

L. O. SURLS.

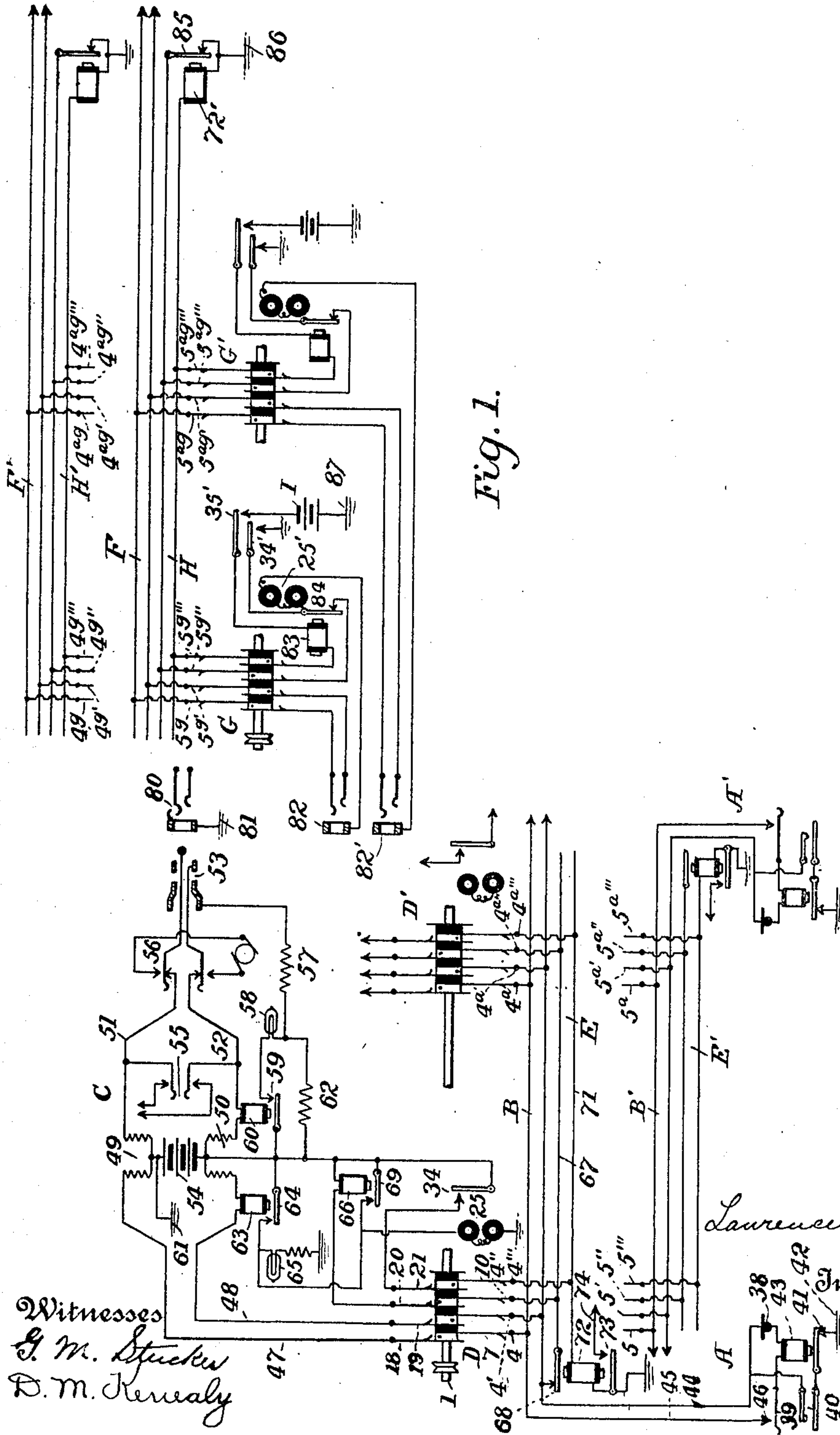
AUTOMATIC TRUNKING APPARATUS FOR ELECTRICAL CIRCUITS.

APPLICATION FILED JUNE 30, 1906.

Patented Apr. 27, 1909.

3 SHEETS—SHEET 1.

919,491.



