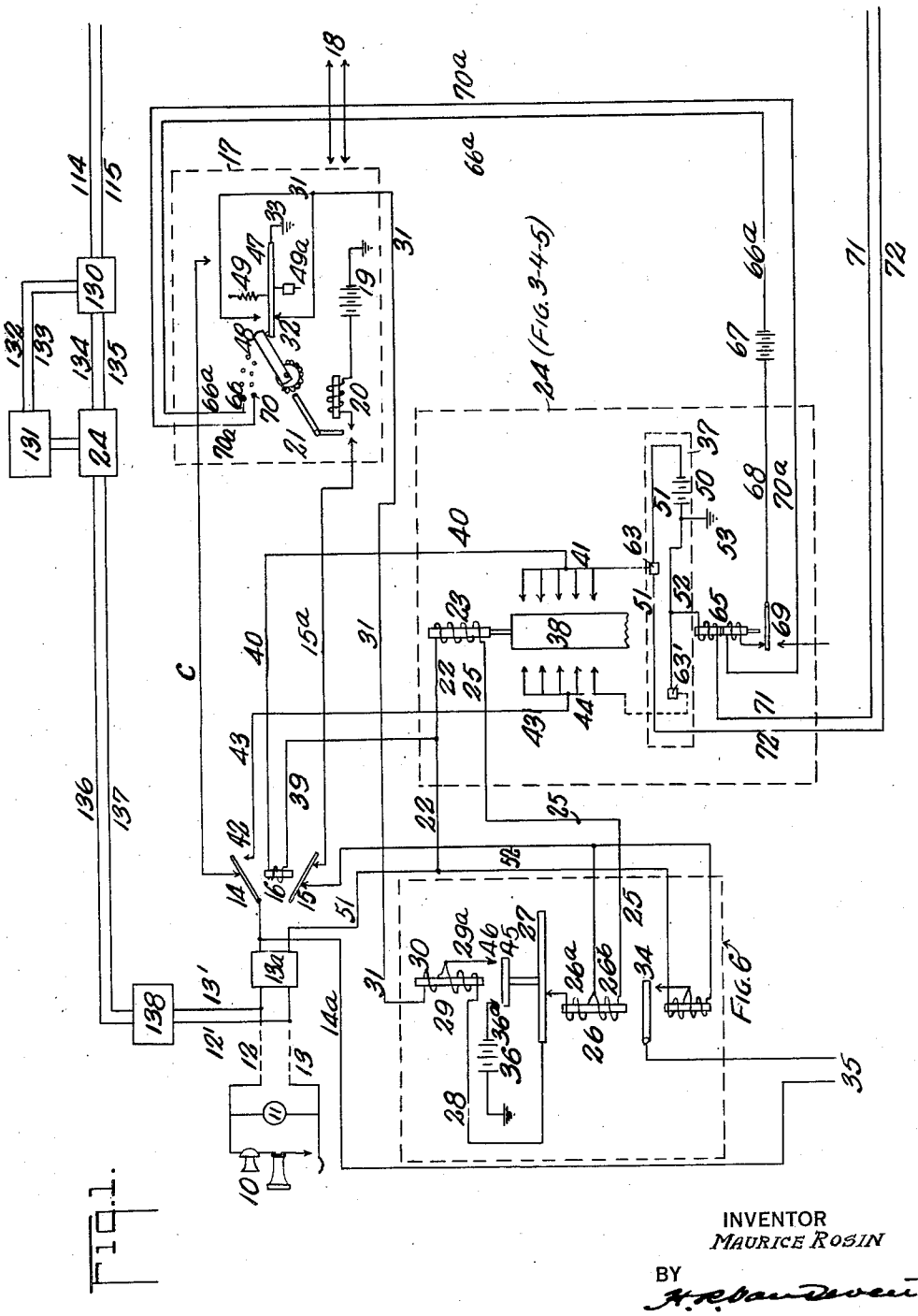
Aug. 22, 1939. M. ROSIN 2,170,429

TELEPHONE SYSTEM

Filed Sept. 27, 1935 4 Sheets-Sheet 1



INVENTOR
MAURICE ROSIN

BY
H. E. Van Deventer

ATTORNEY

Aug. 22, 1939. M. ROSIN 2,170,429

TELEPHONE SYSTEM

Filed Sept. 27, 1935 4 Sheets-Sheet 2

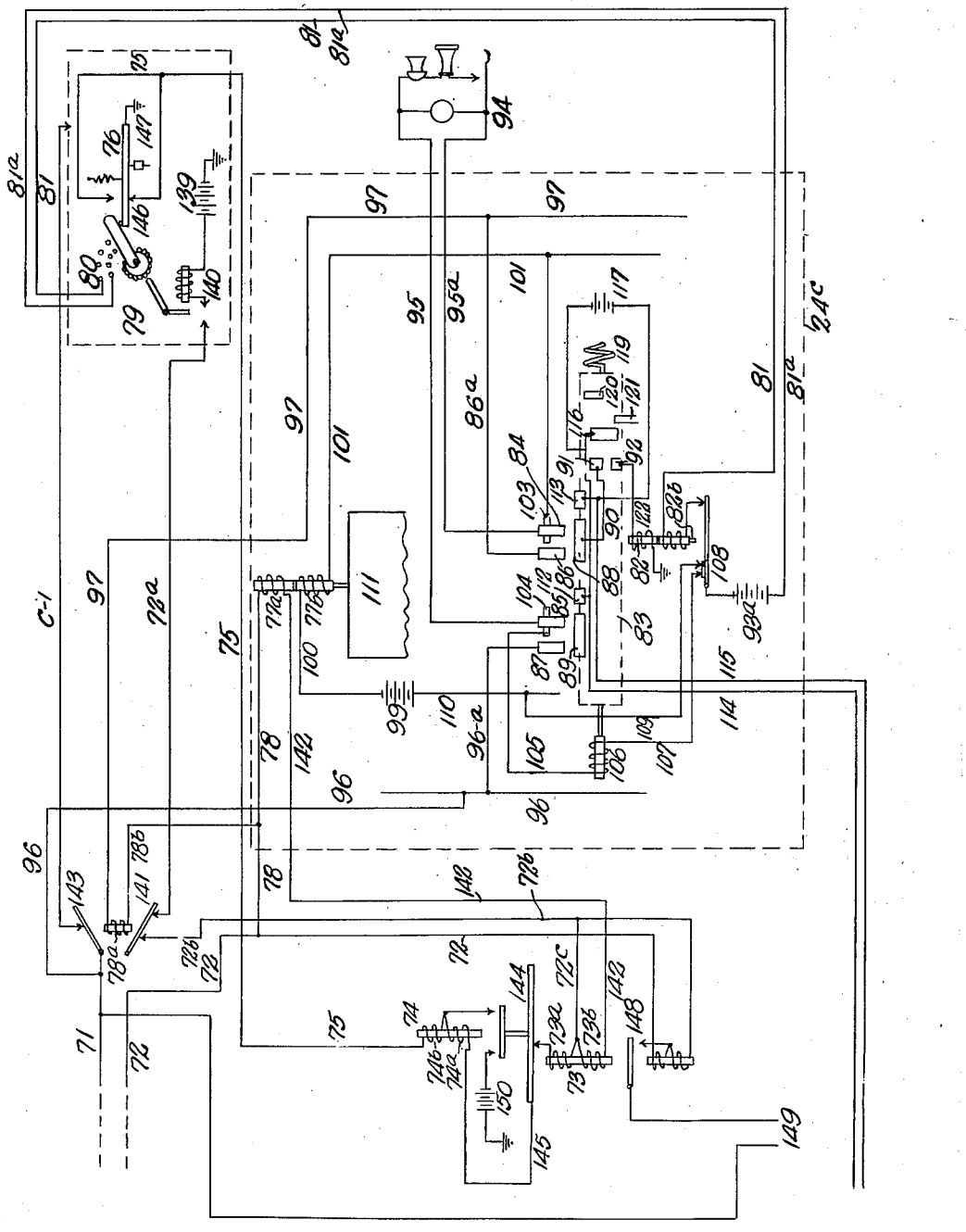


