H. H. IDE.

AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED JULY 29, 1918.

1,413,027.

Patented Apr. 18, 1922.

4 SHEETS—SHEET 1.

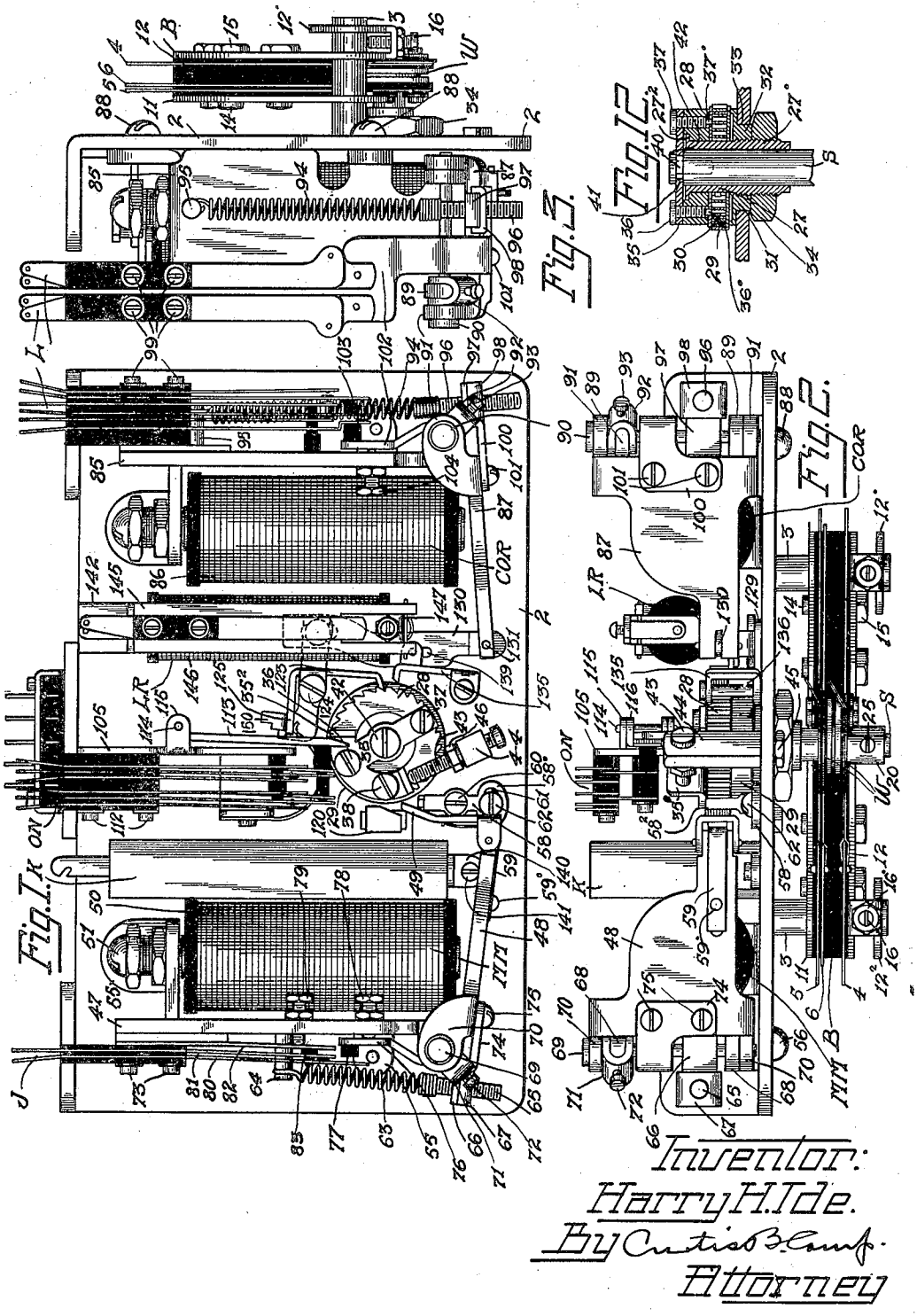

Fig. 1.

Fig. 1C.

Fig. 2.

Inventor:
Harry H. Ide.
By Curtis B. Comfort.
Attorney

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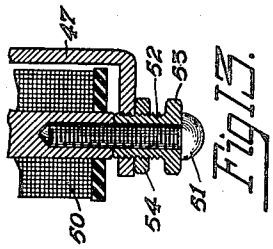


Fig. 6.

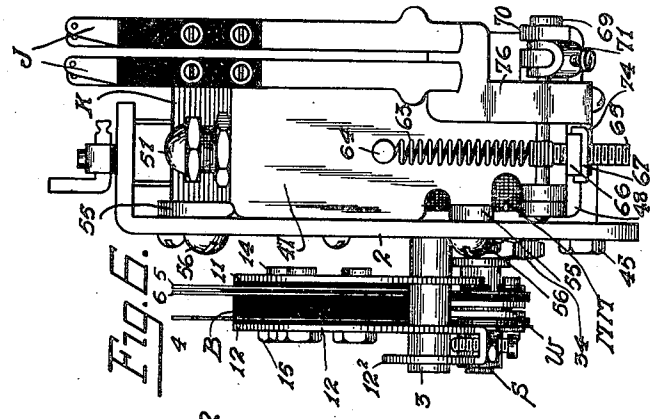


Fig. 5.

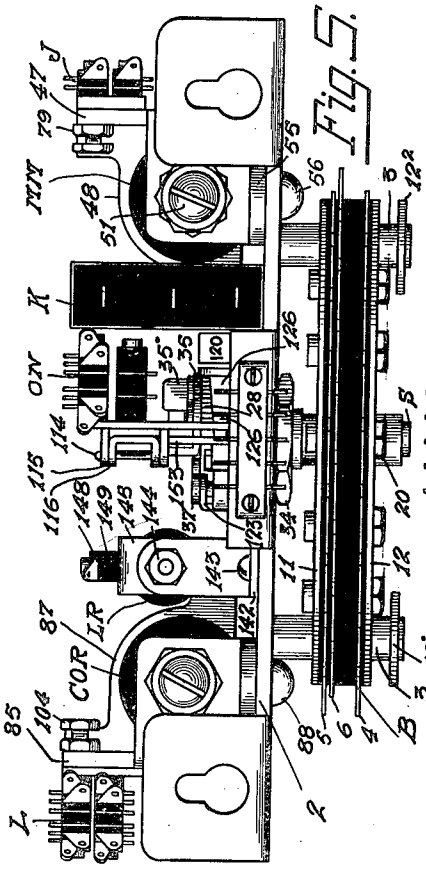
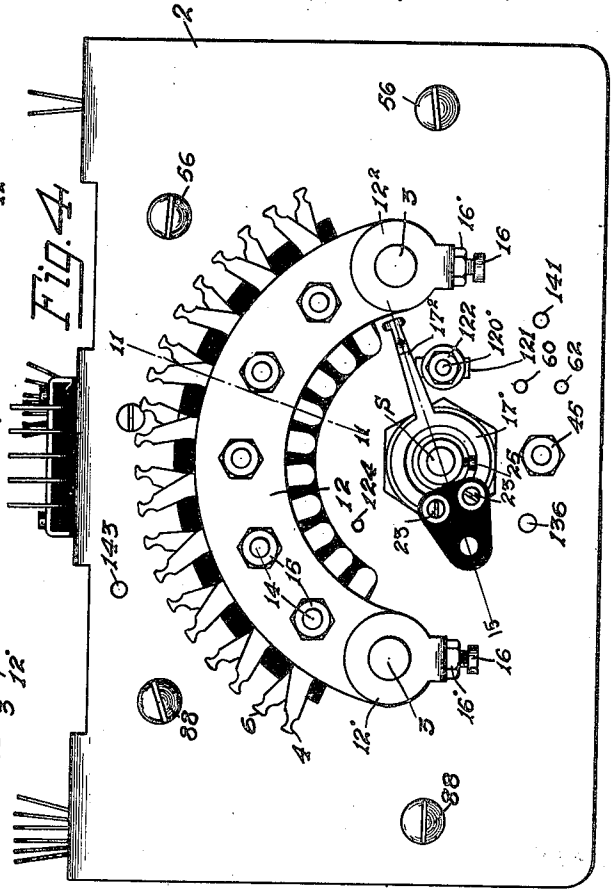


Fig. 4.



