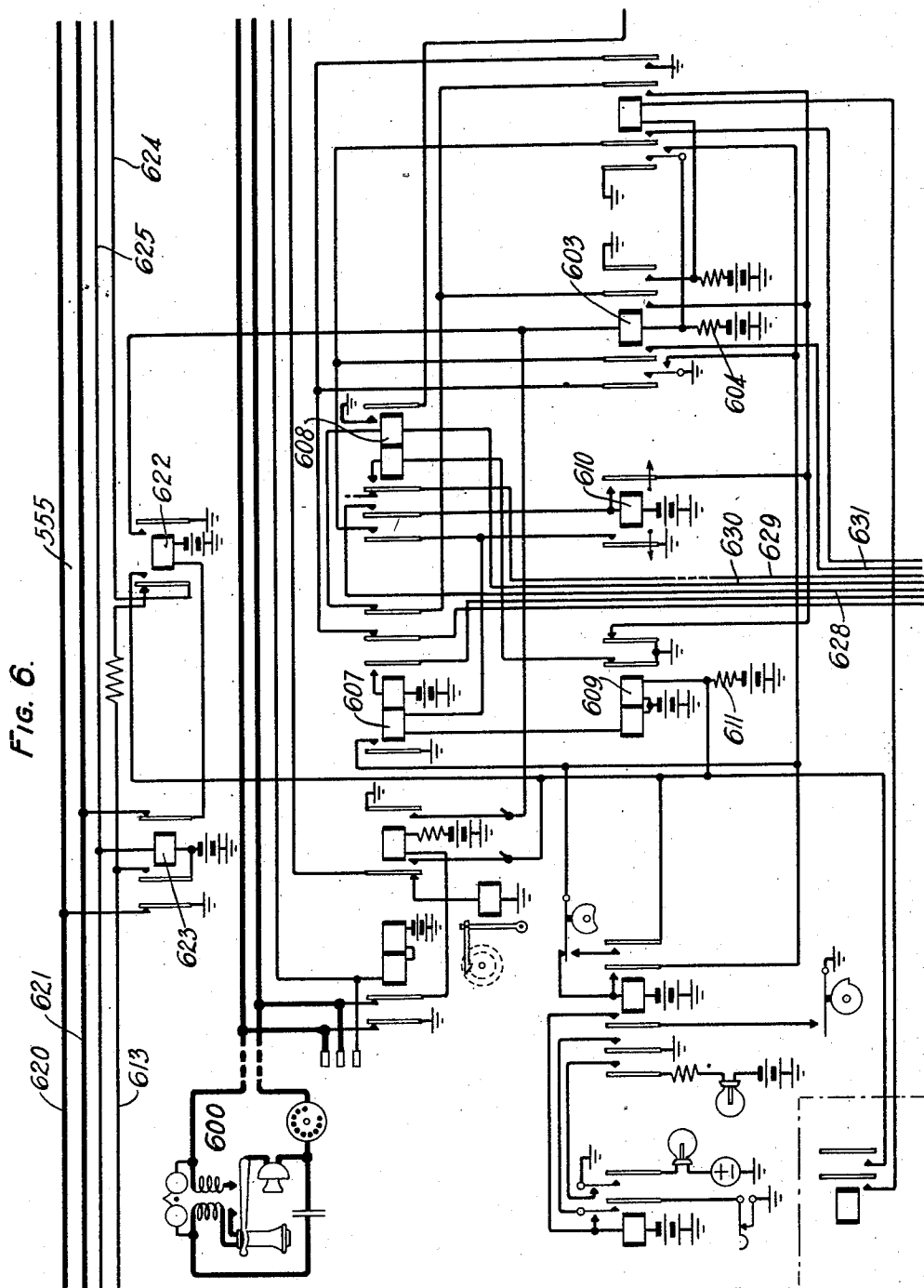
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10 Sheets-Sheet 6



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AUTOMATIC TELEPHONE EXCHANGE SYSTEM

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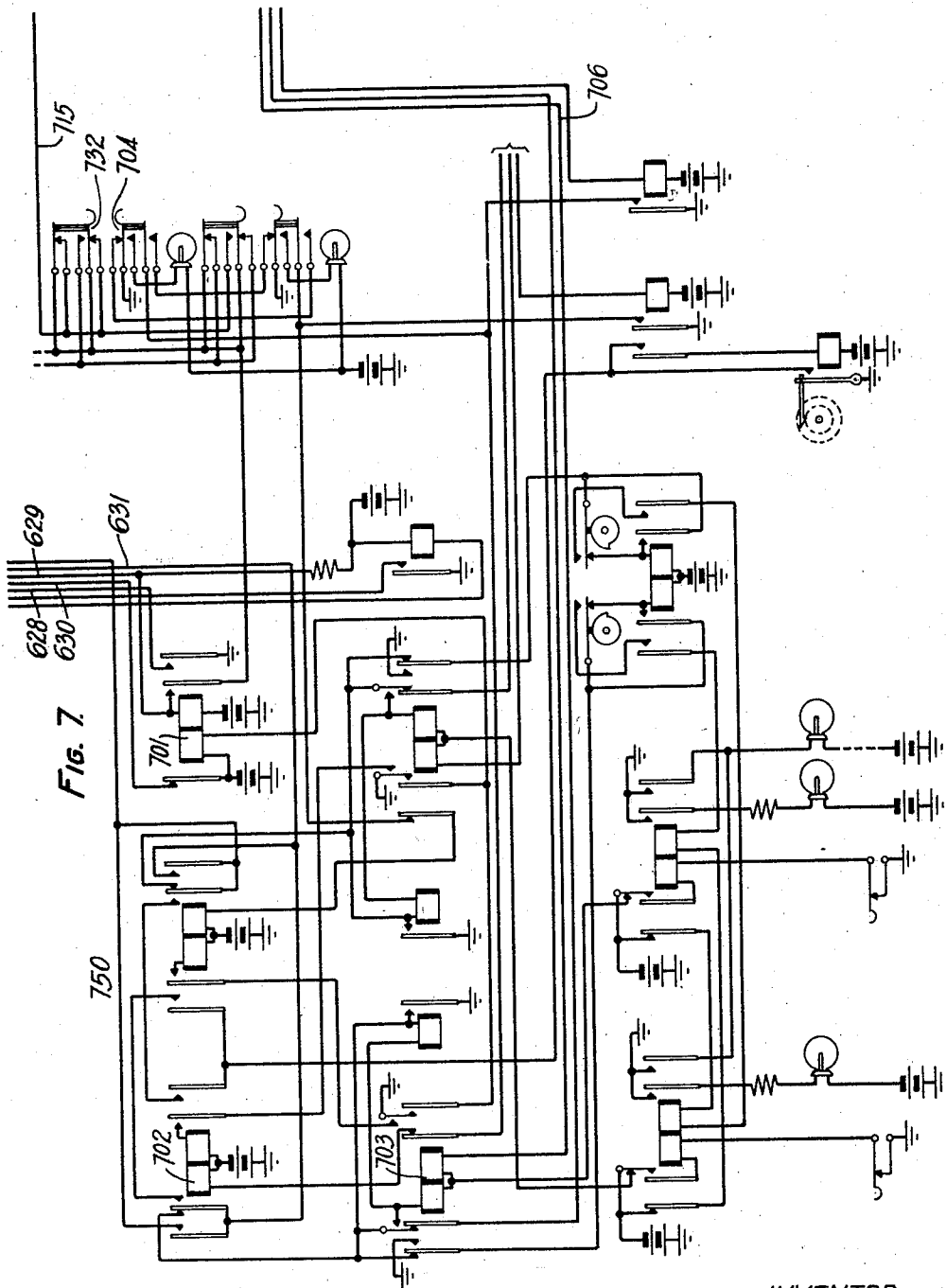


Fig. 7

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AUTOMATIC TELEPHONE EXCHANGE SYSTEM