Witnesses
G. M. Stucker
D. M. Kenealy

Lawrence O. Surls

Inventor

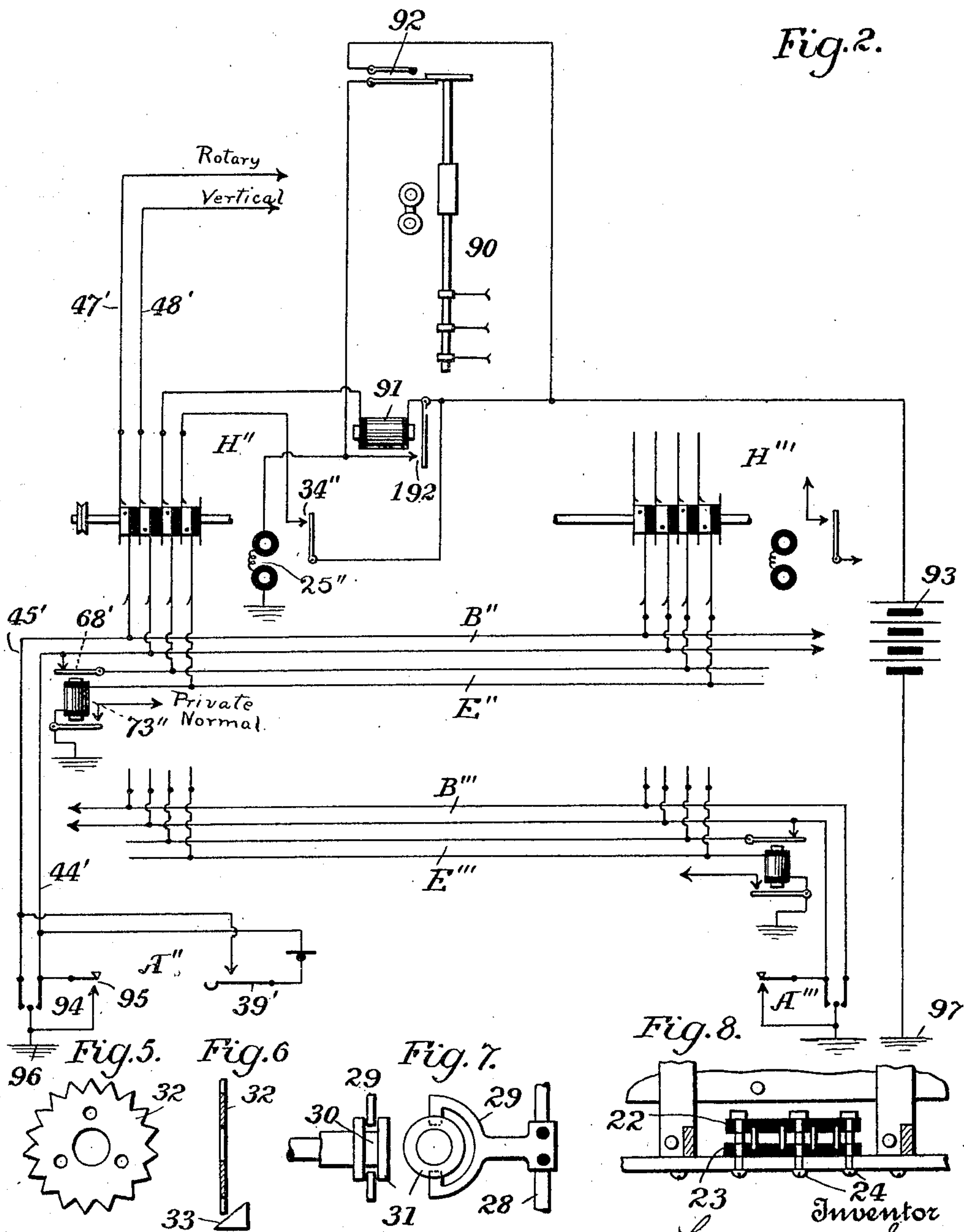
N. L. Davis
Attorneys

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Witnesses
 G. M. Stucker
 D. M. Kenealy.

Inventor
 Lawrence O. Surles
 By H. L. Davis,
 his Attorneys

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3 SHEETS—SHEET 3.

Fig. 4.

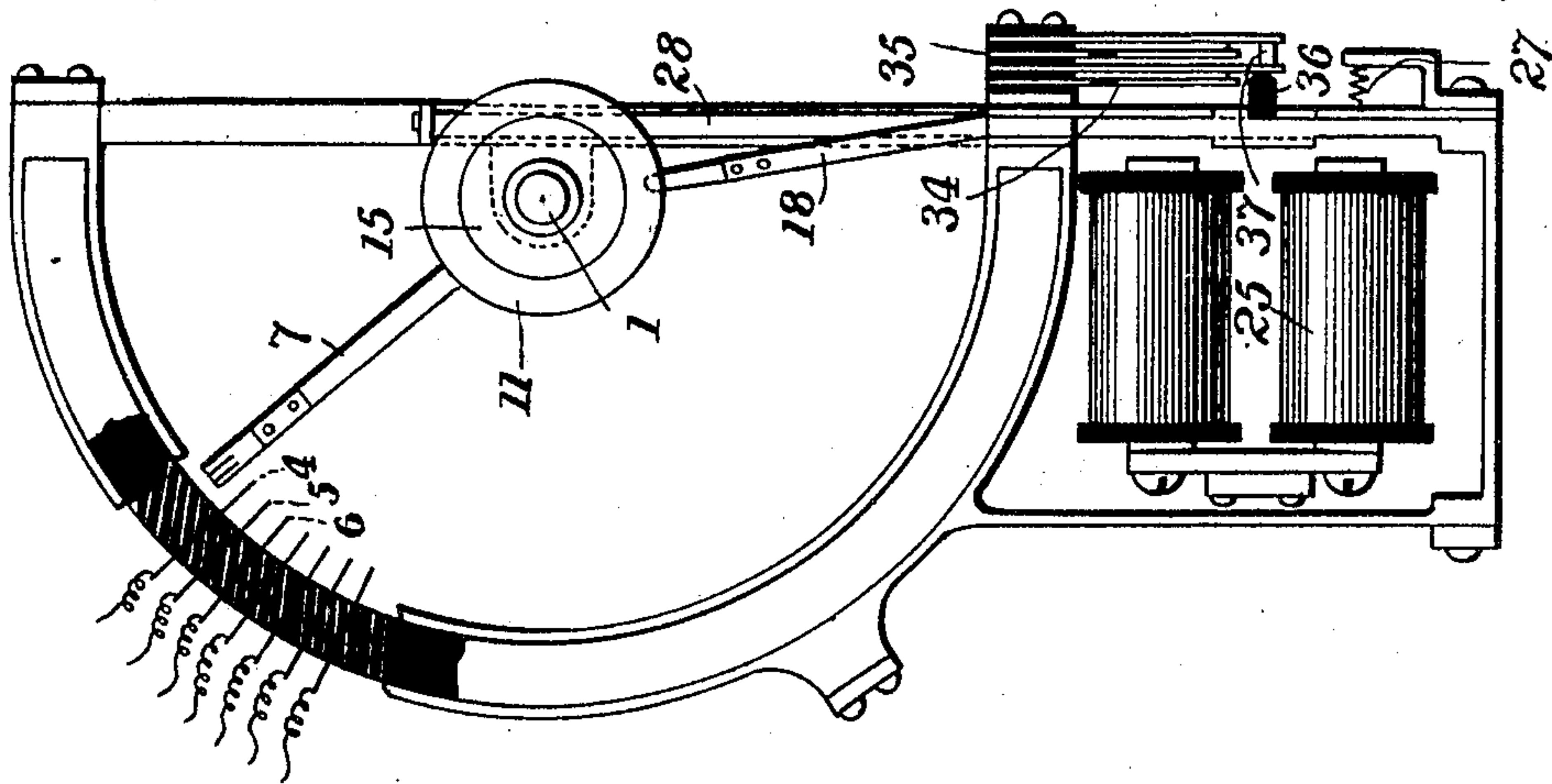
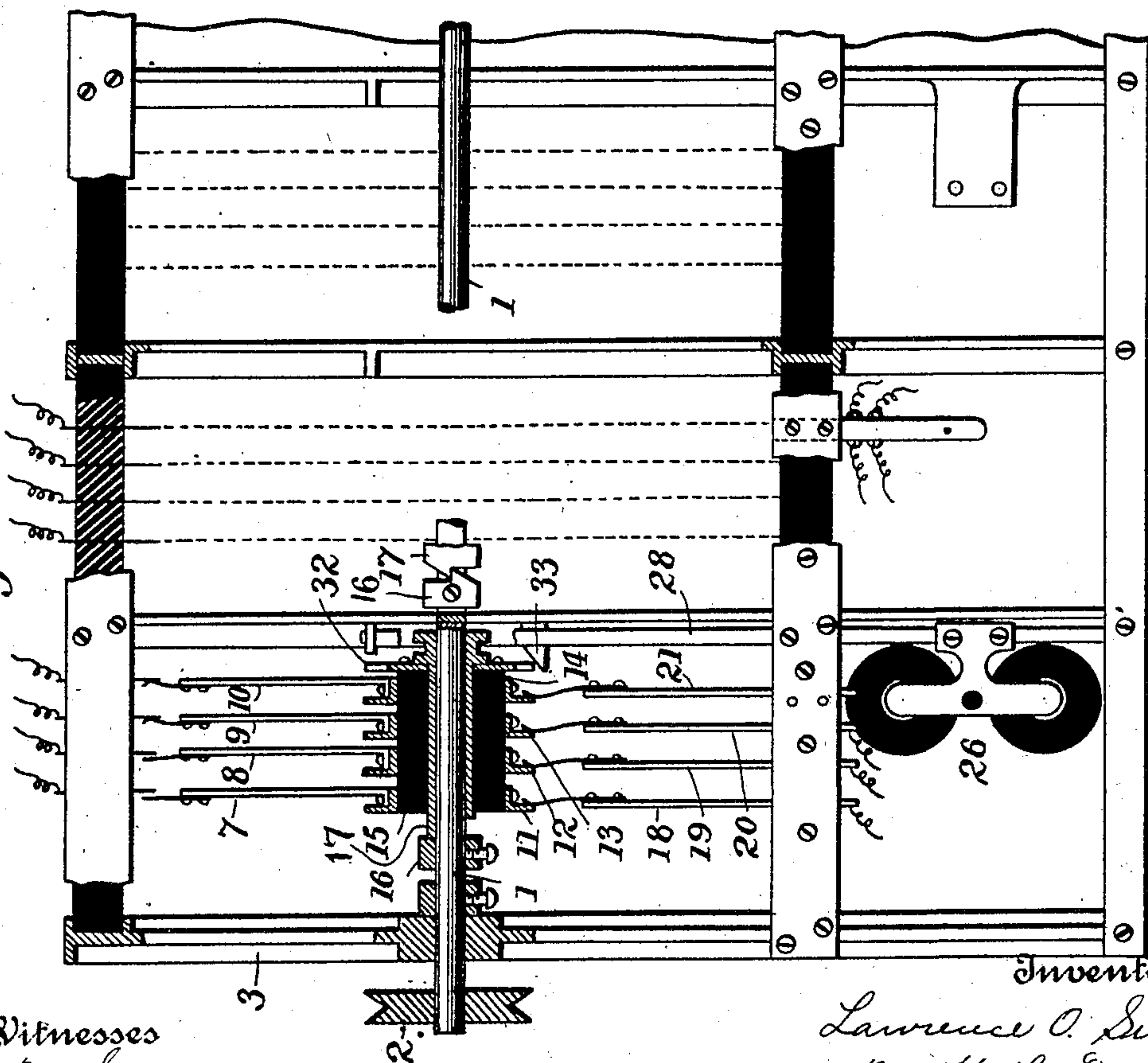