FIG. 2.

INVENTOR
MAURICE ROSIN
BY
H. Blair Davenport
ATTORNEY

Aug. 22, 1939. M. ROSIN 2,170,429

TELEPHONE SYSTEM

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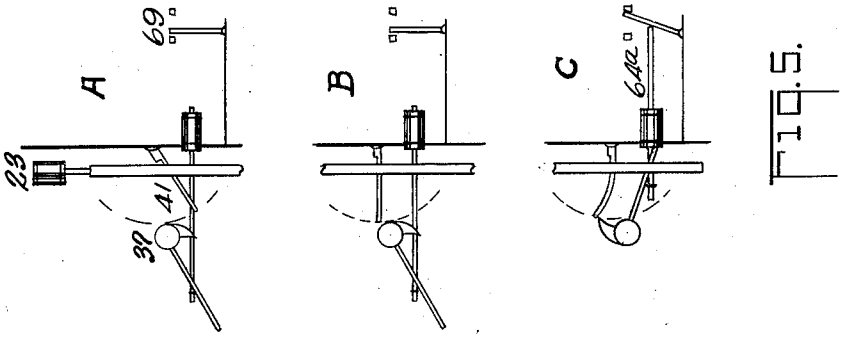


FIG. 5.

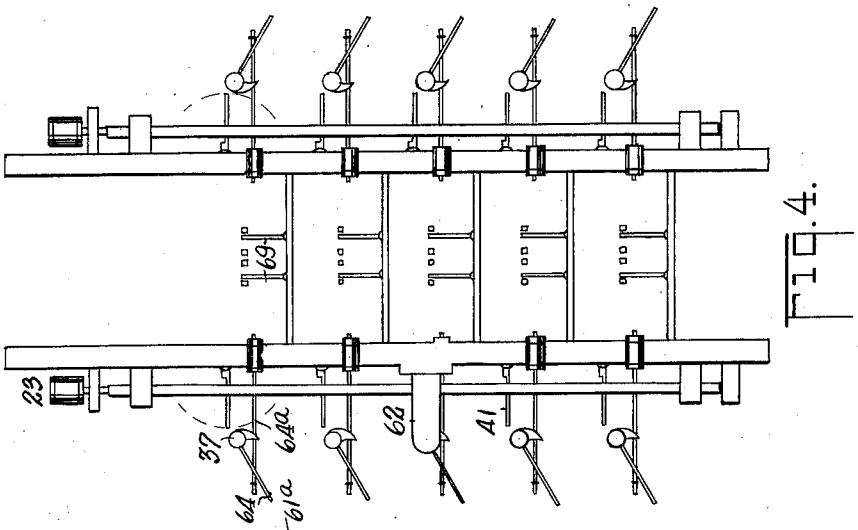


FIG. 4.

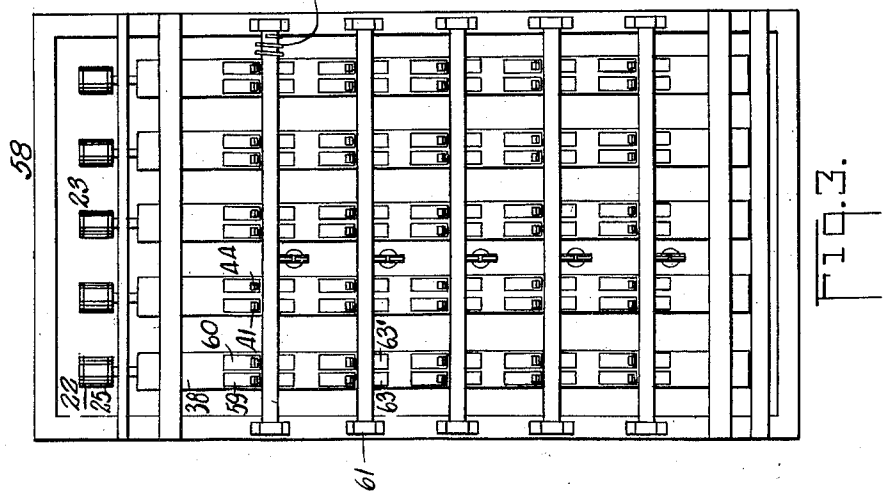


FIG. 3.

