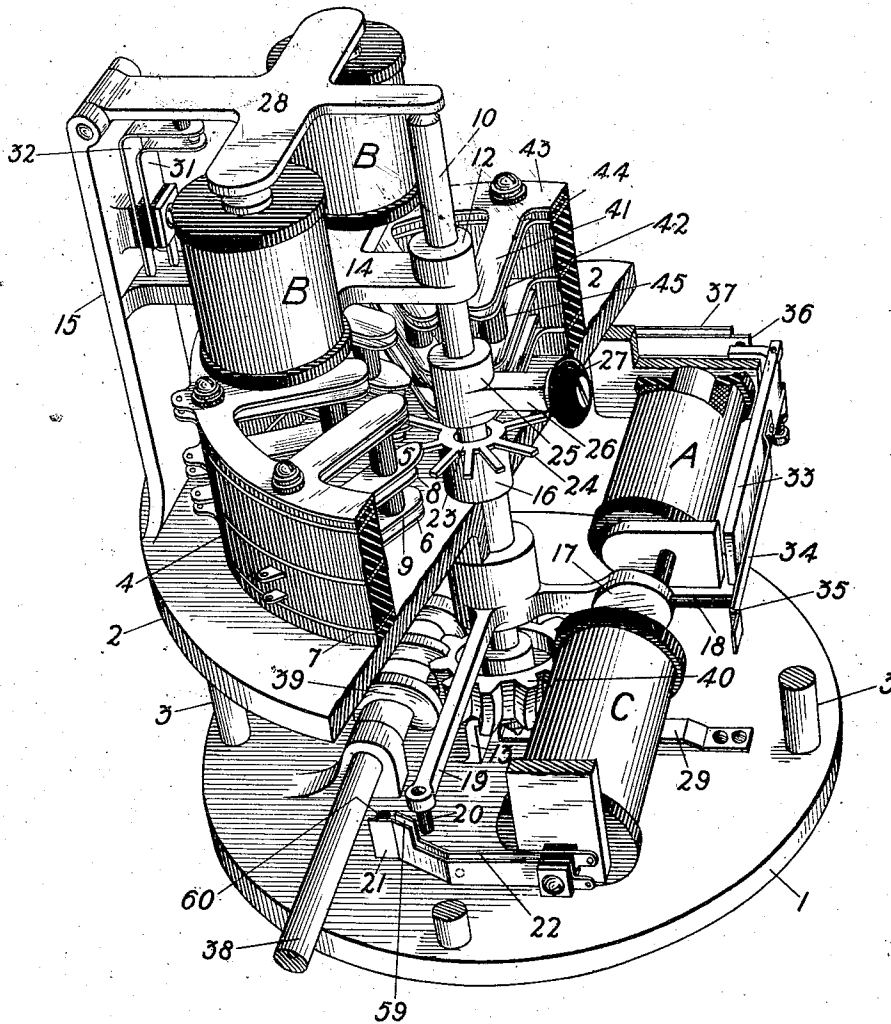


F. A. LUNDQUIST.
TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED FEB. 19, 1913.

1,146,889.

Patented July 20, 1915.
3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

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W. J. Hoffman

Inventor:

Frank A. Lundquist.