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10 Sheets-Sheet 8

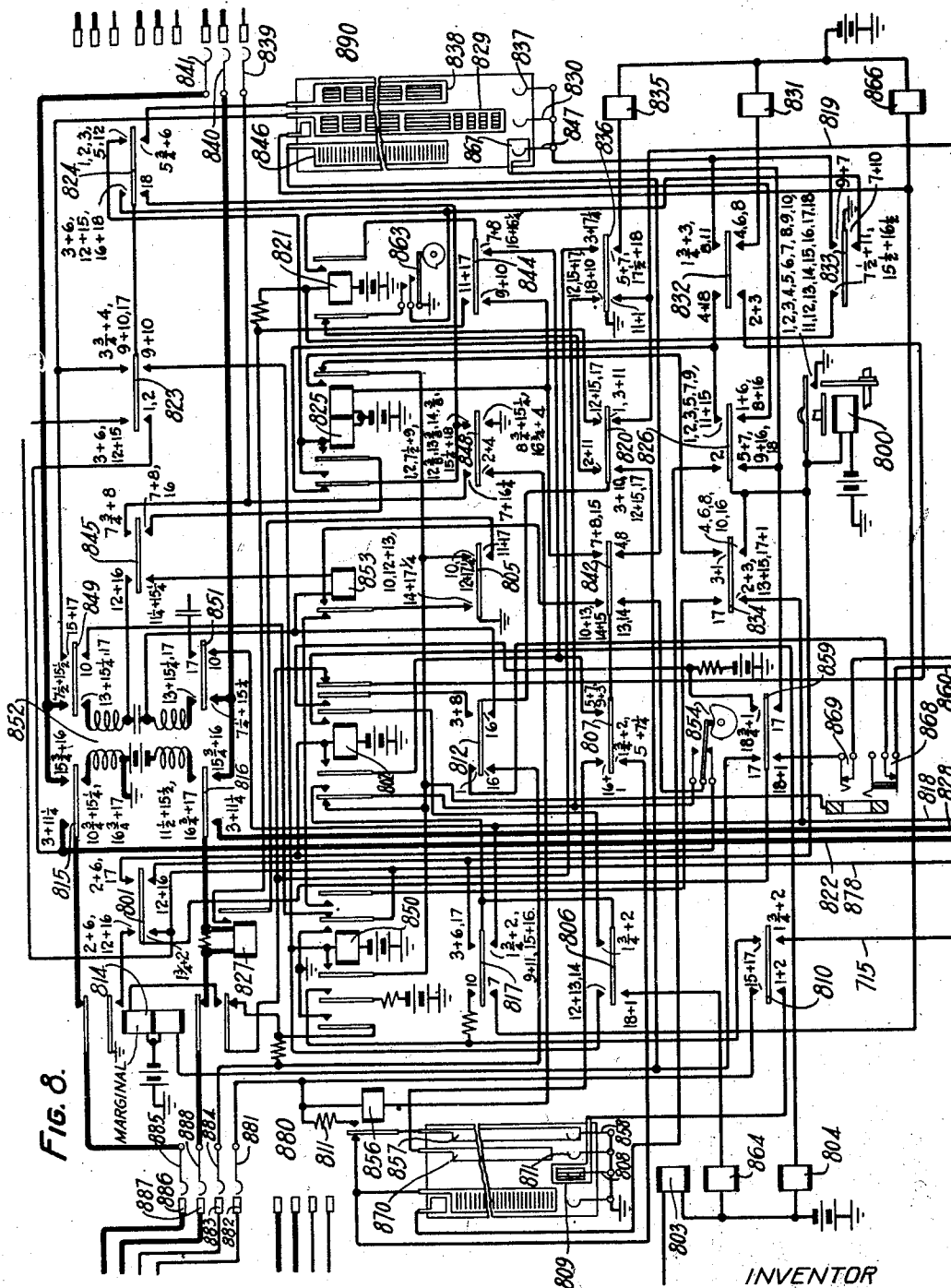


Fig. 8.

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AUTOMATIC TELEPHONE EXCHANGE SYSTEM

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10 Sheets-Sheet 9

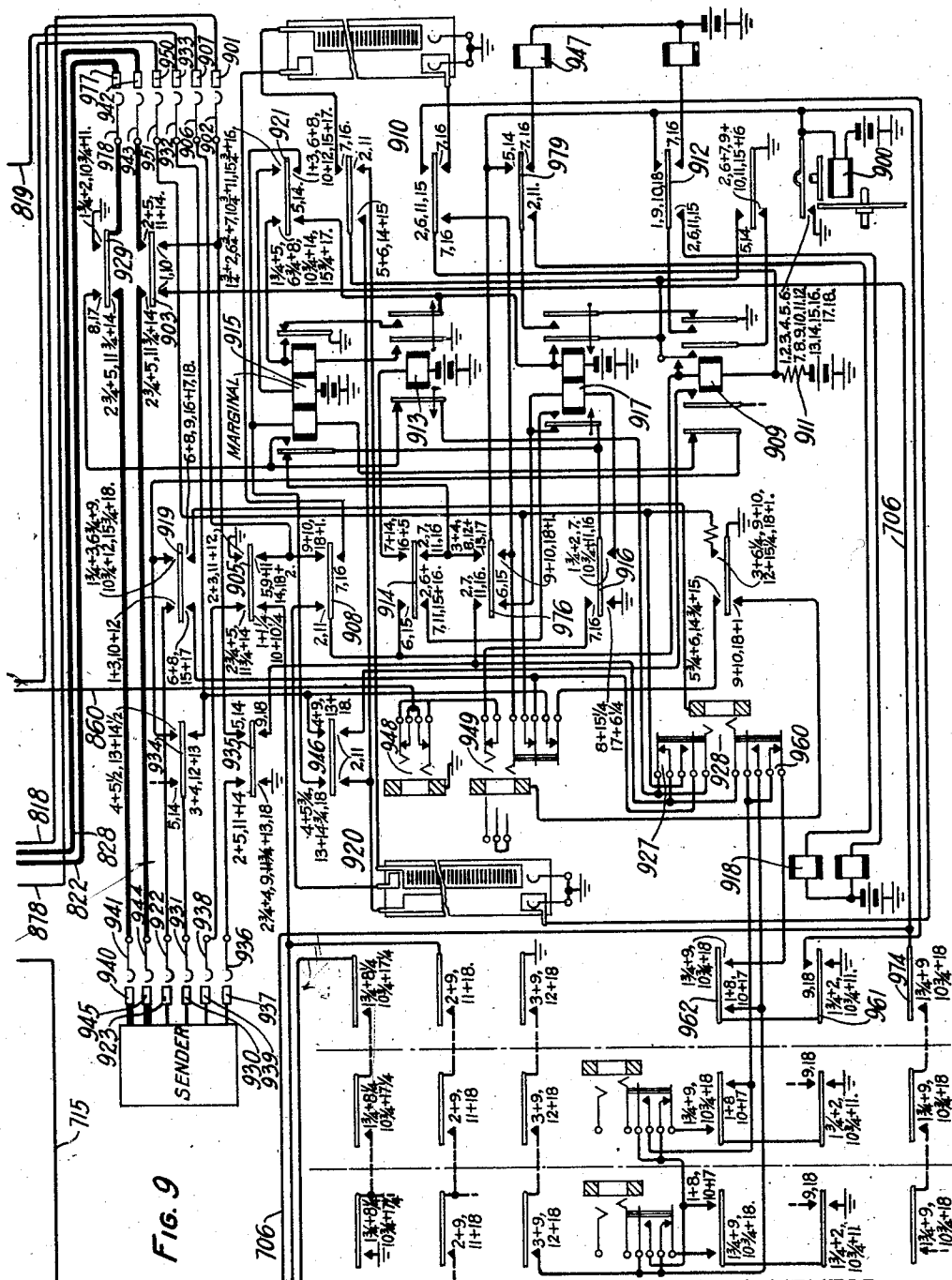


FIG. 9

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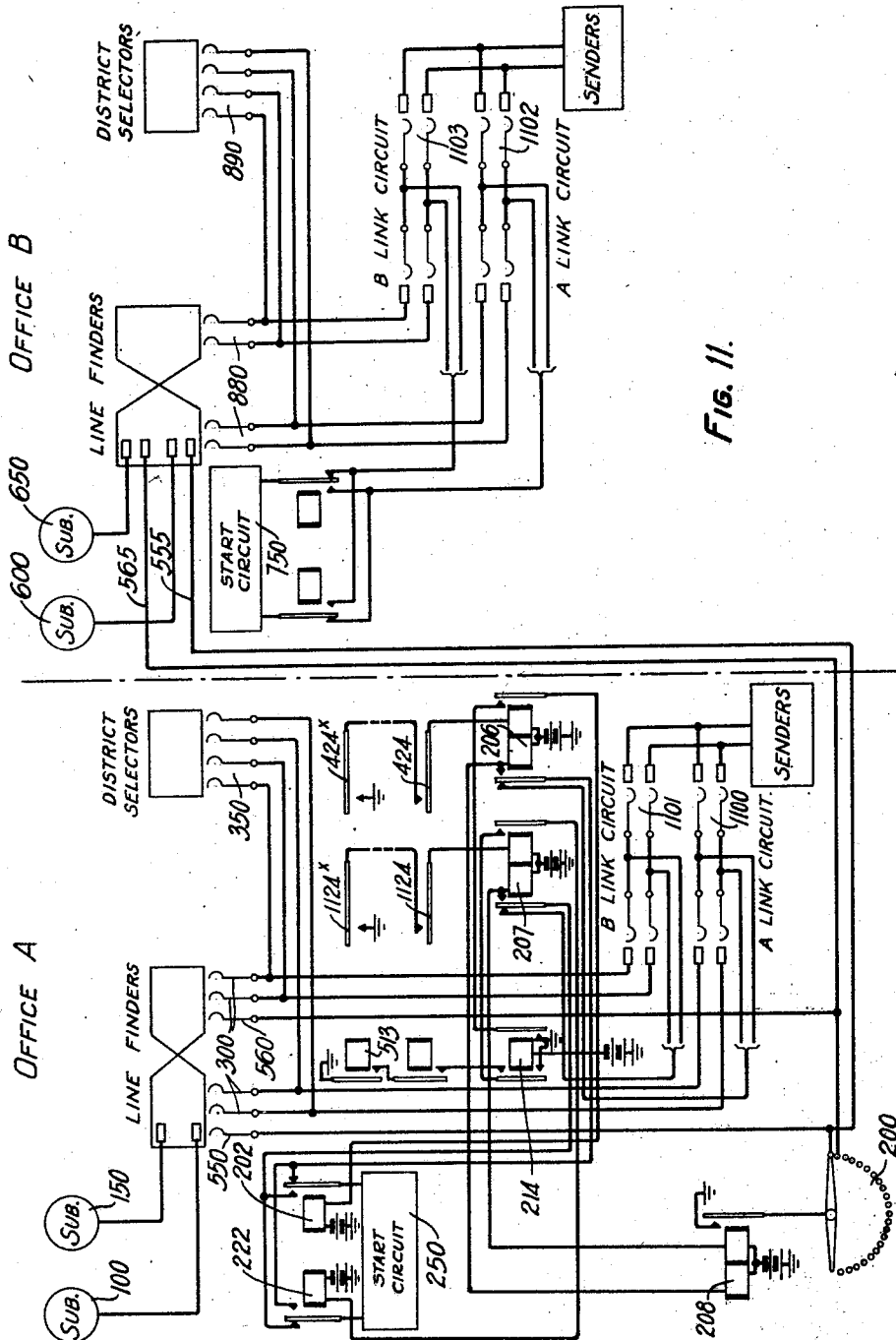