INVENTOR
MAURICE ROSIN
BY H. C. VanSantvoord
ATTORNEY

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TELEPHONE SYSTEM

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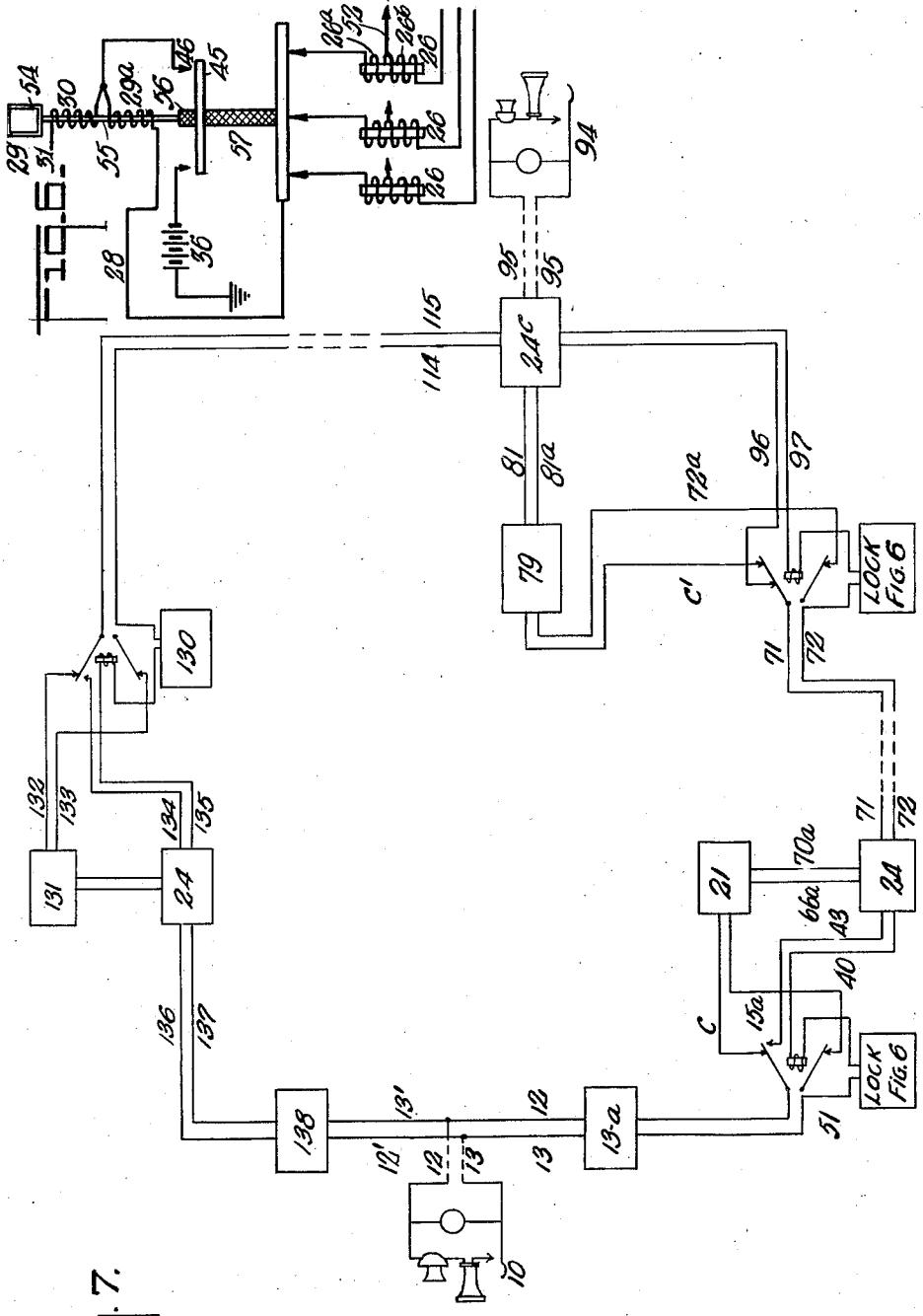


FIG. 7.

INVENTOR
MAURICE ROSIN
BY
ATTORNEY

Patented Aug. 22, 1939 2,170,429

UNITED STATES PATENT OFFICE

2,170,429

TELEPHONE SYSTEM

Maurice Rosin, Brooklyn, N. Y.

Application September 27, 1935, Serial No. 42,400

10 Claims. (Cl. 179—18)

This invention relates to improvements in telephone systems and has for its object the provision of exchange apparatus of a new and useful character for separating the "establishing" functions from the "holding" functions thereof, with a consequent saving in the size, cost and maintenance of the apparatus compared with that used in known systems.

Another object is to provide a telephone system in which the selector switches are released as soon as they have functioned, so that one line selector switch will serve a plurality of incoming circuits.

A further object is to provide a telephone system of great flexibility in which the capacity of the operating apparatus can be easily increased in proportion to the average density of calls-per-trunk, rather than in proportion to the total number of connections to be made.

Another advantage is that selectors, connectors, etc., may be simplified into simple types of line switches, since their functions are now reduced to selecting a pair of contacts in accordance with the dialing, then returning again immediately to normal.

Other objects will more fully hereinafter appear and the following specification is merely illustrative of the invention and is not limitative thereof. The system, by modifications that are obvious to those skilled in the art, may be used with full automatic, semi-automatic, auto-manual or manually operated systems, and with either panel-rod, all relay, or rotary switch apparatus. As the latter is in extended use, it has been chosen to here illustrate the invention.

In any telephone system, the routine process of establishing a connection between the calling and called line may be divided into:

(A) The period necessary to "establish" the connection, which comprises the operation of dialing by the calling subscriber and the operation of the switch mechanism at the exchange or central office to find, connect to and ring the called subscriber.

(B) The period necessary to "holding" the connection (A) above, while the connected subscribers are talking, and then restoring the central office mechanism to normal.