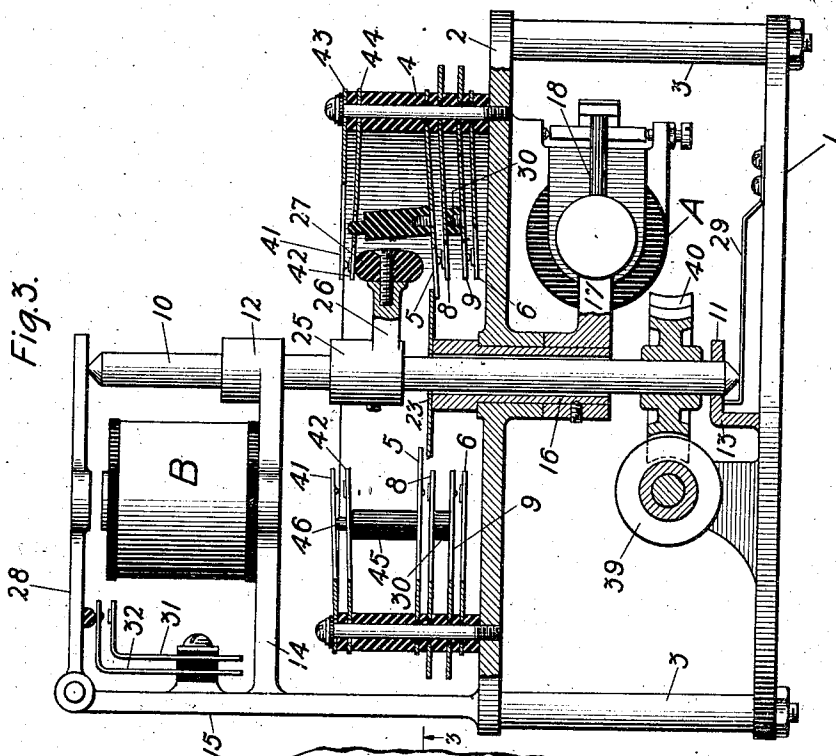
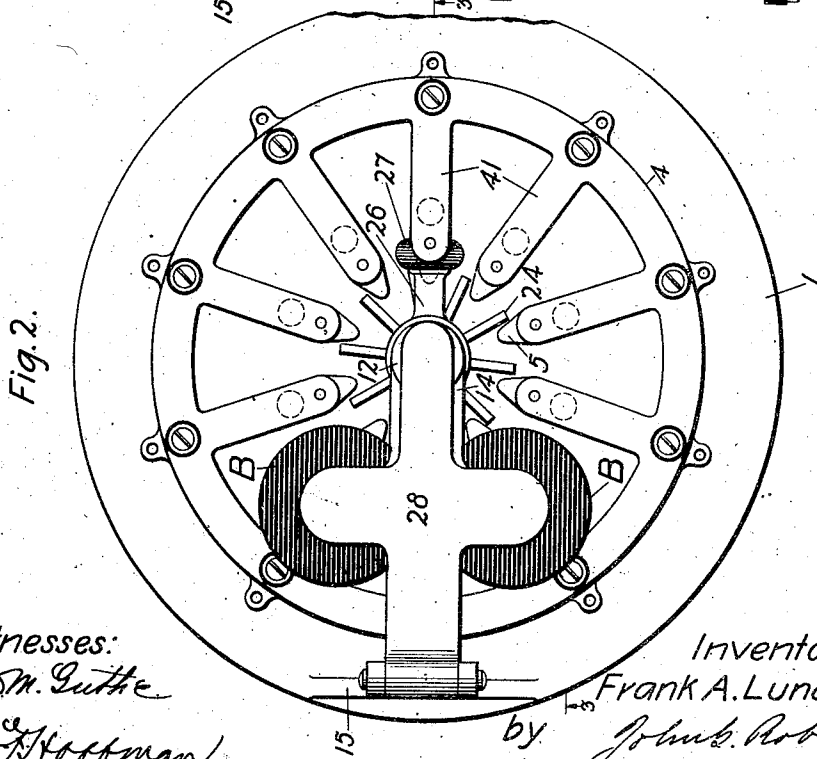
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3 SHEETS—SHEET 2.