Inventor:
Harry H. Ide.
By Curtis B. Camp.
Attorney.

H. H. IDE.

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4 SHEETS—SHEET 3.

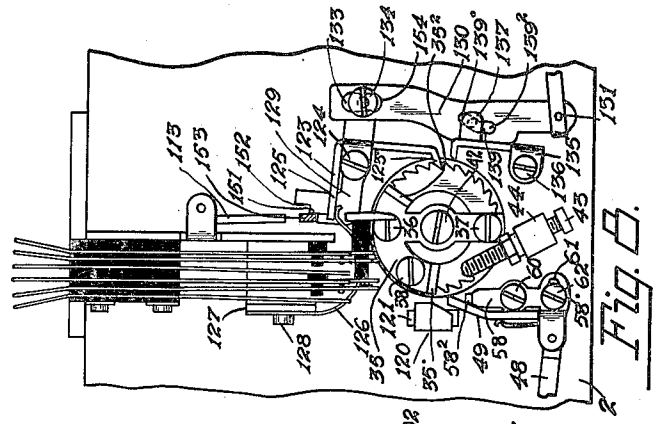

Fig. 8.

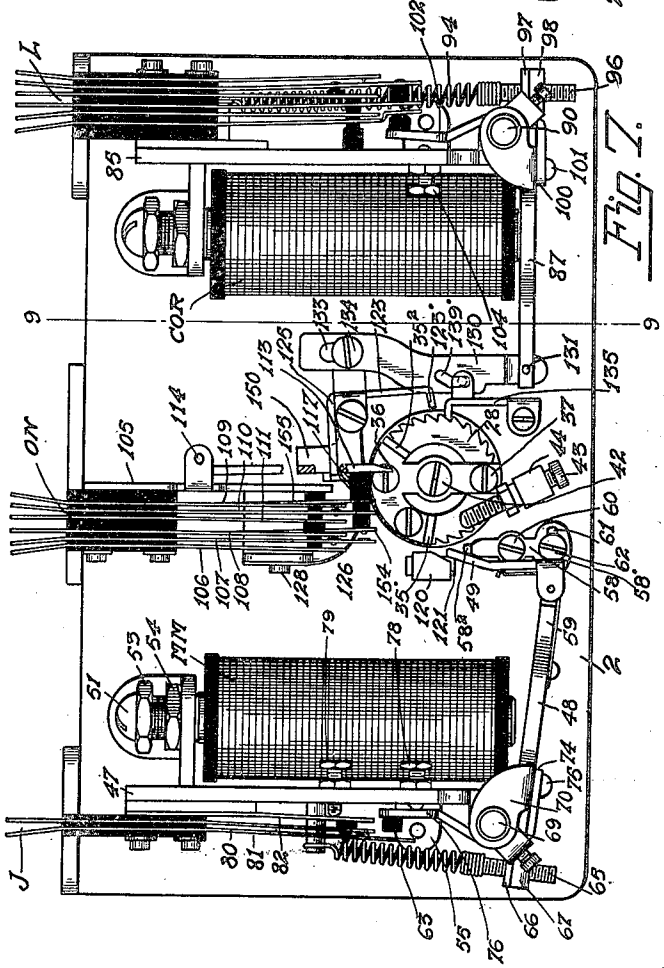

Fig. 7.

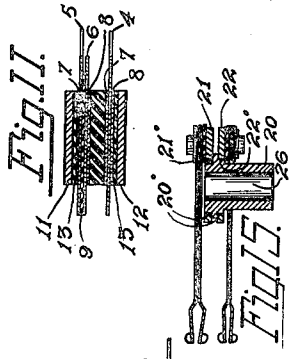

Fig. 11. Fig. 15.

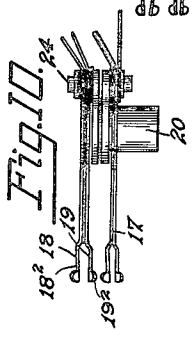

Fig. 10.

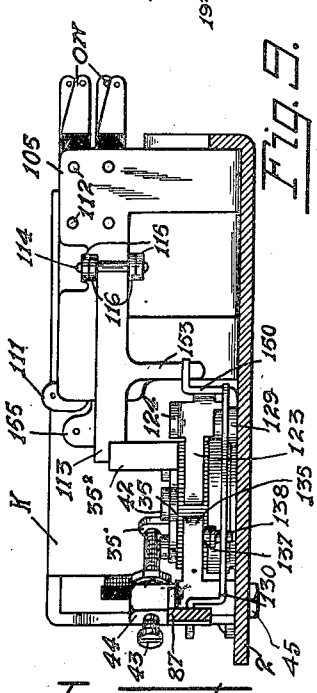

Fig. 9.

Inventor:
Harry H. Ide.
By Curtis B. Clark
Attorney

H. H. IDE.

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4 SHEETS—SHEET 4.

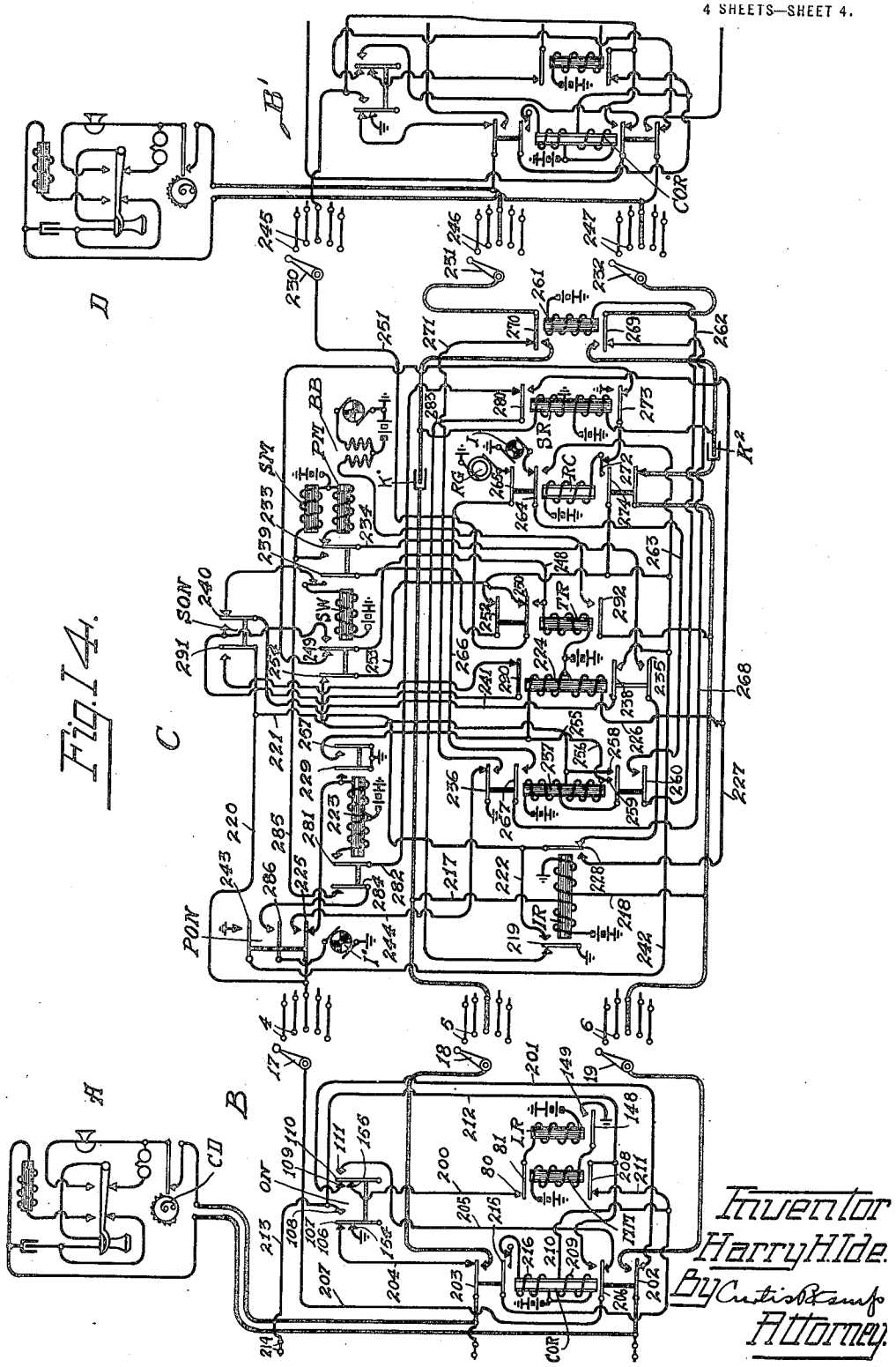

Fig. 1.