Heretofore, in most systems, it has been customary to provide each line with a selector or relay which established the connection (through other or "trunk" switches or relays if necessary) and "held" the connection while the conversation ensued. This tied up two or more switches for the duration of the conversation.

The present invention, by separating the "establishing" from the "holding" functions (as first defined) enables the aforementioned switches to be released and used by other lines as the switches are not tied up in holding the connections.

This is accomplished by providing means to permit a plurality of lines to have access to a selector common to all said lines as said switch serves only to establish connections. Apparatus is provided separate from said switch and by-passing the same (but operated thereby) to set up a circuit from the calling to called line which circuit, as soon as established, holds the desired connection during the duration of the conversation, the calling (and any intermediate switches) being released and permitted to function to set up other circuits.

The average time required to establish a connection in known systems is from 7 to 8 seconds but an additional 1½ to 2 minutes use of the apparatus is necessary to hold the average connection. The use of the equipment for this additional time is eliminated by the present invention, simple and inexpensive apparatus being used during the holding period, while the connected subscribers are talking.

In the accompanying drawings, where by way of illustration a system employing a well known type of rotary switch is shown:

Figures 1 and 2 are schematic diagrams of a telephone system embodying the invention;

Figures 3, 4 and 5 illustrate the connecting frames or boards used to by-pass the regular line and trunk switches as more fully hereinafter described;

Figure 6 is a diagram illustrating the construction of the locking mechanism, Figure 1; and

Figure 7 is a simplified diagram of the apparatus employed where two lines are connected.

Schematic circuit Figures 1 and 2

The numeral **10** denotes a subscriber's telephone instrument having the usual calling dial **11**. This is connected via conductors **12** and **13** with the central office. The conductors **12** and **13** in the central office connect to a pair of contacts on an ordinary line switch **13**—*a* and from there line **12** leads to the movable armature **14** of cut-off relay **16**. The armature **14** normally rests against a contact which is connected to a common wire C, which may extend to similar contacts on a plurality of cut-off relays, one of which is associated with each incoming subscriber's line. The line **13** leads to a conductor **51** and then via conductor **22** to one of the vertical magnets **23** of a connecting or switch frame mechanism Figures 3, 4 and 5 (to be presently described, and which is diagrammatically indicated within the dotted lines **24**), via conductor **25** to winding **26***b* of individual locking magnet **26** (one per line Figure 6), and continues via conductor **52** to armature **15**, and via conductor **15***a*, finally terminating in any

suitable form of switch mechanism 21 such as that shown within the dotted line 17, wherein for the sake of illustration is shown a selector of the rotary type having associated therewith a contact member 47 controlled by the wiper 48 of the switch, as hereinafter described.

So far, with exception of relay 16 and its contacts and contact member 47 in the selector, locking magnet 26 and vertical magnet 23, all of the equipment described is found in known automatic telephone exchanges, the connection being made by the selectors 13a and 21 through a pair of conductors 18 to either line switches, trunk switches or the like, in order to connect with another subscriber's line or trunk. No attempt has been made to show the selector construction in 13a and 21 in detail as any construction can be used with the addition of the member 47 in selector 21 as before-mentioned.

With known equipment, the selector 21 is permanently associated with the incoming line and remains so during the conversation. The present invention releases this selector as soon as it has selected the wanted line, so that it may be used by a plurality of lines.

When subscriber 10 lifts his receiver from the hook, a circuit is completed as follows: from battery 19 through winding 20 of selector mechanism 21 via conductor 15a to armature 15 of cut-off relay 16 one per line), via conductor 52 to winding 26b of individual locking magnet 26, via conductor 25 to one of the vertical magnets 23 of the connecting or switch frame mechanism 24. From this magnet 23, the circuit continues via conductor 22 to conductor 51 to one of the contacts on line switch 13a via conductor 13 to subscriber 10's instrument and dial 11 associated therewith, via conductor 12 to the opposite contact on line switch 13a, via armature 14, via conductor "C" to selector 21.

At the same time a circuit is also completed from conductor 52 through winding 26a of individual locking magnet 26 (one per line), via armature 27 to conductor 28 to common locking magnet 29 (one per switch frame 24) through windings 29a and 30 thereof, via conductor 31 to the bottom contact 32 in selector switch 21 to member 47 in said switch which is grounded at 33. As soon as this circuit is completed, the vertical magnet 23 on the switch frame 24 operates (as presently described) moving its contact fingers to the position shown in Figure 5B, ready to be operated by the subscriber's dialing.

Individual lock magnet 26 also operates pulling up its armature 34 which prevents the dialing from dial 11 going to another free connecting frame connected at 35 (in case frame 24 is busy as presently described). At the same time, the common locking magnet 29 draws up its armatures and locks itself up by reason of current flowing from battery 36 via armature 45 and contact 46 through winding 30 via conductor 31 to contact 32 and ground 33. The locking operation is now completed and the connecting frame 24 is closed to all other subscribers until the calling subscriber 10 has finished dialing the first digit of the number desired, or about 4 seconds time.

When subscriber 10 operates dial 11, the impulses pass over conductors 12 and 13 in the usual manner, through line switch 13a and into the switching mechanism 21, operating the latter in the usual manner.

Supposing the selector, in accordance with the dialing, stops on contacts 66 and 70 on its bank; circuit is then established as follows: from contact 66 via conductor 66a to battery 67 via conductor 68 and via armature 69 into lower winding of horizontal magnet 65 via conductor 70a back to contact 70 on the selector bank. Horizontal magnet 65 now operates, and rotates horizontal rod 37 on its own axis, bringing cams 63 and 63' into contact with those vertical contact fingers 41 and 44 facing them on their own level.

Cut-off relay 16 now obtains current over the following circuit: battery 50 via conductor 51 to cam 63, via one of the contact fingers 41, via conductor 40 to relay 16, via conductor 39, via conductor 22, via conductor 51 via one bank contact on line switch 13a via conductor 13 through subscriber 10's instrument, via conductor 12 to opposite bank contact in line switch 13a, via armature 14 via line "C" terminating in ground of battery 19.