Fig. 11.

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UNITED STATES PATENT OFFICE

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AUTOMATIC TELEPHONE EXCHANGE SYSTEM

Application filed January 11, 1930. Serial No. 420,072.

The invention relates to an automatic telephone system and more particularly to a novel method and system of circuits for utilizing equipment at one office in a large exchange area as overflow or auxiliary equipment for a plurality of other offices in the same area.

Where there is a large number of telephone lines to be served as is the case in most cities, these lines are divided among a number of offices which together form what is known as an exchange area. The number of offices, of course, is determined by the geographical distribution of the subscribers to be served and by the density of the telephone development in a given section. In large cities it generally occurs that certain of these offices will be grouped in sections in which lines are used almost exclusively for business purposes and others will serve lines which are used for a variety of purposes other than those which may be classed as strictly business. In offices where business lines predominate the peak load is during business hours and after business hours the load may drop off to practically nothing whereas in residential districts the peak load is often after business hours. There may be other local conditions which would cause the peak load in the various offices to occur at different times during the day. For example, reference may be made to the situation in New York City where offices serving the financial district in the lower part of the city are practically without load after five o'clock whereas the peak load in an office serving the hotel and theatre district comes on between seven and eight in the evening.

It is the usual practice in offices which are worked on an automatic basis to provide sufficient equipment in the way of line finders, selectors and control equipment to take care of the peak load. A certain per cent of this equipment is idle when the load is at its minimum. Apparatus which is idle is not worked at a maximum efficiency and fixed charges and depreciation are present whether the equipment is operating or not.

In accordance with the invention it is proposed to provide in each of a plurality of of-

fices in addition to the usual groups of line finders normally paired with district selectors an auxiliary group of line finders which become effective only when the regular line finders are all engaged in handling the peak load of each such office and which auxiliary line finders are individual to trunks terminating as calling lines in the line finder banks of an overflow office which may be common to a plurality of offices in which overflow peak loads may occur.

For example, a plurality of offices in the financial district in New York City are situated in one or more buildings, several offices in each building. The common overflow offices might be situated in one of these buildings and be connected by interoffice trunk cables to such other offices in which overflow loads occur during the business period of the day. The trunks from each such office would terminate as incoming lines in the banks of line finder frames in the overflow office and be handled at the overflow office exactly like subscriber calls. For instance, should an overflow load occur at the Hanover office during the period in which the stock market is in session and all the regular line finder equipment be in service, the auxiliary line finders would be automatically rendered effective to route calls over the interoffice trunks to the overflow office where the line finders thereat would pick-up the calls and terminate them by the call extending equipment of the overflow office.

Further, the overflow office instead of being located adjacent to the offices in the financial district might be located at a point, for example, between the financial district and theatre district and thus receive an overflow load from the offices in the financial district during one period of the day and an overflow load from the offices in the theatre district during another period of the day. In this manner the most efficient operation in all such offices including the overflow office would be attained.

A further feature of the invention incident to the provision of such an overflow office is that the usual line finders, districts, links and senders may be reduced to a number sufficient

to handle the average traffic load and the auxiliary line finders added in sufficient numbers to care for the peak load. Since the line finders, districts, links and senders, which are installed at the overflow office need only care for the overflow from the offices to which it is common, the percentage of such equipment to the number of incoming trunks need not be as great as the usual percentage of such equipment supplied in the originating offices. Thus considerable economy may be attained through the use of the invention.

A clearer conception of the scope and purpose of the invention may be obtained from a consideration of the following description in connection with the attached drawings in which:

Figs. 1 to 5 show apparatus at an office A of an exchange system; and

Figs. 6 to 9 show apparatus at an office B which may serve as an overflow office for a plurality of offices, such as office A.

Fig. 1 shows a calling subscriber's line together with relay equipment common to a group of lines;

Fig. 2 shows a start circuit and a selecting switch for selecting idle line finders and interoffice trunks for handling overflow calls;

Fig. 3 shows a line finder and district selector;

Fig. 4 shows a link circuit for associating a sender diagrammatically illustrated with the district selector of Fig. 3;

Fig. 5 shows an auxiliary line finder individual to an interoffice trunk having access to the calling line of Fig. 1 during periods of peak load;

Fig. 6 shows a calling subscriber's line together with common relay equipment terminating in office B and an interoffice trunk;

Fig. 7 shows a start circuit;

Fig. 8 shows a line finder and district selector;

Fig. 9 shows a link circuit for associating a sender diagrammatically illustrated with the district selector of Fig. 8;

Fig. 10 is a diagram showing how the several figures should be arranged to illustrate the complete circuits of the invention; and

Fig. 11 is a schematic drawing illustrating the principles of the invention.

The invention has been embodied in a disclosure which is substantially like that of Patent No. 1,690,206, granted to A. Raynsford, November 6, 1928. The senders diagrammatically indicated by small rectangles in the upper left corner of Figs. 4 and 9 are of the character disclosed in the Patent No. 1,589,402, granted to O. H. Kopp, June 22, 1926, and reference to the Kopp patent may be made for operations not fully described herein.

As in the disclosures of the above mentioned patents, a plurality of link circuits is provided at each exchange office arranged to

serve a group of calling lines and are taken into service in rotation. When a link circuit completes its function it hunts for and associates itself with a district selector which is ready for use and the link and district remain in a suballotted condition until the next link in the series has been put into service. The link circuit is then placed in an allotted position from which it will be advanced by the initiation of a call and the action of the associated start circuit. For example, the trip circuit of Fig. 1 and start circuit of Fig. 2 are so arranged that only one line of a group of lines may be served at a time and so that there may be cooperation between two subgroups of lines to each of which the group of link circuits of Fig. 4 is individual. The details of its functions form no particular part of the present invention and are fully described in Patent No. 1,567,072, granted to W. H. Matthies, December 29, 1925.

The start circuit of Fig. 2, however, differs from the start circuits of the above mentioned patents in that it is provided with a selecting switch which selects an idle line finder of an auxiliary group of line finders mounted on the same line finder frame as the regular line finders which serve the calling line group. One of these auxiliary line finders is disclosed in Fig. 5. The start circuit is so arranged that in the event that at the time a call is initiated in the line group in which the calling line is located, the traffic is so heavy that there are no links and regular line finders available in the group normally arranged for giving first choice service for the call, an auxiliary line finder will be started to connect with the calling line to trunk the call over an interoffice trunk to the overflow office.

As stated hereinbefore, the auxiliary line finders such as the line finder of Fig. 5 are mounted upon the same frame as the regular line finders, one of which is shown in Fig. 3 and the brush tripping magnets, one of which is shown at 303 in Fig. 3, serve both the regular and auxiliary line finders in common. The line finder of Fig. 5 is individual to an interoffice trunk which terminates as a calling line in the terminal banks of a group of line finders in the overflow office. One of the group of line finders in the overflow office is shown in Fig. 8. Although in the present disclosure but one office having overflow trunks terminating in the overflow office has been illustrated, it will be obvious that overflow trunks from a plurality of offices may terminate in line finder banks of the overflow office, so that the overflow office may serve to complete overflow calls at peak load periods from a plurality of originating offices.

Referring particularly to Fig. 11 in which apparatus of an office A and an overflow office B of an exchange system have been

schematically illustrated, it will be assumed that office A is an office in which a peak load may occur at a time when the regular load in the overflow office B is light. In office

5 A the line finders 300, serving the group of subscribers' lines in which lines 100 and 150 are located, are paired in the usual manner with district selectors 350. The line finders in the left half of the line finder frame are arranged to be started through the start circuit 250 and a pre-allotted link of the A group of link circuits 1100 and the line finders in the right half of the frame are arranged to be started through the same start circuit 15 250 and a pre-allotted link of the B group of link circuits 1101 in accordance with the practice set forth in the above mentioned patents. In accordance with this invention each half of the line finder frame is also equipped with auxiliary line finders, such as 550 and 20 560, which are individual respectively to interoffice trunks 555 and 565 terminating as calling lines in the banks of line finders 880 of the overflow office B. These auxiliary line finders may for example be substituted for 25 certain of the regular line finders.