UNITED STATES PATENT OFFICE.

HARRY H. IDE, OF LA GRANGE, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

1,413,027. Specification of Letters Patent. Patented Apr. 18, 1922.

Application filed July 29, 1918. Serial No. 247,122.

To all whom it may concern:

Be it known that I, HARRY H. IDE, a citizen of the United States of America, residing at La Grange, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a specification.

My invention relates to telephone systems, and has to do more particularly with automatic or semi-automatic systems in which individual line switches are used for connecting a calling line to an idle trunk.

An object of my invention is to produce an improved switch and circuit arrangement which embodies desirable features and advantages, all in a simple, efficient and economical manner, which is most efficient and economical in its operation, and which has its parts so constructed and combined as to make them readily accessible for adjustment and repairs.

One of the features of my invention is the construction of the switch mechanism in several units which may be readily removed and quickly replaced by other assembled units.

Another feature of my invention is the method of controlling the off-normal switch contacts.

A still further feature of my invention resides in the method of adjusting the pawl guides, etc.

These and other features will be hereinafter more particularly described in the ensuing specification and in the appended claims.

For a better understanding of my invention, reference may be had to the accompanying drawings in which like reference characters denote like parts, and in which:

Fig. 1 is a plan view of the line switch of my invention;

Fig. 2 is a bottom view of Fig. 1;

Fig. 3 is a right side view of Fig. 1;

Fig. 4 is a rear elevation of Fig. 1;

Fig. 5 is a top view of Fig. 4;

Fig. 6 is a right side view of Fig. 4;

Fig. 7 is a plan view of the line switch showing it in an off-normal position with parts removed to more clearly show the apparatus;

Fig. 8 is a view with parts broken away, showing the pawl and ratchet arrangement for advancing the switch wipers and also illustrating one of the positions of the off-normal springs;

Fig. 9 is a sectional view along the line 9—9 of Fig. 8;

Fig. 10 is a view of the wipers;

Fig. 11 is a sectional view along the line 11—11 of Fig. 4;

Fig. 12 is a sectional view of the main shaft showing its construction;

Fig. 13 is a sectional view showing the method of mounting the magnet coils;

Fig. 14 illustrates diagrammatically an automatic telephone system including the line switch of my invention; and

Fig. 15 is a sectional view along the line 15—15 of Fig. 4.

Referring now more particularly to the structure as illustrated in Figs. 1 to 13, inclusive, and Fig. 15, the line switch of my invention comprises a mounting plate 2 to which are secured the operating magnets and movable parts of the line switch. The plate 2 also carries a bank of contacts B, the said bank of contacts B co-operating with a set of wipers W, which wipers W are supported upon a shaft S. A motor magnet MM, a combined line and interrupter relay LR, and a cut-off relay COR are also supported by the mounting plate 2, as is also certain other apparatus which will be more fully herein-after described.

To support the bank of contacts B upon the plate 2, posts 3 are provided which are secured to the bottom face of the plate in any suitable manner, and the said bank of contacts B, as a whole, is adjustably secured to the posts 3, as will be presently described.

The bank of contacts B comprises the private bank contacts 4, and two sets of line bank contacts, namely, the vertical and rotary contacts 5 and 6. The private contacts 4 and vertical and rotary contacts 5 and 6 are arranged in horizontal rows, there being ten sets of contacts, each set of contacts including a vertical and a rotary line contact and a private contact. The vertical and rotary and private contacts are radially disposed and are placed between strips of insulation cloth 7 and 8, the vertical and rotary contacts 5 and 6 having a strip of insulation material 9, such as micarta or other

suitable material, placed between the said vertical and rotary contacts to properly space and insulate them. The private contacts 4 are also placed between strips of cloth insulation 7 and 8, and a strip of insulation material 10 is placed between the row of rotary contacts 6 and the row of private contacts 4 to properly space them. The three rows of contacts, containing private, vertical and rotary contacts 4, 5 and 6, are placed between the clamping plates 11 and 12, and a strip of insulation 13 is placed between the plates 11 and 12 and the contacts to properly insulate the contacts from the clamping plates 11 and 12. Bolts 14 and nuts 15 form the clamping means for securing the rows of contacts together, as a whole, between the plates 11 and 12 to form the contact bank B.

To secure the bank of contacts B to the supporting posts 3, I provide the lower clamping plate 12 with ears 12′ and 12^2, preferably formed integral with the said plate 12. The ears 12′ and 12^2 are bent over parallel to the plane of the plate 12 proper. The ears 12′ and 12^2 of the plate 12, and the plates 11 and 12 are provided with openings of a size to receive the posts 3. The contact bank B, as a whole, is slipped on the posts 3, and when the bank is in a desired position the screws 16, which have screw-threaded engagement with the bridge portion of ears 12′ and 12^2, are tightened to maintain the bank of contacts B, as a whole, in its adjusted position. Lock nuts 16′ are provided, which, when he screws 16 are tightened, lock the screws to prevent them from loosening and allowing the bank B to shift.

Adapted to co-operate with the private and line bank contacts 4, 5 and 6, are the bank wipers or active contacts 17, 18 and 19. The private wiper 17, vertical wiper 18 and rotary wiper 19 are mounted upon a shaft S and suitably insulated therefrom. A wiper carrying hub 20 is provided for carrying the wipers 17, 18 and 19. The said hub is provided with shouldered portions 20′, and a pair of disks 21 and 22 are provided with openings 21′ and 22′ of a size to receive the shouldered portions 20′, of the hub 20. When the disks 21 and 22 are in position on the hub 20, the shouldered portions 20′ protrude slightly, and the protruding portion is turned over in any suitable manner by means of staking to securely attach the disks 21 and 22 to the hub 20.

The line wipers 18 and 19, and the private wiper 17, are similarly constructed and the description of one is sufficient. The private wiper 17 has a ring-shaped body portion 17′ and an extending arm 17^2 in the form of a wiper with a flared end for contacting purposes with the private contacts 4. The said private wiper 17 is fastened to the disk 22 by means of screws 23, but suitably insulated from the disk 22 and screws 23, the said screws 23 having screw-threaded engagement with suitable tapped openings in the disk 22.

The line wipers 18 and 19 are similarly constructed and are provided with extending arms 18^2 and 19^2 in the form of wipers, which arms are provided with flared ends for contacting with the vertical and rotary bank or passive contacts 5 and 6, respectively. The wipers 18 and 19 are suitably insulated from each other and the disk 21, and are mounted upon the said disk 21 by means of screws 24. The screws 24 have screw-threaded engagement with suitable tapped openings in the disk 21 and are suitably insulated from the said wipers. The hub 20 is provided with a set screw 25 which has screw-threaded engagement with a suitable tapped opening in the hub. The wipers 17, 18 and 19, and hub 20, as a whole, are slipped over the shaft S, the said hub being provided with a central opening 26 for this purpose, and when the wipers are adjusted in alignment with the contacts 4, 5 and 6, respectively, the set screw 25 is tightened to hold the wiper unit W in its adjusted position upon the shaft S.

A cylindrical sleeve 27 is provided which is supported by the plate 2 and serves as a bearing for the shaft S. The sleeve 27 also acts as a bearing for the ratchet 28 which operates to rotate the shaft S to rotate the wipers W over the contacts of the bank B. A spring casing or drum 29 is also mounted upon the sleeve bearing 27, and carries a spiral spring 30, the said spring 30 having one end fastened to the spring casing 29 and the other end fastened to the sleeve 27. The tension of the spring 30 is such that it has a tendency to hold the shaft S in its normal position.