Cut off relay 16 now operates, drawing up armatures 14 and 15, cutting off selector 21 and leaving it free for other calls. Vertical magnet 23 is now also cut off, and drops its rod 38.

The talking circuit is now as follows: from battery 50 via conductor 51, cam 63 to one of the contact fingers 41, via conductor 40 through cut-off relay 16, via conductor 39, via conductor 22, via conductor 51 through line switch 13a, via conductor 13 through subscriber 10's telephone and dial 11 associated therewith, via conductor 12 through the opposite bank contact of line switch 13a, via armature 14 to contact 42 (which is now closed by relay 16) via conductor 43 to the opposite vertical contact finger 44, via cam 63' to line 52, back to battery 50. Lines 51 and 52 constitute the outgoing lines which are extended via conductors or trunks 71 and 72 to any other board or exchange.

In operating, horizontal magnet 65, besides rotating the horizontal rod 37, as described above, also pushes back with its plunger armature 69 thus placing an alternate or duplicate horizontal magnet on an associated board into circuit for the next call on this line, if this horizontal rod 37 is busy. Magnet 65 thus cuts itself off from the battery 67, but at the same time obtains talking circuit current through its upper winding from battery 50, having just closed the cam circuit for talking. Selector mechanism 21 has now been cut out, as explained, by the operation of cut-off relay 16 and is now free to handle other calls.

The common locking magnet 29 (1 for each frame 24) having locked itself up through its upper armature 45, a circuit is completed from battery 36 via contact 36a to armature 45, contact 46 through winding 30 via conductor 31 to contact 32 via the spring controlled member 47 in selector 21 and to ground at 33. The wiper 48 moving in accordance with the dialing of dial 11 permits the spring 49 attached to member 47 to pull up said member very quickly so that the magnet 29 (which is a slow-release magnet) can hold up during the break that occurs on account of the movement of member 47 in the selector; but when wiper 48 returns to normal, in which normal position as shown in Figure 1 it rests against or operates member 47, causing 47 to contact contact 32, it is acting against spring 49 and dash-pot 49a and the breaking period is delayed, so that magnet 29 cannot hold up over this period and consequently falls, breaking the connection with battery 36. This releases the common locking magnet 29, which, together with

the connecting frame 24, is ready for the next call.

After the board is free and selector 21 is released, both free for the next call, there only remain engaged, holding subscriber 10's call, one vertical rod 38 and one horizontal rod 37. The rest of the lines or rods passing through connecting frame 24, together with associated selector 21, are available for other calls; so that as many as 30 or 40 conversations may be going on simultaneously through board 24 and still selector 21 is free for other calls.

In general, one board is assigned to work in conjunction with each selector, so that to make a complete call from subscriber 10 to subscriber 94, a minimum or two boards (one connecting frame 24 and one incoming or subscriber's frame 24c are required. As many connecting frames 24 may be interposed as required, in the manner shown.

One switch frame will handle a plurality of calls. A number of such frames is employed in a central office, depending upon the traffic.

Two types of boards are shown, the connecting frame 24 and the incoming or subscriber's frame 24c; the appended drawings show two methods whereby these boards may be adapted to existing systems:

a. Subscriber 10, at left, is not using subscriber's board 24c and therefore requires a line switch to make a call and a final selector to receive a call, permanently.

b. Subscriber 94, at right of Figure 2, is using frame 24c and thereby eliminates the line switch entirely, and dispenses with the selector after the "establishing" operation is completed.

From the foregoing, it will be evident that the sequence of operations is as follows:

1. Subscriber 10 lifts the receiver from the hook which immediately gives him access to the selector 21 and to an idle connecting frame 24.

2. Subscriber, upon dialing, operates the selector 21 in the usual manner, which in turn operates the connecting frame 24 to select the outgoing or horizontal line desired.

3. As soon as the frame 24 has made the necessary selection, selector 21 is released, and any other lines connected to its common wire C through their cut-off relays 16 may use the same, and therefore one selector 21 may be used by a plurality of subscribers. The function of the selector 21 is purely that of setting up the desired connection through the connecting frame 24, on which one vertical rod and one horizontal rod maintain the connection during the talking period.

Upon termination of the talking period, the subscriber's line is reconnected to the selector, ready for another call.

Continuing now with the call above-described, this continues on the trunks 71 and 72 selected by the dialing, to final subscriber's frame 24c (Figure 2), although any number of boards like 24 just described may be interposed between.

The above described call now enters the final subscriber's board 24c via trunks 71 and 72 as explained, this board 24c operating then exactly like board 24 described previously:

When this call enters board 24c, circuit is completed as follows: from battery 139 through winding 140 of selector mechanism 79 via conductor 72a to armature 141 of cut-off relay 78a (one per line) via conductor 72b via conductor 72c to winding 73b of individual locking magnet 73, via conductor 142 to winding 77a of one of the vertical magnets 77 of the subscriber's or switch frame mechanism 24c. From this magnet 77, the circuit continues via conductor 78 to conductor 72, from whence the circuit continues through frame 24 and to subscriber 10's instrument as already described; returning then on conductor 71, the circuit continues via armature 143 of cut-off relay 78a, via common line C—1 to selector 79.

At the same time, circuit is also completed from conductor 72b via conductor 72c through winding 73a of individual locking magnet 73 (one per line), via armature 144 to conductor 145 to common locking magnet 74 (one per switch frame 24c) through windings 74a and 74b thereof, via conductor 75 to the bottom contact 146 in selector switch 79 to member 76 in said switch which is grounded at 147. As soon as this circuit is completed, the vertical magnet 77 on the switch frame 24c operates (as previously described) moving its rod and the contact fingers thereon to the position shown in Figure 5B, ready to be operated by the second digit of the subscriber's dial.

Individual lock magnet 73 also operates, pulling up its armature 148, which prevents the dialing from dial 11 going to another free connecting frame connected at 149 (in case frame 24c is busy as presently described). At the same time, the common locking magnet 74 draws up its armatures and locks itself up by reason of current flowing from battery 150 through winding 74a via conductor 75 to contact 146 and ground 147. The locking operation is now completed and the subscriber's frame 24c is closed to all other subscribers until the calling subscriber 10 has finished dialing the second digit of the number desired, or about 4 seconds time.