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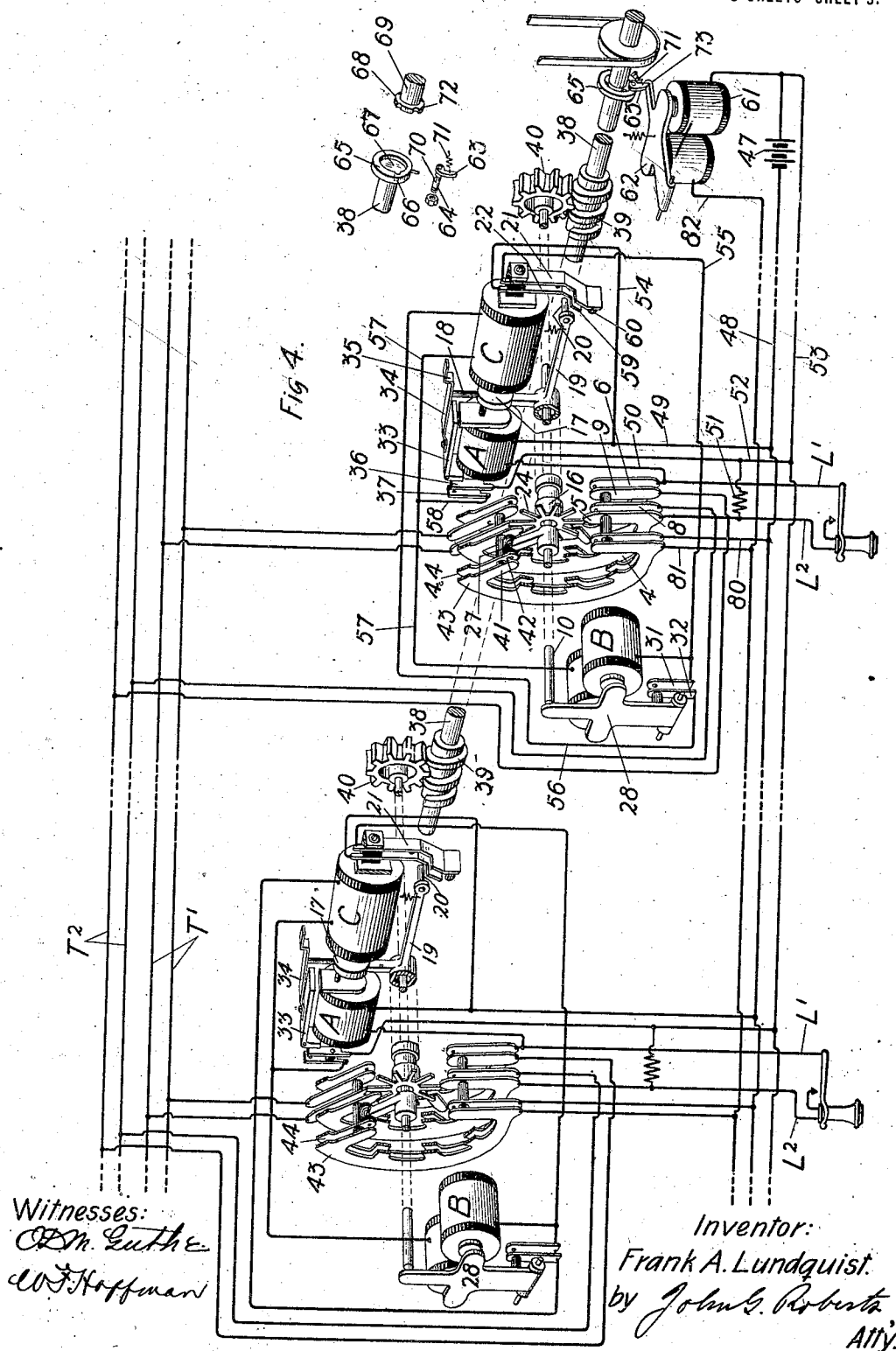
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3 SHEETS—SHEET 3.



UNITED STATES PATENT OFFICE.

FRANK A. LUNDQUIST, OF INGLESIDE, ILLINOIS, ASSIGNOR TO WESTERN ELECTRIC COMPANY, OF NEW YORK, N. Y., A CORPORATION OF ILLINOIS.

TELEPHONE-EXCHANGE SYSTEM.

1,146,889.

Specification of Letters Patent.

Patented July 20, 1915.

Application filed February 19, 1913. Serial No. 749,378.

To all whom it may concern:

Be it known that I, FRANK A. LUNDQUIST, a citizen of the United States, residing at Ingleside, in the county of Lake and State of Illinois, have invented a certain new and useful Improvement in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to an automatic selector for use in automatic and semi-automatic telephone systems, whereby movable contact makers, commonly called wipers, and flexible connections or cords necessarily associated therewith are dispensed with. These selectors, which, in the present embodiment are illustrated as line switches, may be arranged in groups associated with trunks. The contact actuating members of all the switches of a group always stand in the same position adjacent to or directly over the multiplied terminals of an idle trunk. When a subscriber lifts his receiver from the hook, his line, which is connected to one of these switches, immediately becomes connected to an idle trunk. Then this switch together with all other switches of the group advances to the next idle trunk. In the same way when a second calling subscriber lifts his receiver, his line is immediately connected to the next idle trunk by his switch, and all the switches again advance to the idle trunk next in the series. In this process the switch of the calling subscriber does not stop in a fixed position during talking, but merely connects the calling line to an idle trunk and passes on. In this passing from trunk to trunk, the contact actuating parts of the switches do not wipe over contacts but pass adjacent to contact springs which are moved into and locked in engagement by the operation of the switches. This locked position is released by hanging up the receiver without respect to what position the switch may be in.

