

APPLICATION FILED JUNE 12, 1909.

2 SHEETS—SHEET 1.



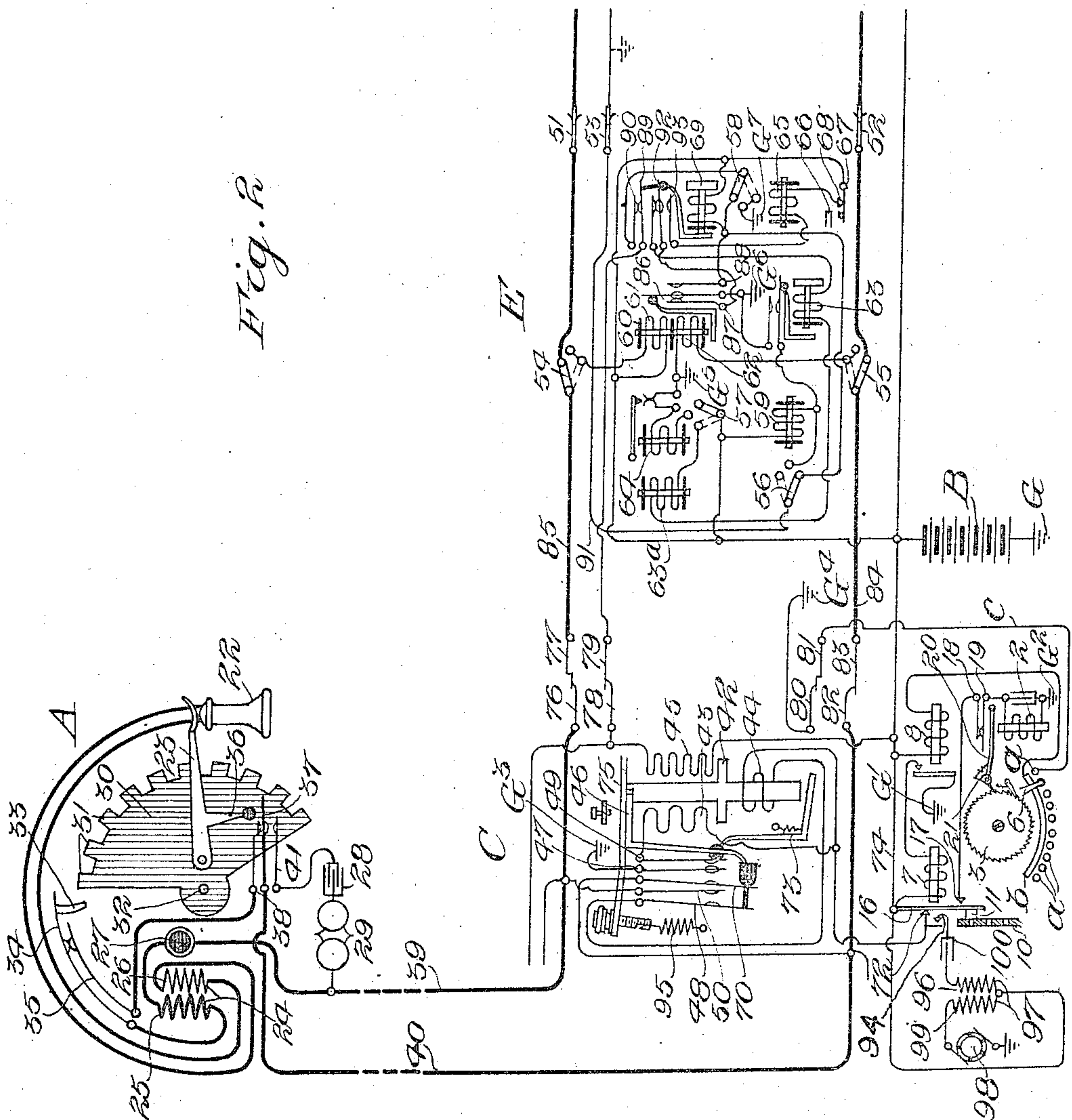
P. H. Burford.
Edward T. Fales

Inventor.
Otto V. Olson,

Guthrie's Ward & Son.
Attorneys.

1,160,951.

Patented Nov. 16, 1915.
 2 SHEETS—SHEET 2.



Witnesses:
 A. C. Burfeind
 Edward D. Fales

Inventor:
 Otto V. Olson,
 By Bulley & Wand & Drury
 Attorneys.

UNITED STATES PATENT OFFICE.

OTTO V. OLSON, OF CHICAGO, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY,
OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TRUNKING SYSTEM.