The sleeve 27 has its one end 27′ threaded and its other end is provided with a flanged portion 27^2, the said flanged portion resting in a recess in the ratchet 28. A collar 31 is threaded onto the sleeve 27, and its upper peripheral surface forms a bearing for the spring casing 29 which contains the restoring spring 30. The lower portion of the collar 31 is provided with a reduced portion 32 which fits into a suitable opening 33 in the mounting plate 2. I provide a nut 34 which has screw-threaded engagement with the threaded portion 27′ of the sleeve 27, and when a proper adjustment of the ratchet 28 and parts is obtained, the nut 34 is tightened to secure the sleeve and supported parts in their adjusted position. A plate 35 is secured to the ratchet by means of screws 36, 37 and 38, the said screws 36 and 37 having reduced ends 36′ and 37′ in the form of pins. The screws 36 and 37 have screw-threaded engagement with suitable tapped openings

in the ratchet 28 and the reduced ends 36′ and 37′ enter suitable openings in the spring casing 29 to keep the said spring casing 29 and the ratchet 28 in proper relation. The screw 38 has screw-threaded engagement with a suitable tapped opening in the ratchet 28 to secure the plate 35 to the ratchet 28. The shaft S is provided with a squared portion 40 at its upper end which enters a square opening 41 in the plate 35. A screw 42 having screw-threaded engagement with a tapped opening in the shaft S secures the plate 35 to the shaft S for purposes to be presently described. A rectangular post 44 is provided which is suitably fastened to the mounting plate 2 in any suitable manner, as by means of the nut 45. An adjustable screw stop 43 is provided which has screw-threaded engagement with a tapped opening in the post 44, and a lock nut 46 is provided which locks the screw stop 43 in its adjusted position in the post 44. The plate 35 is provided with an upturned portion 35′ which is adapted to engage the screw stop 43 so that when the shaft S is in its normal position the portion 35′ rests against the screw stop 43 to limit the restoring movement of shaft S.

The motor magnet MM, which is adapted to move the shaft S and wipers 17, 18 and 19 over the contacts 4, 5 and 6, includes a pole piece 47, an armature 48, and a driving pawl 49. The electromagnet 50 is suitably secured to the pole piece 47 by means of a screw 51 which passes through a stud 52, the said screw 51 having screw-threaded engagement with a suitable tapped opening in the core of the magnet 50. The stud 52, through which the screw 51 passes, serves as an adjusting means for the magnet 50 in a forward or backward direction and has screw-threaded engagement with a suitable tapped opening in the heel iron 47, the other end of the stud 52 being provided with an integrally formed hexagonal head 53. To adjust the electromagnet 50, the screw 51 is loosened and the stud 52 turned to the right or left, as the case may be, to properly adjust the magnet 50, and when this adjustment is obtained a lock nut 54 is tightened to hold the stud 52 in its adjusted position. The pole piece 47 has projecting ears 55 bent at right angles to the main part of the said pole piece, the said ears having suitable tapped openings which receive screws 56 to fasten the magnet 50 and pole piece 47, as a unit, to the mounting plate 2. The pole piece 47 is provided with projecting ears 68, bent at right angles to the main part of the pole piece, the said ears having suitable openings to receive a pivot pin 69, which pivot pin pivotally supports the armature 48 of the motor magnet MM. The armature 48 is also provided with ears 70 which have suitable openings to receive the said pivot pin 69. A U-shaped member 71 is also provided, the arms of which also have suitable openings for receiving the pivot pin 69. To pivotally support the armature 48 upon the pole piece 47, the pivot pin 69 is inserted through the openings in the ears 68 of the pole piece 47 and ears of the armature 48, and through the openings in the arms of the U-shaped member 71. One arm of the member 71 fits between one of the supporting ears 68 of the pole piece 47 and the adjacent ear 70 of the armature 48. A set screw 72 is provided and has screw-threaded engagement with the yoke end of the U-shaped member 71 and when the screw 72 is tightened it engages the ear 61, drawing pin 69 against the opening in the ears 70 and 68, and thus holds the pin 69 in position. The set screw 72 is used to securely hold the pivot pin 69 in place relative to the heel iron 47 and armature 48.

The armature 48 carries a pivoted pawl 49 which is normally held against an adjustable stop 58 by means of a leaf spring 59, the said leaf spring being held in place by means of a screw 59′. The adjustable stop 58 is pivotally secured to the mounting plate 2 by means of a screw 60. The stop 58 has an enlarged end 58′ provided with a slot 61, through which the screw 62 passes. To adjust the pawl 49, the screws 60 and 62 are loosened and the stop 58 is then moved about the pivoted screw 60, causing the upturned portion 58^2 to move to the right or left, as the case may be, and when the proper adjustment is obtained the screws 60 and 62, which have screw-threaded engagement with suitable tapped openings in the plate 2, are tightened to hold it in its adjusted position. The armature 48 is held in its normal position by means of a coiled spring 63, the said coiled spring 63 having its one end fastened to a pin 64 which is staked to the pole piece 47, and the other end of the spring 63 is secured to an adjustable screw 65. The screw 65 passes through a suitable opening in the arm 66, which arm is integrally formed with the armature 48, the said screw being provided with an adjustable nut 67. The tension of the spring 63 is regulated by means of the nut 67. A set of contact springs J are associated with the motor magnet MM, the said springs being insulatingly mounted upon the pole piece 47 by means of screws 73 which are suitably insulated from the springs J. A plate 74 is suitably mounted upon the face of the armature 48 by means of screws 75 and is provided with an angularly extending arm 76, preferably formed integrally with the plate 74. The arm 76 is provided with a rubber buffer 77 which operates the springs of the set J upon the attraction of armature 48 when

the magnet MM is energized. An adjustable screw stop 78 is provided, which screw has screw-threaded engagement with the pole piece 47 and acts as a stop for the arm 76 when the said arm is in its normal position. An adjustment screw 79 is provided and has screw-threaded engagement with the pole piece 47, and is used for adjusting the normal position of springs 80 and 81. A leaf spring 82 is provided and is mounted upon the pole piece 47 by means of the screws 73. A rubber buffer 83 is carried by spring 81 and is used to prevent the said spring 81 from contacting with spring 80. The springs 80 and 81 may be adjusted so that they are separated upon a partial attraction of the armature 48, or not until a full attraction of the armature 48 takes place. This adjustment of the springs 80 and 81 of relay MM is for the purpose of timing the instant at which the line relay LR has its circuit interrupted, as will be more fully herein-after described.

The pawl 49 is adapted to engage a tooth of the ratchet 28 upon each actuation of the motor magnet MM, and an adjustable post 120 is provided to limit the stroke of the pawl 49 so that the wipers 17, 18 and 19 are only advanced one step at a time. The post 120 has a threaded stud 120′ which passes through a suitable slot 121 in the plate 2. The stop 120 may be moved forward or backward as the case may be, and when the desired adjustment is obtained a nut 122 having screw-threaded engagement with the stud 120′ is tightened to securely hold the stop in its adjusted position.

The cut-off relay COR includes a pole piece 85, electromagnet 86, and an armature 87. The magnet 86 is adjustably mounted to the pole piece 85 in a manner similar to that previously described in connection with the motor magnet MM. The electromagnet 86 and pole piece 85, as a unit, are fastened to the mounting plate 2 by means of the screws 88. The pole piece 85 is provided with projecting ears 89 bent at right angles to the main part of the pole piece, and the said ears have suitable openings to receive the pivot pin 90, which pin pivotally supports the armature 87 of the relay COR. The armature 87 is provided with ears 91, and a U-shaped member 92 is also provided having a set screw 93. The pivot pin 90 pivotally supports the armature 87 in a manner similar to that previously described in connection with the motor magnet MM so that when the armature 87 is in position, and pin 90 inserted, and the set screw 93 tightened, the armature 87 is positioned as previously described in connection with relay MM. The armature 87 is held in its normal position by means of a coiled spring 94, the said coiled spring 94 having its one end fastened to a pin 95 which is staked to the pole piece 85, and its other end is secured to a screw 96. The screw passes through a suitable opening in the arm 97, which arm is formed integrally with the armature 87, the said screw being provided with an adjustable nut 98, the tension of the said coiled spring being regulated by means of a nut 98. A set of contact springs L are associated with the cut-off relay COR, the said springs being insulatingly mounted upon the pole piece 85 by means of screws 99 which are suitably insulated from the springs. A plate 100 is provided and suitably mounted upon the face of the armature 87 by means of screws 101, the said plate 100 being provided with an angularly extending arm 102 preferably formed integrally with the plate 100. The arm 102 is provided with a rubber buffer 103 which operates the springs of set L upon the attraction of armature 87 when the relay COR is energized. An adjustable screw stop 104 is provided, which screw has screw-threaded engagement with the pole piece 85, the said stop 104 acting as a stop for the arm 102 when the arm is in its normal position. I provide a set of off-normal contacts ON which are moved to their alternate position upon the first movement of the switch shaft S off normal. An angular mounting plate 105 is provided, being suitably fastened to the main mounting plate 2, upon which the off-normal contacts 106, 107, 108, 109, 110, 111, 154 and 155 are insulatingly mounted by means of screws 112. An angular extension 35^2 of the plate 35, when the shaft S and wipers W are in their normal position, engages an arm 113 pivotally supported on the plate 105 by means of a pivot pin 114 to hold the springs in their normal position. The arm 113 is supported between ears 115 formed integrally with the plate 105, the pivot pin 114 passing through suitable openings in the ears 115 and 116 on arm 113 to support the arm 113 in position. A buffer 117 carried by the arm 113 engages the springs to hold them in their normal positions. Upon the first step of the wiper off normal, the extension 35^2 disengages the arm 113, allowing the springs ON to assume an alternate position, as most clearly illustrated in Fig. 8. Some of the said springs are moved to another alternate position upon attraction of the relay COR, as will be hereinafter more fully explained. The off-normal contacts ON are again restored to normal upon the restoration of the shaft S by the spring 30, due to the angular extension 35^2 again engaging the arm 113, moving it to the left to force the off-normal contacts ON into their normal position.