One of the objects of this invention is the provision of an improved switch of this type having no brushes or wipers.

Another object is the provision of a locking device independent of the contact actuating means whereby the contacts may be retained in their actuated position.

A further object is the provision of a switch of simple structure having few movable parts.

Other objects and advantages will appear

as the description of the invention progresses.

The apparatus herein disclosed comprises essentially a circular or cylindrical bank of contact springs comprising multiplied terminals of the line to which the switch is individual, and trunk line terminals adapted to cooperate therewith. Mounted axially of the contact bank is a rotatable and longitudinally movable shaft having secured thereto an outwardly extending arm adapted to be positioned over any desired set of springs and to be moved by electromagnetic mechanism to cause interengagement of the springs of the set. Rotatably mounted in the framework is a collar or sleeve through which the shaft passes. This collar is provided with a plurality of radially arranged projections, one for each set of springs. After the springs of the set are forced into interengagement, this collar is rotated to position one of these projections or fingers over the uppermost spring of said set, whereby said springs are held in their engaging relation while the shaft is automatically rotated to position the contact operating finger thereof in operative relation to the next set of springs in which are terminals of an idle trunk.

Referring now to the drawings for a more complete disclosure of the device,—Figure 1 is a perspective view, partly in section, of thereof; Fig. 3 is a sectional view on the line 3—3 of Fig. 2, and Fig. 4 is a diagrammatic view of the device and a circuit arrangement of the switching device; Fig. 2 is a plan view with which it is adapted to be used.

Referring now to the drawings in which the same reference characters are applied to the same parts in the several figures, 1 and 2 are circular plates rigidly secured together by the spacing blocks 3. Mounted upon the plate 2 and concentrically therewith is a circular terminal bank 4 consisting of ten sets of stationary terminals, each set of which comprises a pair of springs 5 and 6 which represent the terminals of a subscriber's line. These line terminals are all multiply connected by being formed as inwardly extending fingers on the circular plates 7. Associated with each pair of line springs and located therebetween is a pair of cooperating springs 8 and 9 which represent the terminals of a trunk line or connecting circuit as T¹ or T² to which the calling line is adapted

to be connected. Extending axially through the stationary terminal bank is a rotatable and longitudinally movable shaft 10 mounted in bearings 11 and 12, one of which (11) is formed in a bracket member 13 secured to the circular disk 1, the other of which (12) is carried by a forwardly projecting bracket 14 integral with the upright 15 rigidly secured at one side of the plate 2. Rotatably mounted in the plate 2 is a sleeve or collar 16 through which the shaft loosely passes. This sleeve is provided at one end thereof with an outwardly projecting arm 17 which forms the armature of the electromagnet C mounted on the plate 1. This armature carries an outwardly extending pin 18 for a purpose to be hereinafter described. Extending outwardly from the sleeve 16 at right angles to the armature member 17 is an arm 19 carrying a downwardly projecting insulating lug 20 adapted, when the armature 17 is fully attracted, to cause separation of the normally closed contacts 21 and 22 in a manner which will be hereinafter described. Rigidly secured at the upper end of the sleeve is a disk 23 having a plurality of outwardly or radially extending catch fingers 24. One of these fingers is provided for each set of stationary terminals, and they are so positioned that in the normal position of the sleeve 16 these fingers will occupy positions intermediate the terminal sets, respectively, as shown in Fig. 2.