1,160,951.

Specification of Letters Patent.

Patented Nov. 16, 1915.

Application filed June 12, 1909. Serial No. 501,718.

To all whom it may concern:

Be it known that I, OTTO V. OLSON, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Automatic Trunking Systems, of which the following is a specification.

My invention relates to automatic switching apparatus for telephone or other systems, and more especially to what are commonly known as Keith units, to-wit, a plurality of subscribers' individual line switches controlled or governed by a master switch, whereby each subscriber in calling obtains connection automatically with a preselected idle trunk.

An object of my invention is to provide means for normally locking the master switch and the shaft thereof against movement, whereby the switches will not be liable to give any excess motion by reason of momentum of the parts, and whereby they will not be disturbed or displaced during use of the same for maintaining talking connections, together with means for automatically unlocking the said master switch and shaft simultaneously with the energizing of the magnet by which the same are propelled or operated.

Another object is to provide improved means for maintaining the master switch in operation while traveling from one trunk terminal to another, so as to insure against stoppage of the master switch between trunks—that is to say, in passing from one trunk terminal to another.

A further object is to provide an improved construction and arrangement whereby the device for insuring or maintaining the movement of the master switch from one trunk to another serves also as a device for locking the master switch whenever it comes to rest opposite the trunk line.

It is also an object to provide improved means for giving the calling subscriber the busy signal in the event that all trunks to which his line switch has access are busy.

To the foregoing and other useful ends my invention consists in matters hereinafter set forth and claimed.

In the accompanying drawings Figure 1 is a diagram of an improved master switch in a system embodying the principles of my invention. Fig. 2 is a diagram showing an

automatic two-wire substation connected with the central station, showing the line switch, the said master switch and a selector.

The master switch, as represented in detail in Fig. 1, comprises the motor magnet 2 adapted to operate the ratchet wheel 3, which in turn operates the plunger shaft 4 through the medium of the arm 5 and connecting shaft 9. The master switch bank Q consists of ten insulated contacts *a* and the solid segment *b*. The wiper 6 maintains some one of the individual segments *a* in contact with the common segment *b*. The motor magnet relay 7 closes an energizing circuit through the motor magnet 2. The motor magnet relay is in turn energized by the busy trunk relay 8. At the top of the connecting shaft 9 is a spacing cam or segment 10 adapted to move back and forth having on its arc ten circular openings adapted to fit the pin 11 at the extremity of the armature 12 of the motor magnet relay 7. This spacing cam 10 is fastened to the shaft 9 and rotates with it.

When a trunk upon which is resting the wiper 6 is seized (in this instance *c*), ground is then thrown upon the common segment *b* from the trunk *c* through the wiper 6, thence by means of conductor 15 through the busy relay 8 to the negative side of battery B. The relay 8 energizes and brings the springs 13 and 14 into contact which, by closing another circuit, energizes the motor magnet relay 7. This circuit extends from ground G' through the springs 13 and 14, motor magnet relay 7 to battery B, thence through battery B to ground G. The armature 12 is thus operated, and the finger 11 withdrawn from the particular opening in the cam 10 in which it happens to be normally resting at the time. Also, at the same time the springs 16 and 17 are closed by the operation of said armature, completing an energizing circuit from ground G² through the motor magnet 2, interrupter springs 19 and 18, springs 17 and 16 to battery B, thence through battery B to ground G. The motor magnet 2, upon energizing, draws up the armature 20, causing the pawl 21 to engage the ratchet wheel 3 and rotate it at the same time that the spacing segment 10 is freed from the pin 11. The armature 20, being provided with the interrupter springs 18 and 19, causes the motor magnet 2 to operate in a manner simi-

lar to that of a buzzer, thus giving the ratchet wheel 3 a continual rotary motion as long as the spring 16 engages the spring 17. When the motor magnet relay 7 deenergizes, the armature 12 will not fall back to normal position until another opening in the spacing segment 10 is rotated beneath the pin 11. Until this occurs the energizing circuit through the motor magnet is maintained at the springs 16 and 17. Consequently, the shaft 9 will rotate as long as the wiper 6 strikes grounded contacts, or while the pin 11 of the armature 12 does not rest in one of the apertures of the cam 10. When the shaft comes to rest all the plungers engaging it are opposite a particular trunk line corresponding to the aperture occupied by the armature finger 11. The shaft is thereby locked and cannot be changed in position until the relay 7 is again energized. At the time that the spring 16 breaks contact with the spring 72 and closes with the spring 17, the spring 94 engages the spring 72, closing a circuit which gives the busy signal to a subscriber if all ten trunks are engaged, as will be described later.