Fig. 3.



Witnesses
 G. M. Stucker
 D. M. Keenly.

Inventor
 Lawrence O. Surlles
 By H. L. Davis
 his Attorney

UNITED STATES PATENT OFFICE.

LAWRENCE O. SURLS, OF ATLANTA, GEORGIA.

AUTOMATIC TRUNKING APPARATUS FOR ELECTRICAL CIRCUITS.

No. 919,491.

Specification of Letters Patent.

Patented April 27, 1909.

Application filed June 30, 1906. Serial No. 324,154.

To all whom it may concern:

Be it known that I, LAWRENCE O. SURLS, a citizen of the United States, residing at Atlanta, in the county of Fulton and State of Georgia, have invented new and useful Improvements in Automatic Trunking Apparatus for Electrical Circuits, of which the following is a specification.

This invention relates to automatic trunking apparatus for electrical circuits, being particularly applicable to telephone and telegraph circuits.

The objects of the invention are to reduce the quantity of, and simplify, the apparatus required, thereby facilitating the operation and reducing the cost of construction and installation.

These objects may be accomplished by the use of the present invention in connection with electrical circuits in general and more particularly in connection with telegraph and telephone circuits and in the latter case whether the system is manual or automatic and common battery or otherwise.

The invention is illustrated in the accompanying drawings of which—

Figure 1 is a diagram illustrating the application of the invention to a common battery manually operated system with trunks for connecting between exchanges, Fig. 2 illustrates the application of the invention to a Strowger automatic system, Fig. 3 is a side elevation of a selective device partly broken away, Fig. 4 is an end elevation of the same, and Figs. 5, 6, 7 and 8 are views of details of the selective device as will be hereinafter referred to.

Referring to the drawings, and particularly Fig. 1, it will be seen that the apparatus comprises a plurality of subscribers' stations A, A', etc., signaling conductors B, B', etc., through which the signaling or talking current is transmitted. A cord circuit C by which it is intended to indicate any means and the apparatus appurtenant thereto at a central station or other point for connecting together two subscribers' lines so that their connected stations are placed in communication, selective devices D, D', etc., for connecting the signaling conductors extending from the subscriber's station with any one of a plurality of cord circuits, it being understood that a cord circuit is associated with the selective device D' and others in the same manner as the cord circuit C is shown to be associated with the selective device D, and

selective conductors E, E', etc., corresponding to their respective stations for controlling the operation of the selective devices.