Subscriber 10 now dials the second digit of the number desired, which corresponds (for example) to bank contacts 80 in selector 79. Selector 79 will move its wiper to this pair of contacts, as normally, and thus closes circuit as follows: bank contacts 80 via conductor 81 to lower winding of horizontal magnet 82, via normally closed armature 93, via battery 93a to conductor 81a back to contacts 80 on the selector bank.

Horizontal magnet 82 being energized, rotates horizontal rod 83 on its own axis as usual, and brings incoming cams 88 and 89 under contact fingers 84 and 86 and also 85 and 87 of the vertical rod, facing them on their own level into position shown at Figure 5C, thus connecting contact finger 86 with finger 84 through cam 88, and finger 87 with finger 85 through cam 89. Since fingers 86 and 87 are connected to the incoming lines 96 and 97, and fingers 84 and 85 are connected to subscriber 94's own pair of lines 95 and 95a, it follows that calling subscriber 10 is now connected with called subscriber 94.

Shunt 90 connects contact 91 with cam 88; upon horizontal rod 83 being rotated by horizontal magnet 82, as described, contact 91 comes into contact with contact 92 and passes talking current through upper winding of magnet 82, keeping it energized as long as the conversation is going on and the talking circuit is unbroken.

Horizontal magnet 82, in operating, also pushes back with its plunger armature 93, putting into circuit the associated horizontal magnet of the alternate board (supposed to be 24b), subscriber 10 is now connected to subscriber 94.

The operation of subscriber 94 calling subscriber 10 will now be described.

Upon subscriber 94 lifting his receiver from

the hook to make a call, a circuit is established as follows:

From battery 99, via conductor 100, to winding 77b of vertical magnet 77 via conductor 101, conductor 102, connecting strip 103 (described in specifications for subscriber's board 24c) via subscriber's contact finger 84, via line 95a to subscriber's telephone set 94, via conductor 95 to contact finger 85 to connecting strip 104, via conductor 105 to side magnet 106, via conductor 107 to contact 108, via conductor 109 into conductor 110 back to battery 99.

Vertical magnet 77 operates, pulling up the vertical rod 111 into position B, Figure 5, together with all contact fingers thereon (as explained for connecting frame 24). At the same time, side magnet 106 being energized, pulls horizontal rod 83 sideways to the left, bringing outgoing cams 112 and 113 under subscriber's own contact fingers 85 and 84 respectively; said cams 112 and 113 are connected with the outgoing lines 114 and 115.

When side magnet 106 pulls horizontal rod 83 sideways, as above explained, it also brings contact 116, which is connected with outgoing line 114, under contact 92 which is connected with the upper winding of horizontal magnet 82. This magnet 82 now operates, rotating horizontal rod 83, as usual, and raising subscriber's contact fingers 84 and 85 into position C, Figure 5, as customary, where they remain in contact with outgoing cams 112 and 113, which, as explained, are connected with the outgoing lines 114 and 115. Battery 117 furnishes current for these outgoing lines as usual.

In operating, horizontal magnet 82 pushes back with its plunger armature 93, which simultaneously cuts off side magnet 106 and puts another horizontal magnet on an alternate board into circuit for another subscriber on the same level desiring to make a call while horizontal rod 83 is busy. Side magnet 106 is now de-energized and side spring 119 would pull back the horizontal rod 83 into normal at right, but that projection 120 at right on rod 83 has first been carried over on the rod, by the action of side magnet 106 and then brought down by rod 83 rotating downward, to engage with projection 121.

As long as horizontal magnet 82 remains energized by shunt 122 from which it derives part of the talking current, it will keep the horizontal rod 83 down, and the cams (whichever are chosen) up, in position C of Figure 5 as explained. As soon as the talking circuit is broken, however, by the subscribers hanging up, horizontal magnet 82 de-energizes and allows rotary spring on the horizontal rod (not shown here) to rotate horizontal rod 83 back into normal position. This clears projection 120 from projection 121 and side spring 119 immediately pulls the rod 83 back into normal position, at the right, ready for the next call.

Continuing now with subscriber 94's call, this passes on outgoing lines 114 and 115, as explained, through one or more connecting frames 24 and arrives at selector 138, to the banks of which are connected lines 12' and 13' leading to subscriber 10's telephone instrument. Subscriber 94 is now connected to subscriber 10.

It will be understood that one common battery and ground is used for the system and that no attempt has been made to show ringing, busy and other auxiliary circuits, the application of which will be readily understood.

Herewith follows a detailed description of frames. (Figures 3, 4, 5.)

58 denotes a mounting frame of suitable construction, in which is mounted a plurality of vertical rods 38. A suitable unit could contain 50 such rods of rectangular cross-section, mounted in bearings to permit them to move vertically.

Each rod 38 has connected to it suitable means such as the electromagnet 23, which when energized will raise the rod a desired distance, and which, when de-energized, will release the rod so that it will fall to normal or idle position by gravity.

Each rod has a plurality of pairs of apertures 59, 60, through each of which passes a contact finger 41, 44, hinged at their inner ends. All contact fingers in each pair of vertical rows are moved up and down by their associated rod 38, through which they pass. The fingers are insulated from the rods but all fingers in each vertical row are electrically connected so that each row of fingers forms a vertical row of contacts forming one side of a circuit, both vertical rows on the same rod being shown at 41—44, Figure 1, the associated rod being shown at 38 in said figure. If advisable the fingers may be made of flexible metal, held in normal position by suitable spring means.

Frame 58 also carries supports 61—62 in which are rotatably supported the horizontal rods 37, each of which carries a plurality of cams 63, 63' each cam insulated from the other and each set of cams on each rod insulated from all other cams. These cams correspond to, and are adapted to interlock and contact with the contacts 41—44 when the rod 37 is moved into operating position, being arranged in pairs, each pair facing and lifting the contact fingers 41—44 corresponding to it on the same level. One cam of each pair is electrically connected to a conductor leading out of the frame, and the other cam of the pair is electrically connected to the opposite conductor of this outgoing trunk.