Fixed to the shaft 10 above the sleeve 16 is a collar 25 provided with an outwardly extending arm 26 to the outer end of which is secured a knob of insulating material 27. This contact operating arm is so positioned upon the shaft that in the normal position of the device it will occupy a plane slightly above the uppermost line spring 5. Mounted on the bracket member 14 is an electromagnet B having an armature 28 which, upon attraction thereof, is arranged to longitudinally displace the shaft 10 against the resiliency of the supporting spring 29. As the insulating knob 27 overlies the spring 5 of one of the sets of stationary contacts or springs, this spring 5 will be depressed into engagement with the spring 8 and spring 9 will be forced into contact with the spring 6, through the medium of the insulating spacing member 30. The electromagnet C will then be energized to rotate the star wheel 23 and in so doing will position one of the fingers 24 over the spring 5 of the actuated set of springs. As the other sets of springs are at this time in their normal position the other fingers 24 will pass underneath their respective springs 5 and consequently will have no effect thereon. It may be noted that springs 5 are longer than the other springs of the sets and that the catch fingers 24 are only long enough to overlie the ends of the

springs 5. The attraction of the armature 28 by electromagnet B is arranged to close a set of contact springs 31 and 32 insulatively mounted on the upright member 15. Prior to the energization of the electromagnet C, the electromagnet A has been energized attracting its armature 33 which carries the spring catch member 34, the shoulder 35 of which is adapted to engage the projecting member 18 of the armature 17 to retain the same in its forward position until the electromagnet A is deenergized. The attraction of the armature 33 by electromagnet A is arranged to close a pair of contact springs 36 and 37. Extending adjacent to the shaft 10 of all the line switches of a group is a common drive shaft 38. This shaft is provided with a plurality of worms 39, one for each shaft 10. Rigidly fixed to the shaft 10 and in operative engagement with its respective worm 39 is a worm wheel 40 through the medium of which the shaft is adapted to be rotated. Arranged on the terminal bank above each set of connection springs is a pair of multiply connected springs 41 and 42 adapted to close the circuit for an electromagnet 61 which controls the movement of the power shaft. These springs are formed as inwardly projecting parts of the circular members 43 and 44. Fixed to each spring 5 is an upwardly projecting spacing member 45 having a lug 46 projecting through a spring 42 and into engagement with a spring 41. This member, when the spring 5 is in its normal position, holds the springs 41 and 42 elevated so that they will not be engaged by the insulating knob 27 on the arm 26 when the shaft is rotated. When, however, a set of springs is held depressed or in its actuated position, the member 45 is removed from engagement with the springs 41 and 42 and, if at this time the knob 27 is positioned under these springs and the shaft is in its elevated or normal position, these springs will be forced into engagement to complete a circuit for the clutch controlling magnet through the medium of which the power shaft 38 is controlled.

Reference is now made to Fig. 4 for a description of the operation of the device and the circuits therefor. Upon the subscriber taking down the receiver a circuit will be completed for the electromagnet A from battery 47, through the battery lead 48, wire 49, coil of electromagnet A, wire 50, side L¹ of the line, the receiver hook and telephone set at the calling station, side L² of the line, the resistance 51, wire 52, battery lead 53 and back to battery. Armature 33 is thereupon attracted to place the spring catch 34 carried thereby in a position to engage the pin 18 carried by the armature 17 and hold it in its operated position until the deenergization of electromagnet A. The energiza-

tion of A also effects the closure of the springs 36, 37, thus completing the circuit for the electromagnet B from battery 47, lead 48, wires 49, 54, normally closed contacts 22, 21, wire 55, coils of B, wires 57, 58, contacts 37, 36, wire 52, lead 53 and back to battery. Upon the attraction of the armature 28 of the electromagnet B, the shaft 10 is depressed against the resistance of the spring 29 and the insulating knob 27 carried thereby engages the spring 5 of the set of brushes over which this contact operating member is now positioned, causing engagement of the spring 5 with the trunk terminal 8 and the spring 6 with the trunk terminal 9. This connects the calling line with a connecting circuit leading to a selector or a final connector, as the case may be, and as will hereinafter appear this circuit to which the line is connected is always an idle one. The armature 28 in pulling up causes engagement of the contact springs 31 and 32, thus closing circuit for the electromagnet C from battery 47, battery lead 48, wires 49, 54, springs 22, 21, wire 55, springs 31, 32, wire 56, winding of electromagnet C, wires 57, 58, springs 37, 36, wire 52, battery lead 53 and back to battery. C thereupon attracts its armature 17, rotating the sleeve 16 to position one of the radial extending fingers 24 over the spring 5 of actuated set, thus holding spring 5 in its lowermost position and holding the spring 5 in engagement with the spring 8 and the contact 6 in engagement with contact 9.