To hold the wipers in their advanced position, I provide a retaining pawl 123, pivotally secured to the plate 2 by means of the pivot screw 124. The retaining pawl 123 is provided with an arm 125, preferably

formed integrally therewith, and a leaf spring 126 has its one end suitably fastened to a bracket 127, which is preferably formed integrally with the plate 105, by means of a screw 128. The free end of the spring 126 engages the arm 125 of the pawl 123 to force the nose 123′ of the pawl 123 into engagement with a notch in the ratchet 28. Associated with the retaining pawl 123 is a pivoted bar 129 pivotally secured to the plate 2 by means of the pivot screw 124, which screw also pivotally secures the pawl 123, as before mentioned. A link 130, associated with the relay COR for purposes as will presently be described, has its one end pivotally secured to the armature 87 by means of a pivot pin 131, and its other end is provided with a suitable slot 133, through which a screw 134 passes, the said screw 134 having screw-threaded engagement with a suitable tapped opening in one end of the bar 129 to slidably connect the said link 130 with the bar 129. A pawl 135, pivotally secured to the mounting plate 2 by means of the pivot screw 136, is normally held out of engagement with the ratchet 28. The pawl 135 is provided with an angular extension 137 and has a pin 138 secured thereto in any suitable manner, as by staking. A slot 139 having an angular portion 139′ is cut in the link 130, and normally the pin 138 of pawl 135 rests in the portion 139′ of the slot, thus holding the pawl 135 out of engagement with the ratchet.

The bar 129 has an angularly-shaped extension 150, which extension is provided with a pair of notches 151 and 152. These notches co-operate with a downwardly extending arm 153 of arm 113 so that upon the first step of the shaft S off normal, the extension 35^2 disengages arm 113, allowing the said arm 113 to move to the right, allowing arm 153 to engage notch 151 of the extension 150 of bar 129, and also allowing off-normal contacts to assume an alternate position. Upon the energization of the cut-off relay COR, the link 130, being pivoted to the armature 87, is moved backward causing the pin 138 to leave the angular portion 139′ of the slot 139 and enter the vertical portion 139^2 of the slot 139. This causes the pawl 135 to rotate about its pivot screw 136, moving the nose of the said pawl 135 into engagement with a tooth of the ratchet 28. As the link continues in its movement, due to the movement of the armature 87, the end 154 of the slot 133 engages the screw 134 which loosely connects the bar 129 and link 130, causing the bar 129 to be moved about its pivot screw 124. The angular extension 150 engages the arm 125 of the pawl 123, causing it to rotate about its pivot screw 124, causing its nose to disengage the tooth of the ratchet 28. The pawl 135 engages a tooth of the ratchet 28 before the pawl 123 disengages a tooth of the ratchet 28 to prevent a premature release of the switch. The bar 129 being pivoted by the pivot screw 124, the end provided with the extension 150 moves forward causing the extension 153 of arm 113 to disengage notch 151 and enter notch 152, bringing about circuit changes between the off-normal contact springs 107 and 154, and springs 110 and 155, as is most clearly illustrated in Fig. 7 and as will be more fully hereinafter described. Upon the release of the switch, the cut-off relay COR de-energizes, allowing the armature 87 to retract, drawing the link 130 forward, and the pin 138 again entering the angular portion 139′ of the slot 139 causes the pawl to rotate about its pivot screw 136 to withdraw its nose from engagement with a tooth of the ratchet 28. The shaft S being free to restore, the spring 30 restores the shaft S and wipers W to normal, and when the extension 35^2 again engages the arm 113 it moves it to the left and causes the extension 153 to leave notch 152. The spring 126 now acting against arm 125 moves bar 129 and pawl 123 to their normal positions, the said pawl 123 again engaging a tooth of the ratchet 28 and the extension 150 again resting against the extension 153. The arm 113 in moving to the left restores off-normal contacts ON to their normal positions.

A condenser K is mounted upon the mounting plate 2 by means of a bracket 140 suitably fastened to the condenser K and a screw 141 which passes through a suitable opening in the bracket 140. The said screw 141 having screw-threaded engagement with a suitable tapped opening in the plate 2, secures the condenser K to the mounting plate 2. A line relay LR is suitably supported by a bracket 142, which bracket is in turn secured to the plate 2 by means of a screw 143. The line relay LR is secured to the bracket 142 by means of the nut 144, which nut has screw-threaded engagement with the threaded extension of the core of the relay LR. The line relay LR comprises a heel iron 145, electromagnet 146, armature 147, and a pair of interrupter spring contacts 148 and 149, for purposes as will be presently described.

I represent diagrammatically in Fig. 14 a complete circuit arrangement necessary for connecting a calling subscriber to a called subscriber. The circuit shows a calling substation A terminating in an individual line switch B. The line switch B illustrates the circuit arrangement of the switch of my invention, and is adapted to select an idle connector C, the connector in turn being adapted to connect to the terminals of the called substation D. The called substation D also terminates in an individual line switch B′, similar to that of B. The substation A includes the usual talking ap-

paratus of a common battery telephone and, in addition, is supplied with a calling device CD to send series of impulses to operate the switch to select the called substation D.

The circuit shown for line switch B is a circuit adapted to work with the switch structure illustrated in the different figures. The cut-off relay COR, motor magnet MM, and the combined interrupter and line relay LR and off-normal contacts ON are shown diagrammatically only. The switch structure for connector C may be the same as illustrated and described in my application Serial No. 175,364, filed June 18, 1917.