At the office B, all of the line finders 880 in both halves of the line finder frame serving a group of subscribers' lines including 30 lines 600 and 650 and the interoffice trunks 555 and 565 are paired in the usual manner with district selectors 890. The line finders of the left half of the frame are arranged to be started through the start circuit 750 and a pre-allotted link of the A group of link circuits 1102 and the line finders of the right 35 half of the frame are arranged to be started through the start circuit 750 and a pre-allotted link circuit of the B group of link circuits 1103. The apparatus of the office B is arranged to function at all times in the manner described in the hereinbefore mentioned patents.

At the office A a selecting switch 200 is provided individual to the start circuit 250 which 45 selects an idle line finder 550 or 560 for use at such times as the office A reaches a peak load condition. Associated with the start circuit and common to the link circuits of the A group is a relay 206. A similar relay 207 is provided common to the link circuits of the B group. When all of the link circuits of the A group are busy, a circuit is established over the cams 424—424* of the link 50 circuits of the A group for relay 206 which disconnects the start circuit 250 from the link circuits of the A group and extends it to the winding of relay 208. The relay 208, in turn, controls the closure of the start circuit to a line finder such as 550 or 560. When 60 all of the auxiliary line finders have been placed in service, a chain circuit is established through contacts of relays 513 of those link circuits through the winding of relay 214. Relay 214 upon operating with relay

206 operated then operates relay 202 which transfers the start circuit to the B group of links. Thus the B group of links does not function to serve lines in the subgroup in which line 100 is located until after all of the links of the A group and all of the auxiliary line finders have been placed in service. 70

Similarly, when all of the link circuits of the B group are busy a circuit is established over cams 1124—1124* of the link circuits of the B group for relay 207 which disconnects the start circuit from the B group of links and connects it to a winding of relay 208. Relay 208 then functions to start auxiliary line finders such as 550, 560. When all of these line finders have been placed in service, relay 214 operates, in turn operating relay 222 which transfers the start circuit to the A group of links. Thus the A group of links does not function to serve lines in the subgroup in which line 150 is located until all of the links of the B group and all of the auxiliary line finders have been placed in service. 80 85

Referring now to Figs. 2 to 9, inclusive, of the drawings since under conditions of normal load the apparatus of office A functions in the well-known manner fully set forth in the patents above referred to, it will not be necessary to describe herein in detail, the manner in which a call is extended from the substation 100 to a desired subscriber's line. It will therefore be assumed that at the time the subscriber of substation 100 initiates a call, the links, senders and line finders, such as are disclosed in Figs. 3 and 4 which would ordinarily be available for use, are busy because of a peak load condition. One link circuit of the A group of link circuits giving first choice service to the subgroup of two hundred lines in which the line 100 is located is disclosed in Fig. 4 together with certain sequence switch cams of other link circuits of the same group. When all these link circuits are busy their sequence switches will be standing in some position other than 1 or 10, which are normal positions, and thus a series circuit will be established from ground through the contacts of cams 424*—424', 424, conductor 205 to battery through the left winding of relay 206. 100 105 110 115

When relay 206 operates, a locking circuit is established therefor extending from battery through the right winding and right front contact of relay 206, the inner left normal contacts of relay 203, the left back contact of relay 202, conductor 131, the inner left contact of relay 103, the outer left contact of relay 108 to ground at the left contact of relay 110, relay 110 being operated when the substation 100 initiated the call. The locking ground for relay 206 is now extended through the right winding of relay 208 to battery, thus operating relay 208. Relay 208 establishes a start circuit for the line 120 125 130

finder of Fig. 5, it being assumed that selector 200 is at the time standing in a position to start that line finder. This circuit may be traced from battery through the right normal contact of relay 502, the right back contact of relay 515, the winding of relay 501, conductor 503, brush 209, winding of relay 210, contact of relay 208, conductor 211, to ground at the right back contact of relay 514. A circuit is also closed in parallel from ground on conductor 211 over the contact of relay 208, the back contact of stepping magnet 212 of the selector 200 to battery through the winding of relay 213. Relays 501, 210 and 213 thereupon operate, but the operation of relays 210 and 213 is without effect at this time.

Relay 501 upon operating locks over its energizing circuit to battery at its outer left contact independently of the contacts of relays 502 and 515, at its outer right contacts establishes a bridge across the outgoing conductors 620 and 621 of the interoffice trunk 555 for a purpose to be later described, and at its inner right contacts establishes a circuit extending from battery through the winding of relay 500, normal commutator segment 508, brush 509, brush 510, commutator strip 511, to ground at the inner right contact of relay 501. Relay 500 operates in this circuit and closes obvious circuits for the up-drive magnet 512 and for relay 513. Relay 513 upon operating closes at its right front contact a locking circuit for itself extending through the relay 514 to ground at the left back contact of relay 515. Relay 514 being shunted by ground at the contact of relay 500 does not operate in this locking circuit as long as relay 500 remains energized. The line finder of Fig. 5 under the control of magnet 512 now moves upwardly and since trip magnet 303 is operated, the proper set of brushes is tripped. At its left contact, relay 513 closes one point in a chain circuit extending through contacts of similar relays of auxiliary line finders for a purpose to be later explained.

As soon as the line finder leaves normal, a locking circuit is provided for relay 500 extending from battery through the left contact of relay 500, the back contact of relay 516, commutator strip 517, brush 518 to ground over brush 510, strip 511 and the inner right contact of relay 501 which holds relay 500 operated. As soon as the commutator brush 519 engages segment 520, a circuit is closed from ground over brushes 510 and 519, segment 520, conductor 215, contact 232 of key 204, inner right front contact of relay 201 to conductor 129 and the right winding of relay 201. This circuit shunts the left winding of relay 108 and causes that relay to release, in turn releasing the trip magnet 303. When brush 519 leaves segment 520, the circuit of relay 201 is opened and that re-

lay releases, freeing the start circuit of Fig. 2 and releasing relay 208 which in turn releases relays 210, 213 and 501. When the line finder brush 521 makes contact with terminal 522, which is connected to conductor 114 and therefore to battery through the right winding of relay 109, a circuit is completed from this battery through the winding of relay 516 to ground. Relays 109 and 516 operate, relay 516 opening the holding circuit previously traced for relay 500. As soon as the brushes of the line finder become accurately centered on the terminals of the calling line, a second holding circuit extending from battery through the winding and left contact of relay 500 over commutator strip 523, brushes 509 and 510 to ground, is opened at an insulating segment of strip 523 and relay 500 releases, opening the circuit of up-drive magnet 512 and removes the shunt ground from the winding of relay 514 which now operates in the locking circuit of relay 513.

Relay 514 upon operating, opens the circuit of relays 516 and 109, at its outer right contact removes ground from conductor 211, and establishes an obvious circuit for relay 507, establishes a circuit for the cut-off relay 102 of the calling line extending from battery through the windings of relay 102, conductor 112, terminal 524 and brush 525 to ground and at its left front contact prepares a circuit for the calling line message register 118. Relay 109 which operated in series with relay 516 opens the holding circuit of relay 110, thereby restoring the relay equipment of Fig. 1 so that another calling line in the same line group may have access to the common start circuit for starting another call. Relay 507 upon operating, supplies a ground connection to the commutator strip 511 to replace the ground removed upon the deenergization of relay 501 and at its lower inner and upper transfer contacts, replaces the bridge through the outer right contacts of relay 501 by a bridge extending over brushes 529 and 530 and terminals 531 and 532 of the line finder, conductors 117 and 116, and the calling substation loop.

At the time relay 501 operated to establish a bridge across conductors 620 and 621 of the outgoing end of trunk 555, a circuit was established for line relay 622 at the distant end of the trunk which may be traced from battery through the winding of relay 622, right back contact of cut-off relay 623, thence over conductor 621, the lower normal contacts of relay 507, the outer right contacts of relay 501, the upper normal contacts of relay 507, conductor 620 to ground at the left back contact of relay 623. After the operation of relay 507, relay 622 is held energized over the calling line loop. Relay 622 in operating closes a circuit from battery through resistance 604, winding of relay 603, to ground at the right contact of relay 622. It also pre-

5 pares a circuit from battery through resistance 611 and the right winding of relay 609 in parallel, left front contact of relay 622 to conductor 624 to identify the calling trunk of the line finders having access to that trunk. Relay 603 in operating closes a circuit from battery over the back contact of relay 701, conductor 630, right winding of relay 608, outer right back contact of relay 607, inner right contact of relay 603 to ground at the outer contact of relay 609.