The substation A of Fig. 2 may be of any suitable or approved type. In this instance it comprises the usual receiver 22, switch hook 23, induction coil 24, which consists of the primary winding 25 and secondary winding 26, transmitter 27, condenser 28, ringer 29, and impulse wheel 30 with the usual impulse teeth 31. The impulse wheel 30 is secured to the shaft 32, to which there is also secured the dial (not shown). When the dial is turned the impulse teeth 31 are adapted to engage the cam 33 upon the end of the spring 34 and thereby carry the latter out of engagement with the spring 35. Upon the switch hook 23 is secured the cam 36 which, when the switch hook is up, permits the springs 37 and 38 to engage, thereby bridging across the subscriber's line conductors 39 and 40 the primary circuit including the transmitter 27 in series with the primary winding 25. When, however, the switch hook is lowered the spring 37 is carried out of engagement with the spring 38 and into engagement with the spring 41, whereby the ringer 29 in series with the condenser 28 is bridged across the line conductors 39 and 40 instead.

The line switch C (Fig. 2) is a modified form of that described in British Letters Patent No. 26,301 of 1906. It comprises the coil 42 with three windings 43, 44 and 45 which may be designated as the trip winding, the line relay winding and the bridge-cut-off winding, respectively. The bridge-cut-off armature 46, when operated, shifts the springs 70 and 48 out of engagement with the springs 47 and 50, respectively.

The first selector switch E is of the general type described in United States Letters

Patent No. 815,321, granted March 13, 1906, to Keith, Erickson & Erickson, and, as shown, is modified to adapt it to operate in connection with a two-wire system. It embodies among other details the following features: The switch shaft (not shown) carries the vertical and rotary line wipers 51 and 52 and the private wiper 53. The side switch is well known and comprises the side switch wipers 54, 55, 56, 57 and 58 which may be designated as the vertical, rotary and private side switch wipers, the rotary magnet wiper and the bridge-cut-off wiper, respectively. The side switch is under the control of the private magnet 59; and the windings of the usual vertical and rotary line relays are, in this case, combined in one double-wound relay 60 comprising one winding 61 connected with the battery lead 74, and also with the vertical trunk line conductor, when the side switch wiper 54 is in first or second position. The second winding 62 is connected to ground, and also to the rotary trunk line conductor, when the side switch wiper 55 is in first or second position. Through the medium of this double-wound relay, and while the side switch is in first position, the subscriber controls the vertical magnet 63^a which operates to raise the switch shaft and wipers 51, 52 and 53. The line relay 60 also controls the private magnet relay 63, which latter in turn controls the private magnet 59. While the side switch is in second position the rotary magnet 64, which operates to give the switch shaft and wipers a rotary movement, is energized. The release magnet 65 provides means for restoring the selector switch to normal position. Upon the switch shaft which carries the wipers 51, 52 and 53 there is mounted the arm 66 which, when the shaft is raised one or more steps, permits the spring 67 to engage the contact point 68, whereby the release magnet 65 is connected to the battery lead. The release relay 69 is provided for closing the energizing circuit of the release magnet 65 after the switch is operated. Furthermore, the relay 69, upon energizing, provides an energizing circuit for the cut-off relay winding of the line switch to maintain the latter in its operated position.

The operation of the master switch O may be better understood by showing at what point it enters into the process of making a call. When the receiver is removed from the hook, preliminary to the pulling down of the dial for the first digit of a called subscriber's number, the cam arm 36 permits the spring 37 to engage the spring 38, thereby removing the ringer from across the line and bridging the primary circuit instead. When the primary circuit is thus bridged across the line an energizing circuit is completed for the line relay winding 44, said