Horizontal rod 37 is rotated on its own axis by finger 64 which is in turn moved by plunger 64a of horizontal magnet 65 when this is energized.

Herewith follows a detailed description of frame 24c (subscriber's board, Figures 2, 3, 4 and 5).

Board 24c is is of the same construction as board 24, having the same type of mounting frame, on which is mounted a plurality of vertical rods 111. A suitable unit could contain 50 such rods of rectangular cross-section, mounted in bearings to permit them to move vertically.

Each rod 111 has connected to it suitable means such as the elecromagnet 77 which when energized will raise the rod a desired distance, and which, when de-energized, will release the rod so that it will fall to normal or idle position by gravity.

Each rod has a plurality of apertures, arranged four in a row, through each of which passes a contact finger, 84, 85, 86, 87, hinged at their inner ends. All contact fingers are moved up and down by their associated rod 111, through which they pass. The fingers are insulated from rods, but all the 1st fingers from the left in each horizontal row of four (87, Figure 2) are electrically connected together so that each row of fingers forms a vertical row of contacts forming one side of a circuit; in the same manner all the 3rd fingers from the left in each horizontal row of four (86, Figure 2) are electrically connected together so that each row of fingers forms a vertical row of

contacts forming the other side of the same circuit. 2nd and 4th contact fingers from the left in each horizontal row of four fingers (84 and 85, Figure 2) are each connected to the one side of a particular subscriber's line, leading to his telephone instrument (94). The associated rod is shown at 111 in said Figure 2. If advisable, the fingers may be made of flexible metal, held in normal position by suitable spring means.

While in positions A and B, Figure 5, contact fingers 85 and 84 rest on, and make electrical contact with, strips of metal 104 and 103 respectively, which are inserted in the bottom of the 2nd and 4th apertures from the left in each horizontal row of four, of each vertical rod 111, but insulated from said rod. When, however, contact fingers 85 and 84 are lifted into position C, Figure 5, by the movement of horizontal rod 83, as described herein, contact between said fingers 84 and 85 and connecting strips 103, 104 is broken.

The said mounting frame also carries supports similar to 61—62 on frame 24, already described, in which are rotatably supported the horizontal rods 83, each of which carries a plurality of cams arranged in two pairs, 88, 89 and 112, 113, each cam insulated from the other, and each set of cams on each rod insulated from all other cams. Cams 88 and 89 correspond to and are adapted to interlock and contact with the contact fingers 84, 86 and 85, 87 respectively in normal position; cams 112 and 113 correspond to and are adapted to interlock and contact with the contact fingers 85 and 84 respectively only, when the horizontal rod 83 is shifted to the left by side magnet 106. These cams are arranged in pairs each pair facing and lifting the contact described above, on the same level. One cam of each pair 112, 113 is electrically connected to a conductor leading out of the frame, and the other cam of this pair is electrically connected to the opposite conductor of this outgoing trunk.

The other pair of cams, 88, 89 has no connection, these cams connecting through themselves contact fingers 84, 86 and 85, 87 respectively, when the horizontal rod 83 is rotated in the proper position.

Horizontal rod 83 is rotated on its own axis by finger 82*a* which is in turn moved by plunger 82*b* of horizontal magnet 82 when this is energized.

A suitable electromagnet 106 is provided to shift the entire horizontal rod 83 a suitable distance to the left, when subscriber 94 wishes to make a call, thus bringing cams 112 and 113, which are connected to the outgoing lines 114 and 115, under the subscriber's contact fingers 85, 84. When horizontal rod 83 has thus been shifted to the left by side magnet 106 and then rotated by horizontal magnet 82 (as described in the operation) a metal projection 120 on the rod engages with a corresponding projection of metal 121 on the frame, which projections hold rod 83 in shifted position against spring 119, but as soon as the talking circuit is broken by the subscriber hanging up, horizontal magnet 82 releases, horizontal spring 62*a* rotates rod 83 up, clearing the projections from each other, and side spring 119 immediately pulls rods 83 back to the right, in normal position.

The general operation of the entire system is as follows:

Upon a call entering the lock and frame on one of the lines, the lock will close the board to all other calls until selection has been made. The vertical magnet of that line will raise its rod and all the contact fingers passing through said rod, into position B, Figure 5. Only one vertical rod at a time can thus be in position B in each frame. Upon the subscriber dialing, the selector associated with said frame will energize through its bank contact the horizontal magnet connected with those particular selector contacts dialed, and this magnet will rotate its horizontal rod into position C, Figure 5, so that the cams on said horizontal rod will raise into position C whatever vertical contact fingers on its own level are extended into position B, Figure 5. Since the vertical line on which said subscriber is making his call is the only one in the frame having its contact fingers and vertical rod in this position B, it follows that only those contact fingers in the incoming line can be raised in position C. Further, only those fingers among them which are on the same level as the horizontal rod selected by the subscriber's dialing will be raised by the cams on the horizontal rod into position C, which is the final interlocking position. The vertical magnet and the selector are then cut out by the operation of the cut-off relay and the vertical magnet then drops its rod.

For outgoing calls in frame 24*c*: subscriber, by lifting his receiver, closes a circuit by which the vertical magnet operating the rod on which his contact fingers are located is energized through its lower winding. It raises its vertical rod, including this subscriber's fingers, into position B, as usual. At the same time, the side magnet shifts the horizontal rod on that particular level to the left, bringing the outgoing cams on said horizontal rod under the subscriber's contact fingers.

As soon as this is concluded, the horizontal magnet becomes energized and rotates the horizontal rod, bringing said outgoing cams up under subscriber's contact fingers and lifting them into position C, as usual; they are then connected with the outgoing lines.

The vertical rod in this case is cut out of the circuit by horizontal magnet pushing back its armature, in operating, which armature connects the vertical magnet 77 (lower winding) with the battery.

Construction of locking mechanism, Figure 6.—This has been described in connection with Figure 1 and the construction of same will be evident from Figure 6.