When the armature 17 was attracted the pin 18 carried thereby was engaged by the shoulder 35 of the catch spring 34 to retain it in its attracted or forward position, thus assuring that the actuated set of springs will remain in engagement until the circuit for the electromagnet A is interrupted at the switch hook by the calling subscriber hanging up his receiver. The rotation of the sleeve 16 caused the projecting lug 20 carried by the arm 19 to engage the lateral projection 59 on the spring 22 and as the armature reaches the limit of its travel, this lug passes from engagement with the spring 22, and into engagement with a projecting lug 60 carried by the spring 21 in such a manner as to cause disengagement of the contacts 21 and 22. This interrupts the circuits of the electromagnets B and C. Upon the deenergization of the electromagnet B, the shaft is elevated to its normal position by the spring 29, thus causing the knob 27 to engage the spring 42, and force it into engagement with the spring 43. This closes the circuit for the clutch magnet 61 of the drive shaft 38 from battery 47, lead 48, wire 80, plate 44, contacts 42, 41, plate 43, wire 81, wire 82, coils of electromagnet 61 and back to battery. Magnet 61 upon attracting its armature 62 releases the dog 63, the pivot

64 of which is mounted in the annular flange 65 at the end of the shaft 38. This flange is provided at the inner surface thereof with a circular notch 66 which is slightly greater than a semi-circle. This forms the bearing for the pivot pin 64. Located within the recess 67 is a flange 68 at the end of a constantly rotating power member 69. The pivot pin 64 is provided with a notch or cut away portion 70 within which the flange 68 freely rotates when the dog 63 is in its retracted position. When, however, the dog 63 is released by the attraction of the armature 62, the pivot pin 64 is rotated by the spring 71 to position a portion of the pin 64 in one of the notches 72 in the flange 68, thus locking the shaft 38 to the constantly rotating power shaft 69. As the energizing circuit of electromagnet 61 will be interrupted as soon as the knob 27 passes from engagement with the particular spring 42 which it has now actuated, the armature 62 will be retracted by the spring 71, and when the shaft 38 has made one complete revolution, the dog 63 will be caught by the catch member 73 at the end of the armature 62, thus rotating the pivot pin 64 and releasing the shaft 38 from the constantly rotating member 69. As the wormwheel 40 is provided with ten teeth, it will be seen that the revolution of the worm 39 has advanced the contact operating member 27 one-tenth of one revolution, thus placing it in operative relation to the next set of contact springs. If the trunk associated with this set is busy at some other switch, the spacing member 45 thereat will be removed from engagement with the springs 41, 42 and the member 27 of said switch will thus cause engagement of said springs to effect another revolution of the shaft 38, and so on until the contact operating member 27 has reached a position in operative relation to a set of springs associated with an idle trunk so as to be in a position to immediately connect the next calling line thereto.

When the calling subscriber hangs up his receiver the circuit through the relay A will be interrupted, whereby its armature 33 will be retracted. The armature 17 of relay C will now be released from the catch 35 and the collar 16 will be rotated to release the actuated set of contact springs. When the armature 17 returns to normal the insulating pin 20 carried at the end of the arm 19 will pass under or back of the projecting portion 59 on the spring 22 and when the armature reaches its fully retracted position the springs 21 and 22 will again come together. The apparatus has now been fully returned to its normal position and is ready for another call. It will now be seen that the apparatus when at rest always stands in operative relation to a contact set in which an idle trunk line terminates, thus being in a

position to immediately connect a calling line to an idle connecting circuit.

As it is obvious that many modifications could readily be made in the invention herein disclosed without departing from the spirit thereof, the apparatus should be taken merely as illustrative and the invention should be limited merely by the scope of the appended claims.

10 I claim—

1. In combination a telephone line, a switch associated therewith, terminals of said line at said switch, other terminals for engagement with said line terminals, a shaft 15 capable of movement in two directions whereby said line terminals may be engaged with said other terminals, and independent means for retaining said terminals in engagement.