10 Relay 608 operates in this circuit and closes a locking circuit for itself from battery through the right winding of relay 701, conductor 629, over back contacts of relays similar to relay 608 individual to other subgroups of lines appearing in the same line finder, inner left front contact and left winding of relay 608 to ground at the inner right back contact of relay 609. Relay 608 closes a circuit from ground at its outer right front contact through the winding of trip magnet 803 of the line finders of the frame serving the subgroup of lines in which the trunk 25 555 is located to battery in preparation for tripping the proper set of brushes of the line finder. Relay 701 operates in the locking circuit of relay 608 and in combination therewith closes a circuit from ground over its outer right contact, conductor 628, left middle contact of relay 608, winding of relay 610 to battery. Relay 610 locks over its right contact to ground at the outer back contact of relay 609 and closes a circuit for starting an allotted line finder. It will be assumed that the sequence switch 900 of the link circuit of Fig. 9 is at the time standing in position 1 and is connected with the pre-allotted district selector 890, the sequence switch 800 of which is standing in position 2. At this time the operation of relay 610 will therefore close a circuit from ground at its left contact, the outer left contact of relay 608, the inner left contact of relay 603, conductor 631, left back contact of relay 702, inner left back contact of relay 703, conductor 706, lower contacts of cam 903, brush 902, terminal 901, conductor 878, the lower left and upper right contacts of cam 801, the winding of relay 802 to battery.

50 Relay 802 in operating, closes a circuit from battery through the winding of up-drive magnet 804 of the line finder, inner right front contact of relay 802, right contact of cam 806, outer left front contact of relay 802 to ground at the upper left contact of cam 836. The line finder moves upwardly under the control of magnet 804 and since the tripping magnet 803 is operated, the proper set of brushes is tripped. As soon as the line finder moves upwardly, a locking circuit is provided for relay 802 extending over its inner left front contact, the upper right and lower left contacts of cam 807, the back contact of relay 856, commutator strip

857, brush 858 to ground which holds relay 802 operated independent of the trip circuit. As soon as commutator brush 808 engages segment 809, a circuit is closed from ground over brush 808, segment 809, lower contacts of cam 810, conductor 715, contacts 732 of key 704, inner right front contact of relay 701 to conductor 629 and the right winding of relay 701. This circuit shunts the winding of relay 608 and causes that relay to release, in turn releasing the trip magnet 803. When brush 808 leaves segment 809, the circuit of relay 701 is opened and that relay releases, freeing the start circuit. When line finder brush 881 makes contact with terminal 882 which is connected to conductor 624 and therefore to battery, a circuit is completed from this battery through the winding of relay 856, the lower contacts of cam 848 to ground. Relay 856 operates in this circuit and closes a shunt around its winding through resistance 811 to ground over commutator strip 857 and brush 858. This reduces the resistance in series with the winding of relay 609 sufficiently to cause that relay to operate and open the locking circuit of relay 610 which in turn opens the energizing circuit of relay 802. The operation of relay 856 also opens the locking circuit of relay 802 causing that relay to release. The release of relay 802 closes a circuit from battery through the winding of cut-off relay 623, conductor 625, terminal 883, brush 884, lower back contact of relay 814, right back contact of relay 802, the lower left and upper right contacts of cam 832 to ground at the upper right contact of cam 833. The operation of cut-off relay 623 opens the circuit of line relay 622, which removes battery from conductor 624, thereby releasing relays 609 and 856. Relay 623 also establishes a circuit extending from battery at its left front contact over conductor 613 through the windings of relays 502 and 504, conductor 625, terminal 883, brush 884, the lower back contact of relay 814, right back contact of relay 802 to ground over the lower left and upper right contacts of cam 832. Relay 502 operates in this circuit but relay 504 does not. Relay 502 upon operating removes battery at its right contact from the test circuit extending through the winding of relay 501 to prevent the line finder from being again selected by switch 200, and at its left contact opens the operating circuit of relay 515.

At the time relay 802 operated, it closed a circuit from ground at the upper left contact of cam 836, outer left front contact of relay 802, lower right contact of cam 817, conductor 818, terminal 907 and brush 906 of the link district finder 910, upper right contact of cam 908, winding of relay 909, resistance 911 to battery. Relay 909 operates and closes a circuit from battery through the winding of sequence switch magnet 900, upper contact 130

of cam 912 to ground at the outer right front contact of relay 909 advancing link sequence switch 900 to position 2. When sequence switch 900 leaves position 1, relay 909 releases. In position 2 a circuit is closed from battery through the winding of relay 913, right contacts of cam 914, left back contact of relay 915 to ground at the lower left contact of cam 916. Relay 913 operates, closing a circuit from battery through the right winding of relay 917, the outer right contact of relay 913 to ground at the right back contact of relay 915. Relay 917 in operating, closes a circuit from battery through the winding of up-drive magnet 918 of the sender finder 920, left contact of cam 979, outer right contact of relay 917 to ground at the right back contact of relay 909. The sender finder moves upwardly under the control of magnet 918 in search of an idle sender.

Relay 913 also closes a circuit from battery through the middle winding of relay 915, upper contacts of cam 921, right winding of relay 915, to ground at the inner right contact of relay 913. The current in this circuit however, is not sufficient to operate relay 915 but does create a flux in the winding of that relay so that it becomes quick to operate when the test circuit is closed. The test circuit extends from brush 922, upper contacts of cam 919, left back contact of relay 909, left winding of relay 915, lower right and upper left contacts of cam 921, to ground at the inner right contact of relay 913. An idle sender is characterized by battery potential on terminal 923 and therefore when brush 922 engages terminal 923 the above traced circuit is completed and relay 915 operates quickly, closing a locking circuit for itself from battery through its middle winding, the upper contacts of cam 921, and right front contact of relay 915 to ground. It also opens the circuit of relay 917 which releases to in turn release magnet 918 and bring the sender finder 920 to rest on the terminals of the idle sender. The release of relay 917 in turn releases relay 913. With relay 913 released and relay 915 operated, a circuit is closed from battery through the winding of sequence switch magnet 900, upper left contact of cam 976, contacts 927 of jack 928, left back contact of relay 913, left front contact of relay 915, to ground at the lower left contact of cam 916, thus advancing sequence switch 900 to position 3.

As soon as sequence switch 900 reached position $1\frac{3}{4}$, a circuit was established from ground over the right contact of cam 929, brush 978, terminal 977, conductor 822, the lower left contact of cam 823, the upper right contact of cam 824 to battery through the left winding of relay 825. Relay 825 upon operating with relay 802 released, closes a circuit for advancing sequence switch 800 into position 3. This circuit extends from battery

through the winding of sequence switch magnet 800, the upper right contact of cam 826, the right front contact of relay 825, the left back contact of relay 802 to ground at the upper left contact of cam 836. When sequence switch 900 reaches position 3, a circuit is closed from the ground at the sender over terminal 930, brush 931, the lower contact of cam 934, brush 932, terminal 933, conductor 819, the lower contacts of cam 820 to battery through the lower winding of relay 814 and in parallel therewith over the upper left contact of cam 820 to battery through the winding relay 821. Relay 821 operates although ineffective at this time, but relay 814 being marginal, does not operate.

As soon as sequence switch 900 arrived in position $2\frac{3}{4}$ it prepared the pulsing circuit for receiving dialing impulses. This circuit may be traced from the sender over terminal 940, brush 941, the lower contact of cam 929, brush 978, terminal 977, conductor 822, the left contact of cam 815, the upper back contact of relay 814, brush 885, terminal 886, conductor 620, upper alternate contacts of relay 507, brush 529, terminal 531, conductor 117, over the subscriber's line loop and through his dial returning over conductor 116, terminal 532, brush 530, the inner lower alternate contacts of relay 507, conductor 621, terminal 887, brush 888, the inner lower back contact of relay 814, through the winding of supervisory relay 827, the left contact cam 816, conductor 828, terminal 942, brush 943, the upper contacts of cam 903, brush 944, terminal 945 to the sender. Upon the establishment of this pulsing circuit, a dialing tone is transmitted to the calling line in the well-known manner to inform the calling subscriber that the sender is ready to receive impulses which he may then send out by manipulating his dial.

Upon the seizure of the sender, battery is removed from terminal 923, thus releasing relay 915 which closes a circuit for advancing the sequence switch 900 into position 5. This circuit may be traced from battery through the winding of magnet 900, the upper right contact of cam 976, the left back contact of relay 915 to ground at the lower left contact of cam 916. Sequence switch 900 remains in position 5 throughout the further operation of the sender. As soon as the calling subscriber has dialed the office code digits of the desired line number the sender establishes a fundamental circuit for controlling the district selector of Fig. 8 which may be traced from battery through the left winding of relay 825, the upper right contact of cam 824, the upper left contact of cam 823, conductor 878, terminal 901, brush 902, the upper contacts of cam 935, brush 936, terminal 937 through the winding of the stepping relay (not shown) of the sender to ground. Relay 825 energizes in

this circuit and locks over its outer left front contact and the upper left contact of cam 824 to the fundamental circuit and also closes a circuit from battery through the winding of sequence switch magnet 800, upper right contact of cam 826, right front contact of relay 825, outer left back contact of relay 802, to ground at the upper left contact of cam 836. Magnet 800 operates to advance the sequence switch into position 4.