The manner of application of the invention to the connecting of trunks between exchanges, is shown only in Fig. 1, as the manner of its application to automatic exchanges, such as illustrated in Fig. 2, would be obvious, the necessary modifications being readily made by telephone engineers. Illustration of the application of the invention to trunks between exchanges has therefore been omitted from Fig. 2.

Each of the selective devices may comprise (Figs. 3 to 8 inclusive) a shaft 1 continuously driven by any suitable means, as a pulley 2, to which a belt may be applied. The shaft is rotatably mounted in suitable bearings in a frame 3. Carried by the frame are a plurality of sets of contacts 4, 5, 6, etc., corresponding to the number of subscribers' stations. These contacts are arranged in arcs concentric about the axis of the shaft 1. The contacts of each set are adapted to be engaged by sweepers or movable contacts 7, 8, 9 and 10, there being a sweeper for each of the stationary contacts of a set and the sets are adapted to be successively engaged as the sweepers move in circles about the axis of the shaft 1. The movable contacts or sweepers already referred to are in fixed electrical connection with collars 11, 12, 13 and 14 insulated from each other and from their support by means of an insulating spool 15 which is loose upon the shaft 1 but is adapted to be secured thereto by a clutching device which may consist of a toothed member 16 fixed upon the shaft and adapted to engage with toothed member 17 fixed to the spool 15. When the spool is clutched to the shaft it turns therewith carrying the sweepers 7 to 10 and connection with collars 11 to 14 is maintained during the revolution by means of fixed contacts 18, 19, 20 and 21 which bear upon the said collars and are supported upon the frame 3 in such manner as to be insulated therefrom and from each other. A convenient means of effecting this support is by clamping the contacts 18 to 21 between insulating plates 22 and 23 which are drawn toward each other and secured to the support by means of bolts 24 (see Fig. 8).

Supported by the frame 3 is an electromagnet 25 having an armature 26 normally withdrawn from the magnet as by a spring 27. This armature is fixed to a vertical rod

28 rotatably mounted in the frame, to which is also fixed a forked member 29 engaging in a groove 30 in a hub 31 secured to the spool 15. Upon the attraction of the armature 26 by the magnet 25 the rod 28 will be turned upon its axis thereby shifting the forked end of the member 29 along the shaft 1 and thereby drawing the spool 15 with it, thus disengaging the clutch members 16 and 17 and releasing the spool 15 from the shaft. The drawing of the spool 15 along the shaft, in addition to disengaging the clutch members, whereby the sweepers are brought to a stop, also serves to bring the sweepers 7 and 8 into engagement with their corresponding stationary contacts, these sweepers, when the connector is in its normal condition (that is, in the position as shown in Fig. 3 and revolving with the shaft) not being in position to engage with the stationary contacts, this engagement being only effected when the spool has been drawn to the right and stopped in connecting position. In order that the spool may be stopped accurately in position a notched disk 32 is fixed to the spool and when the latter is drawn along the shaft to release it from connection therewith, as before described, the notched disk will ride upon a stop 33 fixed to the frame which by entering one of the notches will prevent the turning of the spool in either direction. It will be noted that the sweepers 7 to 10 and the stationary contacts 18 to 21 are provided with springs whereby the longitudinal movement of the spool is permitted while the respective sweepers and contacts are in engagement without breaking the contacts. The magnet 26 also serves to control two pairs of contacts 34 and 35 which are mounted upon the frame 3 and by reason of being formed of spring material or in other ways they tend to close. The individual contacts of these pairs are insulated from the frame and from each other. Upon the armature 26 is mounted an insulating projection 36 which, when the magnet is deenergized, bears upon one of the pairs of contacts 34 thereby opening the same and through an insulating piece 37 interposed between a contact of the pair 34 against which the projection 36 bears, and one of the contacts of pair 35, the armature operates when deenergized to open both pairs of contacts 34 and 35. When the magnet 25 is energized and its armature attracted the pairs of contacts 34 and 35 will be respectively closed. The purpose of these pairs of contacts 34 and 35 will be hereinafter set forth.

Each of the subscribers' stations A, A', etc., comprises the usual transmitter 38 and a receiver which may be connected in a well known manner and is not here illustrated, the receiver hook 39, and contacts 40 adapted to be closed when the receiver is removed from the hook. One of the contacts 40 is

connected through contacts 41 with ground at 42. The contacts 41 are controlled by a relay 43 in the signaling, that is, in the talking circuit. From each station extends signaling wires 44 and 45 connected with stationary contacts 4, 4', 4^a, 4^{a'}, etc., of the selective devices D, D', etc. The selective conductors E corresponding to the station A are connected to stationary contacts 4'', 4''' of the selective device D, stationary contacts 4^{a''}, 4^{a'''} of the selective device D' and so on to analogous stationary contacts of all the selective devices. In a similar manner the signal conductors B' and selective conductors E' corresponding to the station A' are connected to the set of contacts 5 to 5''' at the selective device D and to the set of contacts 5^a to 5^{a'''} at selective device D', and in similar manner are connected to any number of other selective devices. In a similar manner each of the stations is provided with a corresponding set of contacts in any desired number of connecting devices. As each of the cord circuits C and the selective devices D, D', etc., is identical and the manner of making connections is the same for each selective device and cord circuit, a description of one of them will be sufficient. The cord circuit comprises the signaling conductors 47 and 48 connected to the stationary contacts 18 and 19 of the selective device D and is continued through the repeating coils 49 and 50 and conductors 51 and 52 to the plug 53 by which connection can be made with any desired subscriber's station by inserting it in the proper jack as is well understood. Between the repeater coils 49 and 50 is connected a source of electricity such as a battery 54 adapted to supply the signaling current, in this case the talking current, to connected stations.