The magnet 29 may be any suitable type of slow-release magnet having a dash-pot 54 operating in the usual manner. The rod 55, when a winding of the relay is energized, draws up the upper armature 45 connected thereto but insulated therefrom at 56; this armature is connected to but insulated at 57 from the lower armature 27 which is also drawn up, breaking contact with all the individual magnets 26.

Simplified diagram, Figure 7.—Subscriber 10 calling subscriber 94—the line goes through lines 12 and 13 through line switch 13—*a* and enters lock of board 24 on line 51, and at the same time via lines "C" and 15*a* into selector 21. Selector 21 operates board 24 via lines 66*a* and 70*a*; incoming lines 40 and 43 are then connected with outgoing trunks 71 and 72.

Entering the lock of board 24*c* on line 72, the call also passes into selector 79 on lines C—1 and 72*a*. Selector 79 operates board 24*c* via lines 81 and 81*a* and the incoming lines 96 and 97 are then connected to lines 95 and 95*a* which are the subscriber's individual lines leading to his instrument 94.

Subscriber 94 calling subscriber 10—the line

goes through conductors 95 and 95a to board 24c on which the subscriber's contact fingers are located, via trunks 114 and 115 into lock 130 and then into selector 131 on lines 132 and 133, which selector operates a board similar to 24. Incoming trunks 134 and 135 are now connected with outgoing trunks 136 and 137 ending on incoming selector 138, which connects trunks 136 and 137 with lines 12' and 13' leading to subscriber 10's instrument.

It will be noted that subscriber 10 is not using frame 24c and therefore requires the line switch 13—a and incoming selector 138 above mentioned. Subscriber 94 is using frame 24c and thus eliminates all permanent line switches and selectors.

What is claimed is:

1. In a telephone system, a central office, a plurality of line circuits terminating therein, each having impulse mechanism connected therewith, a switch common to said circuits, a switch frame and operating mechanism therefor connected to said switch, said frame carrying a plurality of contacts connected to said line circuits, operating mechanism for actuating said frame under control of said impulse mechanism for closing contacts connected to two of said line circuits, and means for locking said switch frame to prevent other line circuits from operating the same until after said closed contacts are opened.

2. In a telephone system, a plurality of circuits, impulse mechanism for each of said circuits, a selector switch common to said circuits, a switch frame and operating mechanism therefor connected to said selector switch, a plurality of contacts carried on said frame and connected to said circuits, operating mechanism for actuating said frame under control of said impulse mechanism for closing contacts connected to at least two of said circuits, and means including a magnetic lock for said frame to prevent other circuits from operating said frame until after the aforesaid connected circuits disconnect.

3. A telephone system comprising a plurality of circuits each having impulse mechanism connected thereto, a selector switch common to said circuits, a switch frame including a plurality of vertical bars having apertures formed therein, contact fingers mounted on said frame and each extending through one of said apertures, magnetic means for moving said bars vertically, said bars being reset by gravity, a plurality of horizontal rods rotatably mounted in said frame and carrying cams adapted to engage said contact fingers, and magnetic means for operating said horizontal bars, said magnetic means being conjointly controlled by said selector switch and said impulse mechanism.

4. A telephone system comprising a plurality of circuits each having impulse mechanism connected thereto, a selector switch common to said circuits, a switch frame including a plurality of vertical bars having apertures formed therein, contact fingers mounted on said frame and each extending through one of said apertures, magnetic means for moving said bars vertically, said bars being reset by gravity, a plurality of horizontal rods rotatably mounted in said frame and carrying cams adapted to engage said contact fingers, electromagnetic means for operating said horizontal bars, locking means operable upon the entrance of a call from one of said circuits adapted to lock and close said frame to all other calls until after a selection has been made by energizing one of said magnetic means to raise its bar, connections between said electromagnetic means and said selector switch whereby said selector switch will energize the electromagnet connected with the contacts selected by said impulse mechanism, thereby causing said magnetic means to rotate its horizontal rod to bring its cams in contact with cooperative fingers.

5. An automatic telephone system comprising subscriber's lines, switching apparatus connected thereto for interconnecting the same including a switch common to a plurality of said lines, means including a cut-off relay connected to each of said lines for disconnecting the same from said switch thereby freeing said switch, means associated with said first means and including a frame having movable contacts thereon for interconnecting said lines to by-pass said switching apparatus connected thereto, and locking mechanism associated with said frame whereby access to the same is prevented when any two said lines are connected thereby.

6. In a communication system of the class described, a plurality of lines, a line switch connected to each of said lines, a circuit extending from each of said switches and including a switch common to said lines, a switch frame connected to said last switch and having contacts thereon connected to said lines, a cut-off relay for each line adapted to disconnect same from said last switch, a locking relay for each frame adapted to prevent the access to any line thereto during the time said frame is holding a connection between any two of said lines.

7. In a communication system of the class described, a plurality of lines each having impulse mechanism connected therewith, a switch common to said lines, a switch frame and operating mechanism therefor connected to said switch, said frame having a plurality of contacts connected to said lines, means under the control of said impulse mechanism for actuating said switch frame operating mechanism to close contacts connected to two of said lines to connect the same, and means for locking said switch frame to prevent another line from operating the same until the aforesaid connected lines disconnect.

8. In a communication system a switch frame, a plurality of vertical movable bars thereon, said bars having apertures formed therein, a plurality of line contacts supported on said frame each extending through one of said apertures and adapted to be moved by said bars, a plurality of horizontal movable rods, a plurality of cams on each rod, each cam corresponding to one of the aforesaid line contacts, electromagnetic means for moving said vertical bars, and electromagnetic means for moving said horizontal rods whereby said cams will be brought into contact with said line contacts.

9. The switch frame as claimed in claim 8 wherein the vertical bars cause the line contacts to move from a non-operative position to an operative position and the horizontal rods cause the cams to contact with the line contacts when the latter are in operative position.

10. The switch frame as claimed in claim 8 having a locking mechanism under the control of a line connected thereto whereby said frame is rendered inaccessible to all other lines when any pair of contacts are closed thereon.

MAURICE ROSIN.