In position 4 relay 825 closes a circuit from battery through the winding of up-drive magnet 831, the lower right and upper left contacts of cam 832; the right front contact of relay 825, thence to ground at the upper left contact of cam 836. The up-drive magnet operates and causes the district selector switch shaft to be moved upwardly in a brush selecting movement. Each time the commutator brush 830 makes contact with a contacting segment of strip 829, a shunt is established from ground at the upper right contact of cam 833 over brush 830 and strip 829, the upper right contact of cam 823, the upper left contact of cam 824, the outer left front contact of relay 825 to the winding of relay 825 for holding this relay operated but shunting down the sender stepping relay. In the well-known manner, the operation of the sender stepping relay operates counting relays of the sender until the sender is satisfied as to the district brush selection coded by the office code registers, when the fundamental circuit is opened at the sender permitting relay 825 to release as soon as brush 830 leaves the conducting segment of strip 829 upon which it last rested. The release of relay 825 opens the circuit of the up-drive magnet 831 and closes a circuit from battery through the winding of sequence switch magnet 800, the right contacts of cam 834, the right back contact of relay 825 to ground as previously traced for advancing the sequence switch into position 5.

With sequence switch 800 in position 5 the fundamental circuit is again closed as previously traced, whereupon the stepping relay of the sender and relay 825 again operate, relay 825 locking to the fundamental circuit over the circuit previously traced and closing the previously traced circuit for advancing sequence switch 800 into position 6. As soon as the sequence switch reaches position 5 a circuit is established for the trip magnet 835 extending from battery through the winding of that magnet to ground at the lower right contact of cam 836. With sequence switch 800 in position 6, the circuit for the up-drive magnet 831 is again closed over the circuit previously traced and magnet 831 causes the switch shaft to move upwardly in its group selection movement. During the initial portion of this movement due to the energization of the trip magnet 835, a set of brushes is tripped for engagement with the terminal bank. As

the shaft continues upwardly, a shunt circuit is intermittently established from ground at the upper right contact of cam 833, over brush 837, commutator strip 838, the lower right and upper left contacts of cam 824, the outer left front contact and left winding of relay 825 to battery for holding relay 825 operated and for shunting down the sender stepping relay.

At the sender in response to the intermittent operation of the stepping relay, counting relays are operated in the well-known manner until the sender is satisfied with respect to the district group selection coded by the office code registers when the fundamental circuit will be opened at the sender permitting the release of relay 825 as soon as brush 837 engages the next insulating portion of strip 838. Relay 825 upon releasing opens the circuit of up-drive magnet 831 to arrest the upward movement of the switch shaft with the tripped set of brushes 839, 840 and 841 in engagement with the lowermost set of bank terminals in the selected trunk group. Relay 825 in releasing also establishes the previously traced circuit for advancing sequence switch 800 into position 7.

In position 7 of sequence switch 800, relay 825 is operated in a circuit extending from battery through its right winding, the upper right contact of cam 842, the lower left contact of cam 807, back contact of relay 856, commutator strip 857, brush 858 to ground. Relay 825 energizes in this circuit, closing a circuit for advancing sequence switch 800 into position 8. This circuit may be traced from battery through the winding of magnet 800, upper right contact of cam 826, right front contact of relay 825, the outer left back contact of relay 802 to ground at the upper left contact of cam 836. In positions $7\frac{1}{4}$ to 8, relay 825 locks over its inner left front contact, the right contacts of cam 845 to the test brush 839 and ground over the sleeve terminal of the trunk provided that trunk is busy. The original energizing circuit of relay 825 is opened when the sequence switch leaves position $7\frac{1}{4}$ at the lower left contact of cam 807. If the first trunk of the group is busy however, relay 825 is held energized in position 8 and a circuit is completed for the up-drive magnet 831 from battery through the winding of magnet 831, lower right and upper left contacts of cam 832, the right front contact of relay 825 to ground as traced. The up-drive magnet is energized and causes the selector shaft to move upwardly in search of an idle outgoing trunk. Relay 825 is held energized as the test brush 839 passes from terminal to terminal over a circuit extending from battery through the right winding of relay 825, the right contacts of cam 842, commutator strip 846, brush 847, the upper contacts of cam 832, the right front contact of relay 825, thence to ground as

traced. As soon as an idle trunk is reached, characterized by the absence of ground on its sleeve terminal, the locking circuit of relay 825 is opened and that relay releases, in turn releasing the up-drive magnet 831 to bring the district selector to rest with its brushes 839, 840 and 841 on the terminals of the selected idle trunk. The release of relay 825 closes a circuit from battery through the winding of sequence switch magnet 800, the right contacts of cam 834, the right back contact of relay 825 to ground as traced for advancing sequence switch 800 into position 9.

As soon as relay 825 releases, ground is connected to sleeve terminal 839 over the upper contacts of cam 848, the outer left back contact of relay 825 to ground at the left contact of cam 833. As soon as the sequence switch moves into position 8 $\frac{3}{4}$, ground is connected over the upper left and lower right contacts of cam 848 to sleeve brush 839 independent of relay 825, which ground is maintained until the sequence switch leaves position 15 $\frac{1}{4}$.

With sequence switch 800 in position 9, a circuit is completed from battery through the right winding of relay 825, lower left contact of cam 844, the right contact of relay 821, the lower right contact of cam 833, to ground. Relay 825 operates and closes a circuit from battery through the winding of sequence switch magnet 800, upper right contact of cam 826, right front contact of relay 825 to ground as traced for advancing sequence switch 800 into position 10, in which position it remains until all subsequent selections have been completed. In this position the fundamental circuit over which subsequent selections are controlled extends from brush 841 over the upper left and lower right contacts of cam 849, the right back contact of relay 850, thence over conductor 878 to the sender, returning over terminal 939, brush 938, the upper left and lower right contacts of cam 905, brush 906, terminal 907, conductor 818, the lower contacts of cam 851 to brush 840.

Following the completion of selections and the advance of the incoming selector, current over the fundamental circuit is reversed and the sender is prepared for making talking selection. At this time, the sender increases the resistance in the circuit of relay 821 to such an extent that it releases, opening the circuit of relay 825, which in turn releases, closing a circuit from battery through the winding of sequence switch magnet 800 over the right contacts of cam 834, the right back contact of relay 825 to ground as traced for advancing sequence switch 800 out of position 10 into position 11. As soon as sequence switch 800 reaches position 11, a circuit is established for magnet 800 over the upper right contact of cam 826, the upper contacts of cam 832 to ground at the upper right con-

tact of cam 833 for advancing sequence switch 800 into position 12.

As sequence switch 800 passes into position 11, a local circuit is established for relay 821 extending from battery through the winding of relay 821, the upper left and lower right contacts of cam 820 to ground at the lower left contact of cam 836 and ground is connected to the sender over the lower left contact of cam 836, conductor 819, terminal 933, brush 932, upper contacts of cam 946, left winding of relay 915, left back contact of relay 909, the upper right contact of cam 934, brush 931, terminal 930 to battery in the sender for advancing the sender for making talking selection. Relay 915 does not, however, operate in this circuit. At this time the calling line is connected over the lower contact of cam 815, through the left windings of repeating coil 852, the upper contact of cam 816, and through the winding of supervisory relay 827, thereby operating relay 827 which establishes a holding circuit for relay 821 extending from battery through the winding of relay 821, the front contact of relay 827, to ground at the lower right contact of cam 805. Relay 821 is maintained operated until the calling subscriber releases the connection.

In position 12 a circuit is established for relay 825 extending from battery through the left winding thereof, the upper right contact of cam 824, the upper left contact of cam 823, conductor 878, thence as traced through the winding of the stepping relay of the sender to ground. Relay 825 and the stepping relay of the sender operate in this circuit, relay 825 closing the previously traced circuit for advancing sequence switch 800 out of position 12 and locking itself to the fundamental circuit over its outer left front contact and the upper left contact of cam 824. Switch 800 now advances under the control of relay 825 and in positions 12 $\frac{3}{8}$, 13 $\frac{3}{8}$ and 14 $\frac{3}{8}$ connects ground over the right contacts of cam 848 in shunt of the winding of the sender stepping relay. The position in which sequence switch 800 comes to rest is determined by the counting relays of the sender in accordance with the talking selection registration set up by the sender code registers. When the sender is satisfied for this selection, the fundamental circuit is opened, thereby releasing relay 825 and stopping the sequence switch 800 in the next stopping position. For the purposes of this description it will be assumed that sequence switch 800 stops in position 14. In this position the right windings of repeating coil 852 are connected over the left contacts of cams 849 and 851 through the winding of polarized relay 853 and the left contacts of cam 845 to the brushes 840 and 841 and thence to the incoming selector.