Assuming now that a call is to be traced from the calling substation A to the called substation D, upon the removal of the receiver by the subscriber at the calling substation A, a circuit for the line relay LR of the individual line switch B is established, traced from battery through the winding of the relay LR, normal contacts 80 and 81 of the motor magnet MM, conductor 200, normal contacts 155, 110 and 109, conductor 201, normal contact 202 of relay COR, through the closed contacts of the substation switch hook, back through normal contact 203 of relay COR and conductor 204, to ground at normal contact 154 through contacts 106 and 107. The relay LR, upon energization, closes its contacts 148 and 149, closing an energizing circuit for the motor magnet MM, traced from battery through the winding of the magnet MM, through the now closed contacts 148 and 149 of relay LR to ground. The motor magnet MM attracts its armature 48, causing the pawl 49 to engage a tooth of the ratchet 28 and step the shaft S and wipers 17, 18 and 19 into engagement with the first set of contacts 4, 5 and 6. Upon the first step of the wipers off normal, the extension 35^2 of plate 35 disengages arm 113 and allows off-normal contacts ON to assume an alternate position; that is, contacts 106 and 107 are open, and contacts 107 and 108 are closed; contacts 109 and 110 are opened and contacts 110 and 111 are closed. Contacts 154 and 107 remain closed as do contacts 155 and 110 upon this movement of the off-normal contacts. Upon the energization of magnet MM, its contacts 80 and 81 are opened, opening the energizing circuit of the line relay LR, and the line relay LR restoring opens its contacts 148 and 149, opening the energizing circuit of the magnet MM. If the first set of contacts 4, 5 and 6 is idle, that is, if there is no ground on the private contact 4, the switch remains on the first set of contacts engaged. Should the first set be busy, there will be a ground upon the private contact 4, and another energizing circuit for the line relay LR is established, traced from battery through the winding of the relay LR, contacts 80 and 81, conductor 200, contacts 155, 110 and 111, conductor 205, normal contact 206 of relay COR, conductor 207, and wiper 17 to the grounded contact 4. The closing of contacts 148 and 149 of relay LR again closes an energizing circuit for the magnet MM, as before described, and the relay LR and magnet MM are thus alternately energized and de-energized to cause magnet MM to step the wipers 17, 18 and 19 from one set of contacts to the next as long as busy grounded contacts are encountered. The normal contact 208 of magnet MM is opened and closed upon each energization and de-energization of magnet MM, and upon each closure of normal contact 208 a circuit is closed through winding 209 of relay COR, traced from battery through the lower winding 209 of relay COR, conductor 210, conductor 211, normal contact 208, conductor 212, alternate contact 108 and contact 107, to ground at contact 154. The winding 209 of relay COR is of high impedance, and as the motor magnet MM energizes and de-energizes with great rapidity, the said winding 209 does not energize during the time that the motor magnet is operating. The ground at contact 154 is connected to the private normal contacts 214 of the connectors having access to the calling line to render the contacts busy, the ground extending over a circuit traced from contacts 154 and 107, through closed contact 108, over conductor 213 to said connector bank contacts 214. When an idle private contact 4 is encountered, relay LR and magnet MM remain at normal, and the closing of normal contact 208 of relay MM now establishes an energizing circuit for the relay COR, traced from battery through winding 209 of relay COR, conductors 210 and 211, contact 208 of said relay MM, conductor 212, and closed contacts 107 and 108 to ground at contact 154. The relay COR, upon energizing, closes its make-before-break contact 215, closing a circuit through the upper winding 216 of said relay COR, traced from battery through winding 216, make-before-break contact 215, conductor 211, contact 208, conductor 212, to ground at contact 154. This circuit through this winding gives the relay COR a positive energization, and the link 130 moves backward, due to the attraction of armature 87 rocking the bar 129 to bring about the withdrawal of pawl 123 from the ratchet 28, and moving causes the pawl 135 to move into engagement with the ratchet 28. The movement of the bar 129 causes the extension 153 of arm 113 to leave notch 151 and enter notch 152 in the extension 150 of bar 129. This movement permits contacts 107 and 110 of off-normal springs ON to move to their final position, thereby causing contacts 154 and 155 to break connection with contacts 107 and 110, respectively, but this movement does not affect the contacts closed upon the first step of the switch off normal. The

opening of contacts 154 with contact 107 opens the initial energizing circuit of relay COR, but the relay COR being slow to release is held up momentarily until a substitute circuit is established for the said relay COR, as will presently be described. The opening of contact 155 and contact 110 disconnects the line relay LR and motor magnet MM to prevent any further stepping of the switch. The circuit which is momentarily closed through the upper winding of relay COR is opened upon the full attraction of the armature of said relay COR.

The relay COR having been energized, its contacts 202 and 203 assume their alternate position, and as the wipers 17, 18 and 19 have engaged contacts 4, 5 and 6, leading to an idle connector, a circuit for impulse relay IR of connector C is established, traced from battery through the left-hand winding of relay IR, conductor 217, contact 5, wiper 18, alternate contact 203 of relay COR, through the substation A, back through alternate contact 202 of relay COR, wiper 19, contact 6, conductor 218, and through the right-hand winding of relay IR to ground. The closing of alternate contact 219 of relay IR closes the substitute circuit for the relay COR of line circuit B, traced from battery through the lower winding 209 of relay COR, conductors 210 and 211, normal contact 208 of relay MM, conductor 212, alternate contact 206 of relay COR, conductor 207, wiper 17, contact 4, conductors 220, 221 and 222, to ground at alternate contact 219 of relay IR.

The energization of the relay IR brings about the energization of the relays 223 and 224, the circuit of relay 223 extending from battery through the right-hand winding of said relay, normal contact 225 of the primary off-normal contact PON, conductor 220 and conductor 221 to ground at alternate contact 219 of relay IR. The circuit for relay 224 extends from battery through the lower winding of the relay 224, conductor 226, conductor 227, and alternate contact 228 of relay IR to ground at alternate contact 219 of impulse relay IR. Upon the energization of relay 223, a locking circuit is closed for the said relay, extending from battery through its alternate contact 229 to ground. Assuming that the called subscriber's number at substation D is 45, the subscriber now operates his calling device CD to send four impulses of current over the line. These four impulses bring about four energizations and de-energizations of the relay IR, causing the primary magnet PM to energize and de-energize four times to step the wipers 230, 231 and 232 in a downward primary direction to the fourth group of contacts containing the contacts of the called line. The circuit of the primary magnet PM may be traced from battery through the winding of the said magnet, normal contact 233 of switching relay SW, conductor 234, alternate contact 235 of relay 224, normal contact 228 of relay IR, conductor 221, conductor 220, and normal contact 225 of the primary off-normal contacts PON to ground at alternate contact 229 of relay 223.

After the primary off-normal contact 225 has moved on the first step of the switch shaft, the ground fed from contact 236 of relay 237 is substituted for the ground fed through contact 229 of relay 223. After the last impulse of the series has been sent, the steady flow of current through both windings of relay 224 causes the said relay 224, due to its differential action, to neutralize and restore its contacts to normal. Relay 224 does not restore during the sending of impulses due to its adjustment, construction, and the rapidity of the interruptions of contact 228. The closing of normal contact 238 of relay 224 brings about the energization of the switching relay SW traced from battery through the winding of said relay to make-before-break contact 239 of said relay, normal contact 240 of secondary off-normal springs SON, conductor 241, normal contact 238 of relay 224, and conductor 242 to ground at alternate contact 243 of primary off-normal contacts PON, the said primary off-normal contacts PON having been moved to their alternate position on the first step of the wipers 230, 231 and 235 of the connector switch. The closing of alternate contact 233 of the switching relay SW now renders the secondary magnet SM operative so that when the calling subscriber at the substation A actuates his call device again to send the last set of impulses, which we have assumed are five in number, the said magnet SM will be energized and de-energized by the impulse relay IR five times over a circuit traced from battery through the winding of the said magnet SM, alternate contact 233 of relay SW, conductor 234, alternate contact 235 of relay 224, normal contact 228 of relay IR, conductor 221, conductor 220, and alternate contact 225 of the primary off-normal contacts PON, and conductor 244 to ground at normal contact 236 of relay 237. The secondary magnet SM now steps the wipers 230, 231 and 232 in a secondary rotary direction to engage contacts 245, 246 and 247 of the called line. Upon the first impulse of the last set, the relay 224 again energizes to permit the secondary magnet SM to be operated, and after the last impulse the relay 224 is again de-energized, as previously described. The restoration of the relay 224 closes a circuit for the test relay TR traced from battery through the winding of the said relay, conductor 248, the alternate contact 249 of relay SW, alternate contact 240 of the secondary off-normal contacts SON, (said contacts having been

moved to their alternate position upon the first step of the wipers in their secondary direction), conductor 241, normal contact 238 of relay 224, conductor 242 to ground at alternate contact 243 of the primary off-normal contacts PON. The closing of alternate contact 250 of relay TR connects the said relay over conductor 251 to the test wiper 230, and should the called line be busy the private contact 245 of the called line would be grounded, thus closing a locking circuit for the said relay TR through the private wiper.

Called line idle.

Assuming that the called line is idle, private contact 245 of the called line will have a battery potential upon it, and the relay TR will not remain energized but will de-energize. The opening of normal contact 252 of relay TR opens the circuit of the switching relay SW. The relay SW de-energizing, opens the circuit for relay TR at its contact 249, leaving the relay TR dependent upon the potential found upon the private contact 245 of the called line for its holding potential; and, as assumed, this contact is free from ground potential, therefore the relay TR de-energizes and returns to normal. The relay TR de-energizing causes the energization of the relay 237 over a circuit which may be traced from battery through the cut-off relay COR′, to bank contact 245, through wiper 230, conductor 251, normal contact 250 of relay TR, conductor 253, normal contact 254 of relay SW, conductor 255, through the lower winding of the relay 237, and conductor 256 to ground at alternate contact 257 of relay 223. The closing of alternate contact 258 of relay 237 short-circuits the lower winding of the said relay, and the closing of alternate contact 259 of relay 237 closes a circuit through the upper winding of the said relay, through the alternate contact 259 and conductor 256 to ground at alternate contact 257 of relay 223.