Across the conductors 51 and 52 is connected the well known listening key 55 to which is connected the operator's apparatus. This apparatus and the manner of its connection and operation is so well understood that it is not shown and needs no further description. The device 56 for ringing up the called subscriber is also well known in the art and will not be further described. Connected with the sleeve of the plug 53 is a resistance 57 through which the circuit of a supervisory signal such as a lamp 58 may be completed when the contacts 59 are closed to the battery 54 by the energization of the relay 60 in the called subscriber side of the cord circuit. One side of the battery it will be noted is grounded at 61. A resistance 62 is shunted about the lamp 58 and contacts 59 to provide a path for current through the resistance 57 from the sleeve of jack 53 to the battery 54 when the contacts 59 are open. The utility of this will be more fully explained in describing the connection of trunks between exchanges. It will be un-

derstood that the resistance 62 is so proportioned with relation to that of the lamp that when the contacts 59 are closed sufficient current will be shunted through the lamp to light it. In the signaling conductor on the calling side of the cord circuit is a relay 63 adapted when energized by the signaling current to close the contacts 64 thereby closing the circuit of the supervisory signal lamp 65 through the battery 54. A relay 66 is adapted to have its circuit closed through the battery 54, the selective device D, a selective conductor 67, contacts 68, and signaling conductor 44, contacts 40, contacts 41 and ground at 42. The energizing of the magnet 66 as described operates to close the normally open contacts 69 thereby closing a circuit through the battery 54, electromagnet 25 and supervisory signal 65, the last two mentioned devices being connected in parallel. Upon the energizing of the magnet 25 the contacts 34 are closed thereby closing a circuit through the battery 54, selective device D, selective conductor 71 and relay 72. The energizing of the relay 72 opens the contacts 68 thereby opening the circuit of and deenergizing the relay 66. It also closes the contacts 73 thereby connecting the conductor 74 with ground, the conductor 74 being connected with the jacks corresponding to the station A and providing a busy test in a well known manner.

The apparatus concerned having been indicated, the operation of connecting two subscribers may be outlined and circuits traced as follows: Let it be assumed that a subscriber at any station, as A, desires to be connected with another subscriber's station. The first operation is to remove the receiver from the receiver hook 39 which results in the closure of the contacts 40 and 46 as before described. This places a ground on the signaling conductor 44. The shaft 1 being revolved continuously all of the spools carrying connecting sweepers which are not in use and therefore disconnected from the shaft or, in other words, all the idle sweepers will be turning with the shaft. The teeth of the clutches for securing the spools to the shaft 1, as hereinbefore referred to, are angularly displaced about the shaft so that no two sets of sweepers will come in contact with sets of stationary contacts corresponding to one subscriber's station at the same time. The first set of sweepers of any of the selective devices D, D', etc., to come in contact with a set of stationary contacts corresponding to the station A, in the instance supposed, will effect the connection of several circuits and the bringing about of certain operations in the cord circuit connected to that selective device as will now be set forth in connection with the selective device D, the sweepers of which it will be assumed are the first to contact with a set of stationary

contacts corresponding to station A. The contacting of the sweepers 9 and 10 inclusive with the stationary contacts 4'' and 4''' inclusive having been accomplished, circuit may be traced from the ground at 42 through contacts 41, contacts 40, signaling conductor 44, contact 68, stationary contact 4'', sweeper 9, stationary contact 20, relay 66 and battery 54 to ground at 61. The relay 66 being thus energized the contacts 69 are closed, thus closing circuit through the supervisory lamp 65 and the electromagnet 25 in parallel through the battery 54. The magnet 25 being thus energized attracts its armature 26, thereupon shifting the spool 15 along the shaft and disengaging the clutch members 16 and 17 while locking the spool in position by means of the stop 33 and notched disk 32, and bringing the sweepers 7 and 8 into engagement with their respective stationary contacts, all as previously described. The sweepers are thus stopped in connecting position and the signaling conductors 44 and 45 are connected through the stationary contacts 4 and 4', sweepers 7 and 8 and stationary contacts 18 and 19 to the signaling conductors 47 and 48 of the cord circuit and thence through signaling conductors 51 and 52 and plug 53. The attraction of the armature 26 also has the effect of permitting the closure of the contacts 34 thereby closing a circuit through the battery 54, stationary contact 21, sweeper 10, stationary contact 4''', selective conductor 71 and relay 72 to ground. The relay being thus energized opens the contact at 68 and thereby removing the ground from the selective conductor 67, previously connected thereto through the signal conductor 44, prevents the formation of a circuit through the relay at any other station corresponding to the relay 66, and thereby prevents a set of sweepers at any other selective device from stopping on the set of contacts corresponding to the station A. The relay 66 having been deenergized and the contact 69 open, the circuit through the supervisory signal 65 and the electromagnet 25 is maintained through the contacts 64 which are held closed by the relay 63 which is energized by the signaling current supplied to the station A by the battery 54. A further effect of the energizing of the relay 72 is the application of the busy test to the jacks of the station A.

Connections having been made as described the lighting of the lamp 65 will indicate to the operator that a subscriber is connected to that cord circuit and desires connection. He will then press the listening key 55 in the usual manner and ascertaining what subscriber is desired, the plug 53 is inserted in an appropriate jack as 80 when the circuit will be completed between the subscribers in the usual manner. The called

subscriber may then be rung up by operating the ringing device 56 in the well known manner. The called subscriber having been rung up, he removes his receiver from the hook thereby completing the signaling or talking circuit as is well understood, the battery 54 serving as a "common" battery, that is supplying transmitter or signaling current to the connected stations. The signaling or talking circuit having been thus completed the relay 60 will be energized thereby closing the contacts 59 and completing a circuit from the ground at 61 through the battery 54 and signal lamp 58 to ground at 81. The subscribers will then be in signaling communication and the lamps 65 and 58 will be lighted. It will also be noted that the establishment of the circuit through the battery 54 and the station A energizes the relay 43, thereby opening the contact 41 and removing the ground from the signaling conductor 44. Conversation may now be carried on through the two connected subscribers and upon the completion of the conversation the hanging up of the receiver hook at station A will break the contacts 46 thereby deenergizing the relay 63 and opening the circuit through the battery of the lamp 65 and the electromagnet 25. The deenergizing of the magnet 25 will permit its armature 26 to move under the influence of spring 27 thereby turning the rod 28 upon its axis and sliding the spool carrying the sweepers into engagement with the shaft as before described. The retraction of the armature 26 also operates to open the contact 34 thereby deenergizing the relay 72 so that the contacts 68 and 73 may assume their normal positions. The sweepers being now connected to the shaft move on out of engagement with the stationary contacts 4 to 4' inclusive and the apparatus is in readiness for a similar connection, it of course being understood that upon the signal for disconnection the plug 53 is removed from the jack 80. If instead of station A, station A' had called up, the sweepers 7 to 10 inclusive would have been arrested in contact with the stationary contacts 5 to 5' inclusive and circuits similar to those which have been traced through cord circuits C and station A could have been traced through the same cord circuits and the circuits of the station A'. Also if the selective device D had not been idle or had not been the first to engage with a set of stationary contacts corresponding to the station A, but, on the other hand, if the selective device D' had been idle and was the first of the selective devices to have its sweepers come in contact with a set of stationary contacts corresponding to the station A, precisely similar circuits would have been traced from the station A, selective device D' and its connected cord circuits as have already been traced through that station, the selective device D and its con-