The called line is tested by the final selector

and if found idle, ringing current is applied from the incoming selector in the usual manner. When the called subscriber answers, relay 853 operates and as soon as interrupter 854 closes its lower contact, it establishes a circuit for relay 802 extending from battery through the winding of relay 802, the lower contact of interrupter 854, left contacts of cam 842, front contact of relay 853 to ground over the upper left contact of cam 805. The operation of relay 802 prepares a circuit for relay 850 which may be traced through the winding of relay 850, upper left contact of cam 806, outer left front contact of relay 802, upper contact of interrupter 854, as soon as the interrupter advances to close its upper contact, the left contacts of cam 842, the front contact of relay 853 to ground over the upper left contact of cam 805. Relay 850, upon operating, locks over its inner left front contact, the upper right contact of cam 805 to ground, and at its left middle front contact prepares a circuit for operating the message register of the calling line. The circuits are now in condition for enabling the calling subscriber and called subscriber to converse.

After the talking selection is completed the current in the circuit previously traced through the left winding of relay 915 is increased to such an extent that relay 915 operates and causes the advance of sequence switch 900 into position 6, disconnecting all conductors extending to the sender and thereby completely releasing the sender. The link circuit of Fig. 9 then functions in the manner fully described in the patent to Raynsford 1,690,206, above referred to, to disassociate itself from the district selector of Fig. 8 and to select and preallot another district selector in readiness for the next incoming call. Inasmuch as these functions do not particularly concern the present invention, they will not be described herein in detail.

At the end of the conversation the calling subscriber 100 hangs his receiver upon the switchhook, thereby opening the circuit previously traced through the winding of relay 827. The release of relay 827 opens the holding circuit of relay 821 which, in turn, releases, establishing a circuit for relay 814 extending from battery through the lower winding of relay 814, the lower left and upper right contacts of cam 820, left back contact of relay 821 to ground, as soon as interrupter 863 closes its upper contact. Relay 814, upon operating, locks over its upper winding and lower front contact to ground at the upper right contact of cam 836 and closes a circuit from battery through the winding of sequence switch magnet 800, the lower right and upper left contacts of cam 801, the upper front contact of relay 814 to ground, advancing sequence switch 800 into position 17. When the sequence switch leaves position 15 relay 802 releases. As the sequence switch passes

through positions 15 to 17, charging current over the middle left front contact of relay 850, the upper contacts of cam 810 is connected over brush 881, terminal 882, conductor 624, the left back contact of relay 622, conductor 613, the winding of relay 502, the winding of relay 504, conductor 625, terminal 883, brush 884, the outer left contacts of relay 850 to ground. The current now flowing through the winding of relay 504 is sufficient to energize that relay, which at its front contact connects operating current over the left front contact of relay 514, thence over the circuit previously traced to ground through the winding of message register magnet 118.

When the sequence switch 800 reaches position 17 a circuit is closed for relay 802 extending from battery, through the winding of relay 802, upper right contact of cam 801, upper left contact of cam 859, lower left and upper right contacts of cam 820, back contact of relay 821 to ground at interrupter 863. Relay 802 operates and locks over its inner left front contact the upper contacts of cam 807, commutator segment 870 to ground at brush 871 and establishes a circuit for advancing sequence switch 800 into position 18 which may be traced from battery through the winding of magnet 800, the upper right contact of cam 817, the outer left front contact of relay 802 to ground at the upper left contact of cam 836. When sequence switch 800 leaves position 17, the holding circuit of relay 814 is opened at the upper right contact of cam 836 and the holding circuit of relay 850 is opened at the upper right contact of cam 805 and these relays release.

The release of relay 850 removes ground from the circuits previously traced through the windings of cutoff relay 628 and relays 502 and 504 and these relays release. Relay 504, upon releasing, removes operating current from the winding of message register magnet 118 and relay 502 establishes the circuit of relay 515 which may be traced from battery through the winding of relay 515, the left back contact of relay 501, the left contact of relay 502, commutator strip 517, brushes 518 and 510, commutator strip 511 to ground at the lower front contact of relay 507. Relay 515, upon operating, locks to ground at its inner front contact, opens at its inner left back contact the circuit of relays 513 and 514, thereby releasing relays 513 and 514, at its right back contact removes battery from the operating circuit of relay 501 to prevent the seizure of the line finder before it becomes fully restored, and at its outer left front contact establishes the circuit of down-drive magnet 535. The release of relay 514 opens the circuit established thereby for the cutoff relay 102 of the calling line, reconnects ground to start conductor 211 and releases relay 507. The release of cutoff relay 102 now restores the calling line circuit to

its normal condition. Downdrive magnet 535, upon energizing, now drives the line finder shaft downwardly into normal position, opening the holding circuit of relay 515 when brush 518 leaves commutator strip 517. The release of relay 515 then opens the circuit of magnet 535 to arrest the downward movement of the switch shaft and connects battery to the winding of relay 501 to mark the line finder as again selectable. All of the circuits of the line finder 550 are now in normal condition.

With sequence switch 800 of the district selector of Fig. 8 in position 18, a circuit is established for the downdrive magnet 864 of the line finder 880 which may be traced from battery through the winding of magnet 864, the lower contact of cam 806, the outer left front contact of relay 802 to ground at the upper left contact of cam 836. The magnet 864 energizes in this circuit driving the line finder shaft into normal position when the holding circuit of relay 802 is opened by brush 871, leaving commutator strip 870. Relay 802 thereupon releases, opening the operating circuit of magnet 864 to arrest the movement of the switch shaft. In position 18 a circuit is also closed for the downdrive magnet 866 of the district selector 890 extending from battery through the winding of magnet 866, left contacts of cam 824 to ground at the right contacts of cam 848. Magnet 866 causes the district selector switch shaft to be driven into normal position, whereupon a circuit is established from ground over the upper right contact of cam 833, brush 847, segment 867, the lower left contact of cam 826 to battery through sequence switch magnet 800 for advancing sequence switch 800 into normal position 1. When the sequence switch left position 16 1/4 ground was removed from the test brush 839 at the upper left contact of cam 848 for releasing succeeding selector switches employed in the established connection. All apparatus has now been restored to normal.

If a call is originated by a line such as 600 in office B, the start circuit 750, link circuit of Fig. 9 and district circuit of Fig. 8 function to connect such line with a desired line in the same manner as previously described in connection with the establishment of a connection between the calling trunk 555 and a desired line.

Second call originated in office A when all links of the A group serving the line group are busy and line finder 550 is busy

Upon the initiation of another call by a line in the same subgroup as line 100 at a time when there are no available link circuits and allotted line finders of the A group normally serving such subgroup of lines, it being further assumed that the line finder 550 is busy serving the call previously described, relay

206 will be energized and the closure of the start circuit over conductor 131 will lock up relay 206 and cause the operation of relay 208 as previously described. As long as there are any idle auxiliary line finders there will be ground potential on conductor 211, over the back contacts of relays of such line finders corresponding to relay 514 and therefore upon the operation of relay 208 a circuit will be established from ground on conductor 211, over the contacts of relay 208, the back contact of stepping magnet 212 of selector 200 to battery through the winding of relay 213, thereby energizing relay 213. Relay 210 will not operate at this time because battery potential over brush 209 and conductor 503 has been removed at the line finder 550 which has been assumed to be busy. Relay 213, upon operating, therefore closes a circuit for stepping magnet 212 from battery through the winding of magnet 212, contacts of relay 213 to ground at the back contact of relay 210. Magnet 212 then operates, opening the circuit of relay 213, which releases in turn opening the circuit of magnet 212, whereby magnet 212 advances the brush 209 to the next terminal of its bank. If this terminal is connected to a conductor similar to conductor 503 which extends to a busy line finder, no battery potential will be found thereon and relay 210 will remain deenergized. Therefore, upon the release of stepping magnet 212, the circuit of relay 213 is again established and relay 213 will again close the circuit of magnet 212. Magnet 212 and relay 213 will therefore interact to advance the selector brush 209 another step. This operation continues until brush 209 encounters battery potential on a terminal of its bank indicative of an idle line finder, when relay 210 will operate, opening the circuit of the stepping magnet 212 to arrest further advance of the selector. When the operating circuit of relay 210 becomes effective, the line relay of the selected line finder corresponding to relay 501 also operates and the call then proceeds in the manner previously described.

It may occur that after several calls have been initiated in the calling line subgroup in which the line 100 is located, utilizing all of the link circuits of the A group and several of the auxiliary line finders, a line finder and link circuit in the A group become idle. If that condition exists at the time another call is initiated in the same calling line subgroup, the chain circuit over cams 424—424^x will be broken at the cam in this circuit corresponding to the idle link circuit and relay 206 will therefore not be operated. The start circuit 131 will therefore be extended over the right back contact of relay 206 and conductor 226 to such idle link circuit and thence to the start circuit of the line finder pre-allotted by such link circuit.