The closing of alternate contact 260 of relay 237 connects the interrupter I to the relay 261. The circuit for relay 261 may be traced from battery through the winding of the said relay 261, conductor 262, alternate contact 260 of relay 237, conductor 263, normal contact 264 of relay RC and through the interrupter I to ground. The relay 261 is thus intermittently energized and de-energized, and upon each de-energization of the relay 261 the ringing generator RG is connected to the called line over a circuit extending from the ungrounded pole of the generator RG, through normal contact 265 of ringing control relay RC, conductor 266, alternate contact 267 of relay 237, conductor 268, normal contact 269 of relay 261, wiper 232, bank contact 247, through the condenser and call bell of the called substation, back through bank contact 246, wiper 231, normal contact 270 of relay 261, and conductor 271 to ground at alternate contact 236 of relay 237.

The call bell of the called subscriber at the substation D is thus intermittently rung, due to the energization and de-energization of the relay 261 by the interrupter I. When the called subscriber answers and the relay 261 is in its energized position, a circuit for the relay SR is closed, which may be traced from battery through the lower winding of the relay SR, through alternate contact 259 of relay 261, wiper 232, contact 247, through the now closed contacts of the substation switch hook at the called substation D, back through contact 246, wiper 231, alternate contact 270 of relay 261, and through the upper winding of the relay SR to ground. The relay SR, upon energizing, closes an energizing circuit for the ringing control relay RC, which may be traced from battery through the winding of the said relay and make-before-break contact 272 to ground at alternate contact 273 of relay SR. The closing of alternate contact 274 of relay RC closes a locking circuit for the said relay which may be traced from battery through the winding of the said relay, its alternate contact 274 and conductor 242 to ground at alternate contact 243 of the primary off-normal contacts PON. The opening of normal contacts 264 and 265 disconnects the interrupter I and the ringing generator RG to prevent further application of ringing current. A substitute circuit for the relay 261 is now established which may be traced from battery through the winding of the relay 261, conductor 262, alternate contact 260 of relay 237, conductor 263, alternate contact 264 of relay RC, and conductor 242 to ground at alternate contact 243 to primary off-normal contacts PON. The subscribers are now in conversational circuit, and the talking circuit may be traced over the heavily marked conductors, said conductors having the condensers K′ and K² interposed.

The subscribers having finished conversation, and assuming that the subscriber at the calling substation A is first to replace his receiver upon the switch hook, the opening of the switch hook contacts brings about the de-energization of the impulse relay IR of the connector C. The restoration of the relay IR brings about the opening of the holding circuit of the relay COR of the individual switch B, which relay COR restores, and the armature of relay COR moves the link 130 forward, causing the pawl 135 to disengage a tooth of the ratchet 28 due to the pin 137 entering the angular portion 139′ of the slot. The spring 30 now restores the wipers to normal, and when the

extension 35² engages the arm 113 it restores the off-normal contacts ON to normal and the spring 126 turns the bar 129 and pawl 123 about the pivot screw 124, allowing the bar to assume its normal position, and allowing the pawl 123 to again engage a tooth of the ratchet.

The subscriber D restoring his receiver upon its switch hook interrupts the circuit of the relay SR at the switch hook contacts, causing the said relay to de-energize. The closing of normal contact 280 of relay SR closes a circuit through the left-hand winding of the relay 223, which may be traced from battery through the left-hand winding of the said relay 223, alternate contact 281 of relay 223, conductor 282, normal contact 280 of relay SR and conductor 283 to ground at normal contact 219 of relay IR. Due to the differential construction of relay 223, the said relay neutralizes and restores to normal. The closing of normal contact 284 of relay 223 closes an energizing circuit for the secondary magnet SM, which may be traced from battery through the winding of said secondary magnet SM, conductor 285, normal contact 284 of relay 223, alternate contact 286 of the primary off-normal contacts PON, through the interrupter I′ to ground. The secondary magnet SM thus steps the wipers 230, 231 and 232 beyond the last set of contacts in the group. The wipers then restore to normal from this position by spring tension. The restoration of the relay 223 brings about the opening of the circuit of the relay 237 at alternate contact 257, and the relay 237 restoring opens the circuit of relay 261 at contact 260 of relay 237, and the primary off-normal contacts PON having restored upon the restoration of the switch, the opening of the alternate contact 243 of PON brings about the de-energization of the relay RC. The relay 223 also brings about the de-energization of the cut-off relay COR′ of the line switch B′ which is associated with the called subscriber D. All the apparatus used in establishing a connection between a calling subscriber at the substation A and the called subscriber at the substation D is now at normal and available for use in establishing other connections.

Assuming now that the subscriber at the called substation D was first to replace his receiver upon the switch hook, the opening of the switch hook contacts at the substation D brings about the de-energization of the relay SR. Nothing else happens at this time as the relay IR is still maintained energized over the line of the calling substation A. The calling subscriber at the substation A replacing his receiver interrupts the circuit of the impulse relay IR at the switch hook contacts. The relay IR de-energizing closes a circuit for the left-hand winding of relay 223, causing the said relay to de-energize, as herein-before described. The restoration of the individual switch B and connector C is the same as previously described from this point on. Should the called subscriber D fail to replace his receiver upon the switch hook after the conversation is terminated, the replacing of the receiver at the substation A brings about the de-energization of the impulse relay IR of connector C, the same as before, and the opening of alternate contact 219 of impulse relay IR opens the circuit of the relay COR of individual switch B as before described, and causes the release of switch B.

The subscriber at the called substation failing to replace his receiver, permits the continued energization of the relay SR, thus holding the contact 280 of said relay in its alternate position, preventing the differential wound relay 223 from restoring to normal and closing the energizing circuit for the secondary magnet SM. The relay 224 energizes when the line relay IR drops back but is immediately restored to normal due to the closure of an energizing circuit through the lower winding of the said relay 224, which may be traced from battery through the said lower winding, conductor 226, alternate contact 280, connector 271, to ground at normal contact 219 of the now restored impulse relay IR. Relay 224 being differentially wound, restores to normal, and the closing of normal contact 290 of the said relay 224 places a ground upon the private contact of the connector C over a circuit which may be traced from ground at alternate contact 243 of the primary off-normal contact PON, conductor 242, normal contact 238 of relay 224, conductor 241, alternate contact 240, normal contact 290, alternate contact 291 of the secondary off-normal contacts SON, to the private contact 4. The placing of this busy potential upon the private contact prevents any individual switch B from engaging the contacts of this busy connector.

Called line busy.

Assuming now that the called line is busy, the operation of the circuit is the same up to and including the time that the relay TR momentarily energizes. The line being busy, the private contact 245 has a busy potential placed upon it, thus closing a locking circuit for the test relay TR from battery through the winding of the said relay, its alternate contact 250, conductor 251, and the wiper 230 to ground at contact 245. The closing of alternate contact 292 of the test relay TR connects the busy signal BB to the line to transmit a busy signal to said calling subscriber at substation A, thus notifying him of the busy condition of the said called substation D. The relay TR upon locking up to ground at the private contact 245,

closes a circuit for relay RC, traced from battery through the winding of relay RC, make-before-break contact 272, normal contact 273 of relay SR, normal contact 249 of relay SW, conductor 248, alternate contact 250 of relay TR, and conductor 251 to the grounded private contact 245. The relay RC thus closes a locking circuit for itself, traced through the winding of said relay RC, alternate contact 274, conductor 242 to ground at alternate contact 243 of the off-normal contacts PON. Now should the line called become idle during the time the busy signal is being transmitted to the calling substation, the falling back of relay TR will not cause the called subscriber to be signaled owing to the fact that relay RC is locked up to ground at contact 243. The calling subscriber now replaces his receiver, bringing about the de-energization of the impulse relay IR. The relay IR restoring, opens the circuit of the relay COR of the individual switch B to release the switch, as previously described, thus bringing about the release of the individual switch B. The relay IR de-energizing, brings about the restoration of the relay 223, due to the fact that the relay SR has not been energized. The closing of the circuit through the left-hand winding of the circuit 223 brings about the neutralization of said relay 223. The closing of normal contact 284 of the said relay 223 closes a circuit through the secondary magnet SM, which magnet steps the wipers 230, 231 and 233 beyond the last set of contacts. The wipers then restore to normal by spring tension. The primary off-normal contacts PON and secondary off-normal contacts SON are also restored, and the apparatus used in this busy connection is now at normal and available for use in establishing other connections.