20 2. In combination a telephone line, a switch associated therewith, pairs of multiply connected terminals of said line at said switch, trunk terminals arranged for engagement with said line terminals respectively, a contact actuating member, means 25 for moving said member in one direction to select a set of contacts, means for moving it in another direction to cause inter-engagement of the contacts of said set, and a locking device acting independently of 30 said contact actuating member for retaining said set of contacts in their actuated position.

3. In combination a telephone line, an automatic switch associated therewith, pairs 35 of multiply connected contact terminals of said line at said switch, trunk terminals arranged for engagement with said line terminals respectively, contact operating means 40 for causing engagement of said line terminals with said trunk terminals, means independent of said contact operating means for retaining said terminals in their operated position, and means whereby said operating 45 means after actuation will be immediately associated with a terminal set wherein are contacts of an idle trunk.

4. In combination, a subscriber's line, a switch associated therewith, sets of stationary contact springs arranged for inter-engagement at said switch, certain springs 50 of each set representing multiplied terminals of said line, other springs of each set being trunk line terminals, a contact operating device for causing engagement of line 55 terminals with the terminals of an idle trunk upon the initiation of a call, means independent of said contact operating device for retaining said terminals in engagement, 60 and means whereby said operating means will be immediately associated with the next terminal set wherein are the contacts of an idle trunk.

5. In combination, a telephone line, an 65 automatic switch associated therewith, sets

of contact springs arranged for inter-engagement at said switch, springs of each set representing multiplied terminals of said line, other springs of each set representing trunk terminals, a rotatable and longitudinally movable shaft, and means whereby, 70 upon the initiation of a call, said shaft will be actuated to operatively connect said line to an idle trunk, and means independent of said shaft for retaining contacts of the actuated set in engagement. 75

6. In combination, a telephone line, a switch associated therewith, a circular bank of contacts at said switch, said bank comprising contact sets in each of which are 80 represented terminals of said line and of a trunk line, means whereby, upon the initiation of a call, one of said sets of contacts will be actuated to connect the calling line to an idle trunk, and mechanism independent 85 of said contact actuating means for retaining the contacts of said set in engagement.

7. In combination, a telephone line, an automatic switch associated therewith, multiplied contact terminals of said line at said switch, trunk line terminals arranged for engagement with said line terminals respectively, contact operating means for causing 90 engagement of said line terminals with said trunk terminals, independently operable locking means for retaining said terminals in engagement, and means whereby said contact operating means is moved to operative 95 relation to a contact set, wherein are terminals of an idle trunk line, upon the actuation of said locking means. 100

8. In combination, a telephone line, a switch associated therewith, a circular bank of sets of stationary contact springs arranged for inter-engagement at said switch, 105 contacts of each set comprising multiplied terminals of said line and terminals of a trunk line, a shaft extending axially through said bank, a contact actuating member on said shaft, a locking member having a plurality of fingers, said fingers being 110 normally located intermediate said sets of springs, respectively, means for moving said shaft longitudinally to actuate one of said sets of springs, means for rotating said 115 locking member to operatively engage one of said fingers with a spring of the actuated set whereby said springs are held in engagement, and means for rotating said shaft 120 whereby said contact actuating member is moved to operative relation to a contact set, wherein are terminals of an idle trunk, upon the actuation of said locking means.

9. In an exchange, telephone lines terminating thereat, a group of switches associated 125 with said lines, respectively, sets of contacts at each of said switches, each set comprising multiple terminals of a line and trunk line terminals, a contact actuating 130

member at each switch, and means for moving the contact actuating members of a group of switches in unison whereby said actuating members when at rest are always
5 associated with a set of contacts wherein are terminals of the same idle trunk line.

10 In an exchange, a group of switches, telephone lines, multiple terminals of said lines at said switches, respectively, terminals of trunk lines at each of said switches, actuating members, one at each switch for causing engagement of said line terminals with

said trunk terminals, and means effective when one of said actuating members is operated for moving all of said actuating
15 members into association with the terminals of an idle trunk.

In witness whereof, I hereunto subscribe my name this 14th day of February A. D., 1913.

FRANK A. LUNDQUIST.

Witnesses:

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McCLELLAN YOUNG.