circuit extending from ground G^3 through the springs 47 and 70 to the line conductor 40, through the primary circuit of the substation to the line conductor 39, through the springs 50 and 48, winding 44, springs 72 and 16 to battery B, thence through battery B to ground G. The relay winding 44, upon energizing, attracts the armature 73 and thereby closes contact between the springs 47 and 49. When this occurs an energizing circuit is established through the trip-in winding 43 of the coil 42. This circuit extends from ground G^3 through the springs 47 and 49, trip-in winding 43 to the contact point 72, spring 16, to the battery lead 74, thence through battery B to ground G. On becoming energized the winding 43 attracts the armature 46 and the plunger arm 75. The armature 46 acts to separate the springs 70 and 48 from the springs 47 and 50, respectively, disconnecting the line conductors 40 and 39 from the line switch coils. The plunger arm 75 serves to thrust the plunger (not shown) into the bank terminal of an idle trunk, pressing the bank springs into contact, said springs represented in Fig. 2 by springs 76 and 77, 78 and 79, 80 and 81, and 82 and 83. The engagement of the springs 76 and 77 and 82 and 83 extends the subscriber's line conductors 39 and 40, respectively, to the line relay 60 of the first selector switch E. When the bank springs 80 and 81 engage, an energizing circuit is established through the busy trunk relay over the trunk c from ground G^4 , which results in the operation of the master switch, as hereinbefore described, to carry the wiper 6 to the next non-grounded contact. Until the line switch has been released, and the master switch returns to the original position from which the plunger was released, the operation of the line switch or of the instrument A in no way affects the master switch. The subscriber at substation A proceeds to rotate his dial and make his call in the regular manner, operating the first selector E to connect his line with another switch, or other switches, according to the numeral of the called subscriber.

When the line conductors 39 and 40 are extended to the first selector by the closing of the bank springs 76 and 77, 82 and 83, a circuit is completed extending from ground G^5 through the winding 62 of the relay 60 to the side switch wiper 55, thence over conductor 84, through the bank springs 83 and 82, line conductor 40, through the substation A, thence back over the line conductor 39, through the bank springs 76 and 77, conductor 85, through the side switch wiper 54, winding 61 of the line relay 60 to the battery lead 74, thence through battery B to ground G. The line relay 60 is energized and separates the spring 86 from the spring 87 and places it in contact with

the spring 88. A circuit is thus closed through the releasing relay 69, said circuit extending from ground G^6 through the springs 86 and 88, relay 69 to the battery lead 74, thence through battery B to ground G. The releasing relay, in energizing, closes contact between the springs 89 and 90, thereby completing a circuit from ground G^7 through the side switch wiper 58, springs 90 and 89, bank springs 79 and 78, through the bridge-cut-off winding 45 of the line switch coil 42 to the battery lead 74, thence through battery B to ground G. This circuit is maintained as long as the receiver is off the hook, ground being obtained at G^7 through the side switch wiper 58 in the first and second positions, and over the release trunk 91 when the side switch is in third position. The winding 45 of the coil 42 holds down the armature 75 and retains the plunger in the bank until the connection is released. When the receiver is returned to the hook, ground is removed from the release trunk 91 by the release of the switch succeeding the selector E. Consequently, the releasing relay 69 deenergizes and closes a circuit through the release magnet 65 as follows: From ground G^6 through the line relay springs 86 and 87, springs 92 and 93, release magnet 65, contact point 68, spring 67 to the battery lead 74, thence through battery B to ground G. The armature of the release magnet, pulling up, restores the side switch and shaft to their normal positions. As the shaft drops to its original position the finger 66 of the shaft breaks the contact between the contact point 68 and the spring 67 and allows the release magnet to deenergize. When the releasing relay 69 deenergizes, the circuit through the bridge-cut-off coil 45 is broken by the separation of the springs 89 and 90. The bridge-cut-off winding deenergizes, allowing the spiral spring 95 acting upon the arm 75 to withdraw the plunger from the bank. The bank springs thus separate, and ground is removed from the trunk c (by the separation of the springs 80 and 81) leading to the master switch bank contact upon which the wiper 6 was resting just previous to the call. The trunk lines corresponding to this contact are now free to be seized by the same or another subscriber as soon as the master switch in its rotation brings the plungers again over said trunk. If all the ten trunks c of the master switch bank are grounded, as will be the case when all the trunks from the line switch banks are engaged, the master switch will continue to rotate until some trunk is disengaged. Should a subscriber attempt to make a call at this time he will receive the busy signal. The motor magnet relay 7 will be energized by the busy trunk relay 8, which is energized as long as the master switch wiper continues to

engage busy trunks. Consequently, the springs 72 and 94 will remain in contact, and the spring 16 will continue separated from the spring 72 and in contact with the spring 17. The line switch of the subscriber will, therefore, not be operated, since battery current is cut off from the line by the separation of the springs 72 and 16. A circuit will then be maintained from the line conductor 39 through the springs 50 and 48, line relay winding 44, springs 72 and 94, condenser 100, secondary winding 96 of the transformer 97 to the battery lead 74, thence through the battery B to ground G. The busy machine 98, sending ground impulses through the primary winding 99 by induction, thus transmits the signal to the subscriber's line.