nected cord circuits C. It will now be seen that in the system illustrated and described there are a plurality of subscribers' stations, a plurality of cord circuits and selective devices one corresponding to each cord circuit whereby any of said stations may be connected with a given cord circuit. It will thus be seen that a flexible system is produced by which it becomes necessary to supply only a sufficient number of cord circuits to care for the maximum number of simultaneous calls which is much less than the number of subscribers' stations, this being rendered possible by the fact that every cord circuit is available for connecting any station and moreover the selective device or connecting means are made to correspond in number to the cord circuits, thereby greatly cutting down the apparatus over what it would be where a connecting device is supplied for each subscriber's station.

While in the foregoing the invention has been described as relating to the connection of subscribers' stations to the cord circuits, it will be understood that it might be employed for connecting subscribers' stations with any other apparatus or for connecting sets of conductors generally, and it will also be understood that any two points between which signaling communication is desired, will correspond to the subscribers' stations.

The apparatus whereby connections are trunked out from an exchange when the lines of the called subscriber do not run directly to the exchange at which the call is made but run to another exchange, may now be described, referring to Fig. 1. In addition to the jacks 80 which connect with subscribers' lines running directly to the exchange there may be also provided jacks 82, 82', etc., for connecting the cord circuit at the central station with one of the pairs of trunk conductors F and F', etc., the connection being effected through selective devices G, G', etc., pairs of selective conductors H, H', etc., one pair of selective conductors corresponding to each trunk line. The selective devices G, G', etc., are identical in construction with the selective devices D, D', etc., previously described. In the previous description the contacts 35 mounted upon the frame of the selective devices have not been employed but in the trunking connections these contacts will be brought into use. A battery I, common to all the selective devices G, G', etc., is provided for a purpose as will be hereinafter set forth. The electromagnet 25' performs the same function as the magnet 25 and in the same manner as heretofore described. A relay 83 is provided at each of the selective devices for a purpose as will be hereinafter set forth and also a relay 72' corresponding to each trunk circuit similar in function to relay 72 hereinbefore described. In the portion of apparatus under present

discussion each trunk circuit and its corresponding selective conductors are connected to a set of stationary contacts in each of the selective devices G, G', etc., thus the trunk
 5 conductors F' and their corresponding selective conductors H' are connected to the sets of contacts 4^g, 4^{g'}, 4^{g''} and 4^{g'''}, and 4^{ag}, 4^{ag'}, 4^{ag''}, 4^{ag'''}, etc., of the selective devices G, G', etc., while the trunk conductors F and
 10 corresponding selective conductors H are connected to the stationary contacts 5^g, 5^{g'}, 5^{g''}, 5^{g'''} and 5^{ag}, 5^{ag'}, 5^{ag''}, 5^{ag'''}, etc., of the selective devices G, G', etc. The sweepers and manner of maintaining connection
 15 with them in the selective devices G, G', etc., are the same as those described in connection with the selective devices D, D', etc. The manner of operation of the selective devices G, G', etc., in selecting a trunk is the
 20 same as that of selective devices D, D', etc., in selecting a cord circuit, the sweepers being continuously driven and when a set of sweepers engages an idle trunk it is arrested to maintain the contact while each of the sets of
 25 sweepers in other selective devices is prevented from being arrested in contact with a set of contacts corresponding to the trunk in question.

Since the operation of selecting one trunk
 30 circuit is the same as that of selecting any other, a description of this selection in connection with one of the trunk circuits will be illustrative of this operation in connection with each of them. Let it be assumed that
 35 the subscriber having signaled the central station, as hereinbefore described, and has indicated to the operator his desire to be connected with a subscriber not directly connected with the exchange called. The op-
 40 erator then inserts the plug 53 in one of the trunk jacks 82, 82', etc. Let it be assumed that the jack chosen is 82. Upon the engagement of the set of sweepers corresponding to the jack 82 with the contacts of an idle
 45 trunk the sweepers will be arrested and circuit between the cord circuit C and the trunk conductors F will be secured. Let it be assumed that the sweepers at the selective device G come in contact with an idle trunk
 50 circuit and that the first idle trunk circuit engaged is F. Upon the contact of the sweepers as referred to, circuit may be traced from the ground at 61 through the battery 54, resistance 62, resistance 57, sleeve of jack
 55 82, magnet 25', normally closed contacts 84, a sweeper of the device G, stationary contact 5^{g''}, selective conductor H and normally closed contacts 85 to ground at 86. The magnet 25' being thus energized operates to
 60 disconnect the spool carrying the sweepers from the driving shaft and hold it in fixed position as before described. Energizing of the magnet 25' also has the effect of closing the contacts 34' and 35' thereby closing a
 65 circuit from the ground at 87 through the

battery I, contacts 35', relay 83, a sweeper of the selective device G and stationary contact 5^{g'''} through one of the selective conductors H and relay 72' to ground at 86. The energizing of the relay 72' opens the
 70 contacts 85 thereby cutting off the ground connection through the one of the selective conductors H through which circuit for arresting sweepers is made and thereby making it impossible for sweepers of other select-
 75 ive device which later engage with the sets of contacts corresponding to the trunk in connection from being arrested upon those contacts. The making of the circuit through the stationary contact 5^{g'''} described also
 80 energizes the relay 83, thereby opening the contacts 84 and breaking the circuit of the magnet 25' through the stationary contact 5^{g''}. The circuit of this magnet is, however, completed at this stage by the contacts 34'.
 85