When the traffic in the calling line sub-

group becomes heavy enough to have utilized all links of the A group of links and the regular line finders pre-allotted thereby and all auxiliary line finders accessible to the selector 200, ground will be removed from conductor 211, at the back contacts of relays corresponding to relay 514 of all such busy auxiliary line finders to prevent the endless hunting of selector 200 and a chain circuit will be established from ground through the front contacts of relays corresponding to relay 513 of all such busy auxiliary line finders over conductor 505 to battery through the winding of relay 214. Relay 214 will therefore operate, closing a circuit from ground at its right contact over the left contacts of relay 206 to battery through the winding of relay 216. Relay 216 operates in this circuit and establishes a circuit from battery through the left winding of relay 202, the right back contact of relay 203 to ground at the contact of relay 216. Relay 202 operates and disconnects conductor 131 from conductor 217 extending to the right armature of relay 206 and transfers it over the outer left front contact of relay 202, the right back contact of relay 222 and the inner right back contact of relay 218; the back contact of relay 207, thence to start conductor 219, extending to the B group of links normally assigned to give second choice service to such calling line subgroup. When now the allotted line finder in the B group starts, relay 220 is operated in a circuit from ground over conductor 221 corresponding to conductor 223, in turn, establishing a circuit for relay 218 extending from battery over the inner left normal contacts of relay 224, the left winding of relay 218, the contact of relay 220 to ground at the left contact of relay 214. Relay 218 closes a locking circuit for itself through its right winding and inner right front contact to the start conductor 131 and establishes a locking circuit for relay 202 extending over the right winding and inner right contact of relay 202 to ground at the left front contact of relay 218, thus preventing the release of relay 202 should a link circuit in the A group become free before the calling line has been found.

Similarly, if calls are initiated in the subgroup of lines normally served by the B group of links in such rapid succession that all links of the B group become busy and relay 207 operates, succeeding calls will be extended in the manner previously described by auxiliary line finders. When the condition arises that all the links of the B group and all of the auxiliary line finders are busy, relay 214 will operate as previously described and a circuit will be established for relay 225 which, in turn, will operate relay 222 to transfer the start conductor 127 from its normal connection with start conductor 219 into connection over conductor 217 with start conductor 226 extending to the A group of links. Relays 227, 203

and 222 then function in the manner previously described in connection with the operation of corresponding relays 220, 218 and 202.

What is claimed is:

1. A telephone exchange system comprising a plurality of offices, call distributing and call extending equipment at each office, an overflow office common to said offices, interoffice trunks appearing as calling lines at said overflow office and terminating in call distributing equipment at said other offices, and means at each of said other offices for diverting calls originating thereat over said line finders and trunks to said overflow office.
2. A telephone exchange system comprising a plurality of offices, call distributing and call extending equipment at each office, an overflow office common to said offices, call distributing and call extending equipment at said overflow office, interoffice trunks appearing as calling lines at said overflow office and terminating in call distributing equipment at said other offices, and means at each of said other offices for diverting calls originated thereat over said line finders and trunks to said overflow office.
3. A telephone exchange system comprising a plurality of offices, call distributing and call extending equipment at each office, an overflow office common to said offices, call distributing and call extending equipment at said overflow office, interoffice trunks appearing as calling lines at said overflow office and terminating in call distributing equipment at said other offices, and means responsive at each of said other offices when a peak load occurs thereat for diverting the calls originated thereat over said line finders and trunks to said overflow office.
4. A telephone exchange system comprising a plurality of offices, call distributing and call extending equipment at each office, an overflow office common to said offices, call distributing and call extending equipment at said overflow office, groups of interoffice trunks appearing as calling lines at said overflow office, the trunks of each group terminating at one of said other offices in call distributing equipment, means at each of said other offices for selecting an idle trunk, and means responsive at each of said other offices when a peak load occurs thereat for diverting calls originated thereat over idle trunks to said overflow office.
5. A telephone exchange system comprising a plurality of offices, call distributing and call extending equipment at each office, an overflow office common to said offices, interoffice trunk appearing as calling lines at said overflow office and terminating in call distributing equipment at said other offices, and means at each of said other offices automatically responsive at such times as a peak load occurs at each such office for diverting calls

over said interoffice trunks to said overflow office.

6. A telephone exchange system comprising a plurality of offices, call distributing and call extending equipment at each office, an overflow office common to said offices, call distributing and call extending equipment at said overflow office for serving calls locally initiated at said overflow office, interoffice trunks appearing as calling lines at said overflow office and terminating in call distributing equipment at said other offices, and means at each of said other offices automatically responsive at such times as a peak load occurs at each such office for diverting calls over said trunks to said overflow office.

7. A telephone exchange system comprising a first office, line finders and call extending equipment at said office, an overflow office, line finders and call extending equipment at said overflow office, calling lines and interoffice trunks appearing as calling lines terminating in the banks of line finders in said overflow office, said trunks terminating at said first office in auxiliary line finders, calling lines in said first office terminating in the banks of said first mentioned line finders and in the banks of said auxiliary line finders, and means at said first office for diverting calls originated thereat from completion over the first mentioned line finders and call extending equipment for completion over said auxiliary line finders, trunks and the line finders and call extending equipment of said overflow office.

8. A telephone exchange system comprising a first office, line finders and call extending equipment at said office, an overflow office, line finders and call extending equipment at said overflow office, calling lines and interoffice trunks appearing as calling lines terminating in the banks of line finders of said overflow office, said trunks terminating at said first office in auxiliary line finders, calling lines in said first office terminating in the banks of said first mentioned line finders and in the banks of said auxiliary line finders, and means at said first office automatically responsive at such times as a peak load occurs thereat for diverting calls originated thereat from completion over the first mentioned line finders and call extending equipment for completion over said auxiliary line finders, trunks and the line finders and call extending equipment of said overflow office.

9. A telephone exchange system comprising a first office, line finders and call extending equipment at said office, an overflow office line, line finders and call extending equipment at said overflow office, calling lines and interoffice trunks appearing as calling lines terminating in the banks of line finders in said overflow office, said trunks terminating at said first office in auxiliary line finders, calling lines in said first office terminating in the banks of

said first mentioned line finders and in the banks of said auxiliary line finders, and means at said first office automatically responsive at such times as a peak load occurs thereat for selecting an idle auxiliary line finder to divert calls originated thereat from completion over the first mentioned line finders and call extending equipment for completion over the selected auxiliary line finder, interoffice trunk and the line finders and call extending equipment of said overflow office.

10. A telephone exchange system comprising a first office, calling lines terminating therein, a group of line finders and associated call extending equipment normally available for serving said calling lines, an overflow office, line finders and call extending equipment at said overflow office, calling lines and interoffice trunks appearing as calling lines terminating in the banks of line finders of said overflow office, said trunks terminating at said first office in auxiliary line finders having access to said calling lines of the first mentioned office, and means at said first office automatically operative upon the initiation of a call when all said first mentioned line finders are in use for selecting an idle auxiliary line finder whereby said call is diverted for completion over said auxiliary line finder and a line finder and call extending equipment of said overflow office.

11. A telephone exchange system comprising a first office, calling lines terminating therein, a group of line finders and associated call extending equipment normally available for giving first choice service to said calling lines, a second group of line finders and associated call extending equipment normally available for giving second choice service to said calling lines, an overflow office having line finders and call extending equipment, interoffice trunks extending between said office appearing as calling lines in the banks of line finders of said overflow office and terminating at said first office in auxiliary line finders having access to said calling lines, means at said first office operative when all of said first choice equipment is busy to divert calls initiated on said calling lines for completion over said auxiliary line finders, interoffice trunks and the line finders and call extending equipment of said overflow office, and means operative when all of said auxiliary line finders are also busy to render said second choice line finders and call extending equipment effective to serve said calling lines.

12. A telephone exchange system comprising a first office, calling lines terminating therein, call extending equipment normally available for giving first choice service to said calling lines, call extending equipment for giving second choice service to said calling lines, an overflow office having equipment for completing calls initiated on calling lines terminating therein, interoffice trunks extend-

ing between said offices appearing as calling lines in said overflow office, means at said first office operative when all of said first choice equipment is busy to divert calls initiated on the calling lines of said first office over inter-office trunks for completion by the call completing equipment of said overflow office, and means operative when all of said trunks are also busy to render said second choice equipment effective to serve said calling lines.

13. A telephone exchange system comprising a first office, calling lines terminating therein, call extending equipment normally available for giving first choice service to said calling lines, call extending equipment for giving second choice service to said calling lines, an overflow office having equipment for completing calls initiated on calling lines terminating therein, interoffice trunks extending between said offices appearing as calling lines in said overflow office, a selector switch at said first office for selecting idle trunks, means operative when all of said first choice equipment is busy to cause said switch to select idle trunks and to divert calls initiated on the calling lines of said first office over said trunks for completion by the call extending equipment of said overflow office, and means operative when all of said trunks are also busy to render said second choice equipment effective to serve said calling lines.

14. A telephone exchange system comprising a first office, a first and a second group of calling lines terminating therein, call extending equipment normally available for giving first choice service to said first group of lines and second choice service to said second group of lines, call extending equipment normally available for giving first choice service to said second group of lines and second choice service to said first group of lines, an overflow office having equipment for completing calls initiated on calling lines terminating therein, interoffice trunks extending between said offices and appearing as calling lines in said overflow office, means at said first office operative upon the initiation of calls in either group of lines when all of first choice equipment normally serving such group of lines is busy to divert such calls over said trunks for completion by the call extending equipment of said overflow office, and means operative when all of said trunks are also busy to render the second choice equipment effective to serve said calling lines.

In witness whereof, I hereunto subscribe my name this 8th day of January, 1930.

FREDERICK J. SCUDDER.