It is understood, of course, that the ground represented at the right of the private wiper 53 is not present until the side switch reaches its third position. When the side switch wipers 54 and 55 extend the trunks 85 and 84 through the shaft wipers 51 and 52 to the next switch, the line relay and release relay of that switch operate to ground the private bank contact on which the wiper 53 is resting in the same manner in which the first selector E grounds the bank contact 79 when the line switch C is operated.

From the foregoing it will be seen that the means consisting of the apertured segment 10 and the relay-controlled locking pin 11 constitute a device for not only locking the master switch while it is at rest, but also for maintaining the motion of the master switch while passing from one trunk to another. This device also governs the means for giving the busy signal to the calling subscriber in the event that all of the trunks to which his line switch has access are busy. If a subscriber calls when the master switch is in motion he receives the busy signal, in the manner explained.

It will also be seen that my invention is disclosed in connection with a system of that character in which the subscribers are divided into groups, and in which connectors may be employed having vertical motion to select groups, and then rotary motion to find the called line in any selected group. Each group may be made up of ten subscribers, and the ten levels constitute the larger group of one hundred subscribers. The trunks are also divided into groups, so that the selectors have vertical motion to select groups, and then rotary motion to find an idle trunk in any selected group. It will be understood that this principle of trunking can be carried out to any desired extent as by using first and second selectors, or even third and fourth and other selectors, depending upon the size or ultimate capacity of the exchange.

What I claim as my invention is:—

1. In a telephone system, a line-switch-governing master switch provided with automatic means for positively locking the same against motion while at rest, and means for unlocking the same when said switch is operated. 70

2. In a telephone system, a line-switch-governing master switch provided with a controlling relay, a device for locking the master switch against motion while at rest, an automatic means for unlocking said master switch by the energizing of said relay. 75

3. In a telephone system, a line-switch-governing master switch provided with a propelling magnet, a device for positively locking the master-switch against motion while at rest, automatic means for unlocking said device, and automatic means whereby the said device when unlocked maintains the circuit of said magnet closed at one point to insure the operation of the master switch. 85

4. In a telephone system, a line-switch-governing master switch provided with a propelling magnet, and means including a back and forth operating or swinging member provided with openings and contacts controlled thereby whereby the energizing of the said magnet is interrupted at intervals, and the master switch positively locked against motion while at rest. 95

5. In a telephone system, a line-switch-governing master switch provided with a propelling magnet, a relay controlling said magnet, a device operated by the master switch to mechanically control the operation of said relay, and another relay controlling said first-mentioned relay. 100

6. In a telephone system, a line-switch-governing master switch provided with a propelling magnet, a relay controlling said magnet, said relay having an armature, a device operated by the master switch and co-operating with said armature to govern the energizing of said magnet, and means controlling the energizing of said relay. 110

7. In a telephone system, a line-switch-governing master switch provided with a relay having normally open contacts, and a busy signal controlled by said contacts, whereby a calling subscriber will receive the busy signal if the call is made while the said contacts are closed. 115

8. In a telephone system, a line-switch-governing master switch provided with a relay controlling the operations thereof, a device operated by the master switch to govern the control exercised by said relay over the master switch, and automatic means controlled by said relay for giving the calling subscriber the busy signal if the call is made while the master switch is in motion. 125

9. In a telephone system, a line-switch-governing master switch provided with an oscillating shaft, automatic means for posi- 130

tively locking said shaft against motion while at rest, and a relay for operating said means to unlock the shaft.

5 10. A telephone system including a line-switch-governing master switch provided with a propelling magnet for moving said switch into a plurality of positions, a relay for controlling the circuit of said magnet, an arc-shaped rack operated by the movement
10 of said switch having a plurality of openings corresponding to the various positions of said switch, and means controlled by said rack to control the circuit of said operating magnet so as to insure the proper operation
15 of said switch.

11. In a telephone system, a plurality of switches, trunks associated with said switches, a master switch provided with automatic means comprising a magnet for locating an idle trunk, a relay for controlling
20

the circuit of said magnet, and automatic means independent of said relay for maintaining the circuit of said magnet closed at one point to insure the proper operation of the switch.

12. In a telephone system, a plurality of switches, trunks associated with said switches, a master switch provided with automatic means comprising a magnet for locating an idle trunk, a relay for controlling
30 the circuit of said magnet, and automatic means operated by said switch for also controlling the circuit of said magnet to insure the operation of said switch.

Signed by me at Chicago, Cook county, Illinois, this 24 day of May, 1909.

OTTO V. OLSON.

Witnesses:

ARTHUR J. RAY,
EDWARD D. FALES.