It will now be seen that the connection of the signaling conductors 51 and 52 of the cord C is now established through the plug
 53, trunk jack 82 and stationary contacts 5^g and 5^{g'} with the trunk signaling conductors
 90 F. Connection having been thus established, by repetition of trunking if necessary, with the exchange to which the desired subscriber is directly connected, the cord circuit at the
 exchange last mentioned is plugged into a
 95 subscriber's jack corresponding to the jack 80 when the operations of signaling and disconnection, so far as the subscribers' stations and cord circuits are concerned, are per-
 formed as hereinbefore described. Upon the
 100 signal for disconnection and the withdrawal of the plug 53 from the jack 82 the circuit of magnet 25' will be broken at the jack and the deenergizing of this magnet will result in the opening of the contacts 34' and 35', this de-
 105 energizing the relays 83 and 72' when the various parts will be returned to the position occupied before connection, in readiness for a repetition of the connection.

In Fig. 2 is shown the manner in which a
 110 subscriber's station is connected with the selector switches of a Strowger automatic system and the apparatus is analogous with slight modifications to that described with
 reference to the connection of subscribers
 115 with cord circuits, as shown in Fig. 1. In Fig. 2 the subscribers' stations A'' and A''', etc., are supplied with signaling conductors B'', B''', etc., selective conductors E'', E''', etc., magnets as 73'', for preventing the
 120 duplication of connections from the subscriber's line to the automatic switches, and selective devices H'' and H''', etc. Thus far the apparatus is precisely analogous and
 operates in exactly the same way as do the
 125 corresponding devices for connecting the subscriber's station with the central station apparatus in Fig. 1. An automatic Strowger selective switch is indicated at 90 sufficient to illustrate the application of the in-
 130

vention but the construction of the switch is not shown in detail and it is unnecessary to an understanding of the present invention and moreover is well known to persons skilled in the art. A Strowger selective switch, as referred to, is shown in Fig. 1 of an article in "Telephony", the said figure appearing on page 102 of volume 8, issue of August, 1904. A relay 91, normally closed contacts 92 and a source of current 93 are provided and their functions will be pointed out hereinafter in connection with a description of the operation of the apparatus. Apparatus 94 of well known design is provided at each of the central subscribers' stations for controlling the Strowger switches.

The operation of connecting one subscriber to a selective switch is typical of similar connections of other subscribers and therefore the operation will be described in connection with one subscriber's station only and for purposes of illustration the station A' has been chosen.

A subscriber desiring connection removes the receiver from the hook 39' in the usual manner which thereupon closes the circuit through the telephone instruments at the station. The contacts 95 are then closed for a short time, a second or little longer, whereupon, when the sweepers of one of the selective devices H'', H''', etc., each corresponding to a Strowger switch, as 90, come in contact with a set of stationary contacts corresponding to the calling station A'', circuit may be traced from the ground at 96 through the contacts 95, contacts 68', one of the sweepers, relay 91 and battery 93 to the ground at 97. The relay 91 being energized contacts 192 will be closed thereby completing a circuit through the battery 93 and the magnet 25'' whereupon the magnet will be energized and the sweepers of the selective device H will be arrested and the contacts 34'' will be closed as described in connection with Fig. 1. The closing of the contacts 34'' operates to close a circuit through, and energize, the relay 73'' thereby opening the contacts 68' and breaking the circuit through the relay 91 whereupon the contacts 192 are opened. Contacts 92 are closed at this stage and a shunt established about the contacts 192 thereby maintaining the circuit of the magnet 25''. The signaling conductors 44' and 45' are, upon the arresting of the sweepers of the selective device, connected with the signaling conductors 48' and 47' which are respectively connected to the vertical and rotary relays for operating the Strowger switch. The application of the relays to the switch whereby one operates to move the switch vertically and the other to rotate it, are well understood as is also the manner of controlling these relays through the signaling conductors, the arrangement and connection being as shown and described in the article in "Teleph-

ony" before referred to. It is unnecessary, therefore, to describe further the switch relays and they are not shown in the drawing. It is sufficient to say that the vertical relay is actuated by grounding the conductor 44' and its connected conductor 48', while the placing of a ground upon the signaling conductor 45' and upon its connected conductor 47' operates to actuate the rotary relay. It will now be seen that upon the engagement of the sweepers of the selective device as before described, the circuit will be completed from the ground 96 through contacts 95 and signaling conductors 44' and 48' to the vertical relay whereby the switch will be stepped up vertically one step. This will permit the contacts 92 to close with results as previously indicated. The stationary or bank contacts of the Strowger switch are elevated one step higher than usual with relation to the wiper or spindle contacts, so, that upon the first vertical impulse, the wipers are not brought opposite the rows of bank contacts, but this condition is brought about by a second vertical impulse. The first vertical impulse then, which is brought about by the closing of the contacts 95, simply raises the switch spindle one step, thereby permitting the closure of the contacts 92 as before referred to. The next impulse, instead of being a rotary impulse as in the ordinary operation of a Strowger switch, is a second vertical impulse which is followed by a rotary impulse caused by the grounding of the conductor 45' and thereafter the Strowger switch may be moved into any desired selective position by alternately grounding the conductors 44' and 45' in a well known manner, the selection by the Strowger switch being accomplished in the same manner as if connections were made directly to the switch 90 instead of through the selective device H''. When the conversation has been finished the subscriber returns the receiver to its hook thereby opening the transmitter circuit and releasing the selector switch in a well known manner. As the switch returns to its normal vertical position it comes against one of the contacts 92 and opens the circuit at that point thereby opening the circuit of and de-energizing the magnet 25'' whereupon the retaining means of the selective device H'' is released and the apparatus returns to normal position in readiness for operation to effect other connections as described in connection with the apparatus of Fig. 1.

In view of the fact that by the system and apparatus just outlined any subscriber's station may be connected with any Strowger switch, it will be obvious that the number of selective switches need only correspond to those required to serve the maximum number of simultaneous calls which is much less than the number of switches which are required when a Strowger switch for each sub-

subscriber's station is supplied as heretofore. As in the case of the cord circuits of Fig. 1, there is one selective device corresponding to the smaller number of connected apparatus, namely, in this case the Strowger switches and thus the system serves to supply a given number of subscribers with a minimum amount of apparatus and expense.

The invention has been described in what is considered its best applications but it may be embodied in various structures without departing from the spirit of the invention. The invention should not, therefore, be limited to the systems or apparatus shown.

What I claim is:—

1. In a signaling system, the combination with a subscriber's station, of a cord circuit, a "common" battery connected to said cord circuit, a set of movable contacts fixed with relation to each other and means for controlling said movable contacts, said set of movable contacts comprising contacts for connecting the subscriber's station with said cord circuit and a contact adapted to close a circuit for the said means for controlling the set of contacts through said "common" battery simultaneously with the connection of the subscriber's station with the cord circuit and means actuated by current in the signaling circuit for closing a local circuit through said "common" battery and means for controlling the movable contacts but not passing through any of the contacts of said set.

2. In a signaling system, the combination with a subscriber's station, of signaling conductors and a set of movable contacts fixed with relation to each other, a signal whereby a subscriber indicates a desire for communication, and means for controlling said movable contacts, said set of movable contacts comprising contacts for connecting said signaling conductors with said subscriber's station and a contact adapted to close a circuit through said means for controlling the said set of contacts and through said signal simultaneously with the connection of the subscriber's station with the signaling conductor and means actuated by current in the signaling circuit for closing a local circuit through said signal and means for controlling said movable contacts but not passing through any of the contacts of said set.

3. In a signaling system, the combination with a subscriber's station, of signaling conductors, a signal for indicating the desire of the subscriber for connection, a set of movable contacts fixed with relation to each other, a "common" battery adapted to supply signaling current to connected stations, and means for controlling said movable contacts, said set of movable contacts comprising contacts for connecting said signal conductors with said subscriber's station and a contact adapted to close circuits through said "common" battery, said signal and said

means for controlling said movable contacts simultaneously with the connection of the subscriber's station with the signal conductor and means actuated by current in the signaling circuit for closing a local circuit through said common battery, said signal and said means for controlling the movable contacts but not passing through any of the contacts of said set.

4. In a signaling system, the combination with a subscriber's station, of signaling conductors and a set of movable contacts fixed with relation to each other, a signal whereby a subscriber indicates a desire for communication, and means for controlling said movable contacts, said set of movable contacts comprising contacts for connecting said signaling conductors with said subscriber's station and a contact adapted to close a circuit through said means for controlling the said set of contacts and through said signal simultaneously with the connection of the subscriber's station with the signaling conductors and contacts at the subscriber's station for controlling the circuit through the means for controlling the said set of movable contacts.

5. In a signaling system, the combination with a subscriber's station, of signaling conductors and a set of movable contacts fixed with relation to each other, a signal whereby a subscriber indicates a desire for communication, and means for controlling said movable contacts, said set of movable contacts comprising contacts for connecting said signaling conductors with said subscriber's station and a contact adapted to close a circuit through said means for controlling the said set of contacts and through said signal simultaneously with the connection of the subscriber's station with the signaling conductors, the said signal and the said means for controlling the said set of contacts being connected in parallel and contacts at the subscriber's station for controlling the circuit through the means for controlling the said set of movable contacts.

6. In a signaling system, the combination with a subscriber's station provided with the usual receiver hook, of signaling conductors, a set of movable contacts fixed with relation to each other and means for controlling said movable contacts, said set of movable contacts comprising contacts for connecting said signaling conductors with said subscriber's station and a contact adapted to close a circuit for the said means for controlling the said set of contacts simultaneously with the connection of the subscriber's station with the signaling conductors and contacts at the subscriber's station actuated by the receiver hook for controlling the said means for controlling the said set of movable contacts.

7. In a signaling system, the combination with a subscriber's station having a receiver

hook, of a cord circuit, a "common" battery connected to said cord circuit, a set of movable contacts fixed with relation to each other and means for controlling said movable contacts, said set of movable contacts comprising contacts for connecting the subscriber's station with said cord circuit and a contact adapted to close a circuit for the said means for controlling the set of contacts through said "common" battery simultaneously with the connection of the subscriber's station with the cord circuit and contacts at the subscriber's station actuated by the receiver hook for controlling the said means for controlling the said set of movable contacts.

8. In a signaling system, the combination with a subscriber's station having a receiver hook, of signaling conductors and a set of movable contacts fixed with relation to each other, a signal whereby a subscriber indicates a desire for communication, and means for controlling said movable contacts, said set of movable contacts comprising contacts for connecting said signaling conductors with said subscriber's station and a contact adapted to close a circuit through said means for controlling the said set of contacts and through said signal simultaneously with the connection of the subscriber's station with the signaling conductors and contacts at the subscriber's station actuated by the receiver hook for controlling the said means for controlling the said set of movable contacts.

9. In a signaling system the combination with a subscriber's station having a receiver hook, of signaling conductors and a set of movable contacts fixed with relation to each other, a signal whereby a subscriber indicates a desire for communication, and means for controlling said movable contacts, said

set of movable contacts comprising contacts for connecting said signaling conductors with said subscriber's station and a contact adapted to close a circuit through said means for controlling the said set of contacts and through said signal simultaneously with the connection of the subscriber's station with the signaling conductors and contacts at the subscriber's station actuated by the receiver hook for controlling the said means for controlling the said set of movable contacts.

10. In a signaling system, the combination with a plurality of subscribers' stations, of signaling conductors extending from each of said stations, selective conductors corresponding to each subscriber's station, other sets of signaling conductors, selective devices for connecting the conductors extending from the subscribers' stations with the said other sets of signaling conductors, the signaling and-selective conductors corresponding to each station being connected with each of the said selective devices, a circuit for each of the selective devices adapted to control its movement, the circuits for controlling the movement of the selective devices being adapted to be initially closed through one of said selective conductors and means for breaking the circuit through the last mentioned conductor upon the establishment of the signaling circuit through a selective device.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

LAWRENCE O. SURLS.

Witnesses:

R. L. HOGAN,
GUIDEN CHAPIN.