While I have shown a system of 100 capacity, it is to be understood that by inserting first selectors the system may be increased to a 1,000 system, etc.

It is to be understood that I do not wish to be limited to the exact matter shown, as various other arrangements may readily suggest themselves to one skilled in the art. Therefore, I desire to cover all such changes and modifications as come within the spirit and scope of the appended claims.

What I claim as new and desire to secure by United States Letters Patent is:

1. A telephone system including a non-numerical automatic switch provided with only three magnets, a cut-off magnet, a test magnet and a driving magnet, a circuit for said test magnet including a contact of said driving magnet, and a circuit for said driving magnet including a contact of said test magnet.

2. A telephone system including a non-numerical automatic switch provided with wipers and only three operating magnets, a motor magnet for advancing said wipers, a test magnet, and circuits for said motor magnet and said test magnet controlled by contacts of each other whereby when one of said magnets is energized it operates to de-energize the other of said magnets.

3. A telephone system including a non-numerical automatic switch provided with wipers and only three operating magnets, a motor magnet for advancing said wipers, a test magnet, and circuits for said motor magnet and said test magnet controlled by contacts of each other, whereby when one of said magnets energizes it operates to de-energize the other of said magnets, and a magnet for controlling the return of said wipers to normal.

4. A telephone system including a non-numerical spring restored automatic switch, a test magnet, a motor magnet and a cut-off magnet for said switch, a circuit for said motor magnet including contacts of said test magnet, and a circuit for said test magnet including contacts of said motor magnet and said cut-off magnet.

5. A telephone system including an automatic spring restored trunking switch having motion in one plane only, shaft-operated contacts for said switch, a test magnet, a motor magnet and a cut-off magnet for said switch, and a circuit for said test magnet including contacts of said motor magnet, said shaft-operated contacts, and a contact of said cut-off magnet.

6. A telephone system including a subscriber's telephone line, a link circuit, an automatic switch for connecting said link circuit and said subscriber's line, a test magnet for said switch, a circuit for said test magnet including said subscriber's line, a second circuit for said test magnet including a passive bank contact of said switch, said latter circuit being opened upon each step of said automatic switch and a relay adapted to be energized when the idle link circuit is found to connect a busy line to the link circuit.

7. A telephone system including a subscriber's telephone line, an individual trunking switch for said line, trunks adapted to be selected by said switch, a test magnet and a motor magnet for said switch, a circuit for said test magnet including said subscriber's line, a second circuit for said test magnet including conductors of said trunks, said latter circuit adapted to be opened upon each energization of said motor magnet, and a relay adapted to be energized when an idle trunk is selected to connect the subscriber's line to the trunk.

8. An automatic non-numerical trunking switch including a motor magnet, a three-position circuit controlling switch for said

automatic switch, an auxiliary magnet, means controlled by an operation of said motor magnet for moving said switch contact to its intermediate position, and means controlled by said auxiliary magnet for moving said switch contact to its third position.

9. An automatic non-numerical trunking switch including a motor magnet, a three-position circuit controlling switch for said automatic switch, an auxiliary magnet, means controlled by an operation of said motor magnet for moving said switch contact to its intermediate position, means controlled by said auxiliary magnet for moving said switch contact to its third position, and a spring restored switch shaft for returning said switch contact to its normal position.

10. A device of the character described including a pair of normally closed switch contacts, a third contact, a magnet for moving said pair of contacts into engagement with said third contact, and means for then separating one of said pair of contacts from the other of said pair of contacts.

11. An automatic switch including a pair of normally closed switch contacts, a third contact, means for operating said contact so that all said contacts are placed in electrical engagement, and means for operating said contacts so that one of said pair of contacts is separated from the other of said contacts.

12. An automatic spring restored switch provided with a switch shaft and ratchet, a pair of holding pawls for engagement with said switch ratchet, one of said pawls adapted to maintain said switch shaft in its advanced position while said shaft is being rotated, and means for moving the other of said pawls into engagement with said ratchet and for moving said first pawl out of engagement with said ratchet.

13. An automatic switching device of the character described provided with a switch shaft and ratchet, a pair of holding pawls for engagement with said ratchet, one of said holding pawls adapted to hold said switch shaft in its advanced position while said shaft is being actuated, and means adapted to be operated upon completion of the selecting operation of said switch for moving the other of said pawls into engagement with said switch ratchet and for removing said first pawl out of engagement with said switch ratchet.

14. An automatic switch provided with a shaft and ratchet, a holding pawl for said shaft, a magnet for removing said holding pawl from engagement with said ratchet, means for locking said holding pawl in its disengaged position, and means for unlocking said holding pawl.

15. An automatic switch provided with a shaft and ratchet, a holding pawl for said shaft, a magnet for removing said holding pawl from engagement with said ratchet, means for locking said holding pawl in its disengaged position, and means controlled by the return of said switch shaft to normal for releasing said holding pawl.

16. An automatic switch including a switch shaft, a magnet provided with an armature and a pawl for actuating said switch shaft, a guide for said pawl including a pivoted member adapted to be turned about its pivoted point to adjust said pawl, and a slot cut in said guide through which a screw extends for securing the guide in its adjusted position.

17. An automatic switch including a switch shaft, an operating magnet, a driving pawl for said operating magnet for actuating said switch shaft, an angularly pivoted guide for said driving pawl, a slot cut in said guide, and a screw passing through said slot whereby said guide may be turned about its pivoted point to adjust said driving pawl.

18. An automatic switch including a rotatable switch shaft provided with wipers, a driving magnet for rotating said switch shaft and wipers, interrupter springs for said magnet, micrometric means for adjusting the normal position of said springs, and micrometric means for limiting the return movement of the armature of said magnet.

19. An automatic switching device of the character described provided with a progressively movable switch shaft and wipers, an interrupter magnet for effecting the operation of said switch shaft and wipers, a pair of contacts adapted to be interrupted by said magnet, micrometric means for adjusting the normal position of said contacts, and micrometric means for adjusting the normal position of the armature of said magnet.

20. An automatic switching device including a magnet provided with a heel iron, an armature secured to said heel iron, a flexible spring secured to said heel iron, a pair of interrupter contacts, a buffer resting against said flexible spring for maintaining said interrupter contacts in their normal position, and micrometric means for moving said flexible spring to thereby adjust said interrupter contacts.

21. An automatic switching device including a magnet provided with a heel iron, an armature secured to said heel iron, a flexible spring secured to said heel iron, a pair of interrupter contacts, a buffer resting against said flexible spring for maintaining said interrupter contacts in their normal position, and micrometric means for moving said flexible spring to thereby adjust the relation of said armature and said interrupter contact.

22. A non-numerical automatic switch including a rotatable shaft, a removable driving unit for rotating said shaft, and a re-

movable releasing unit for releasing said shaft from an advanced position, each of said units being complete in itself and adapted to be removed and replaced by other units without the necessity of disassembling or reassembling the parts of the units.

23. An automatic switch including a rotary shaft, a pair of holding pawls for said shaft, a magnet, and means controlled by said magnet for moving one of said holding pawls out of engagement with the said shaft, and for moving the other of said holding pawls into engagement with said shaft.

24. An automatic switch including a rotary shaft, a pair of holding pawls for said shaft, a magnet, means controlled by said magnet for moving one of said holding pawls out of engagement with the said shaft and for moving the other of said holding pawls into engagement with said shaft, means for locking said first holding pawl out of engagement with said shaft, and means controlled by the return of said switch shaft to normal to release said first holding pawl.

25. A telephone system including a non-numerical automatic switch provided with an active test contact, a set of passive contacts, a motor magnet, a test magnet, means controlled by said motor magnet for moving said active contact over said passive contacts, means controlled by said motor for connecting said test magnet through said active contact to each passive contact moved over by said active contact, and means controlled by said test magnet to cause said motor magnet to continue to operate as long as busy passive contacts are engaged by said active contact.

26. An automatic switch including a mounting frame, contact banks supported thereby, wipers for co-operation with said contact bank, a shaft for carrying said wipers, a ratchet secured to said shaft, an electromagnet provided with an armature having a driving pawl for engaging said ratchet, and a pair of holding pawls controlled by a single electromagnet for holding the wipers in an advanced position and for releasing the same from such advanced position.

27. A telephone system including a non-numerical automatic switch provided with only three relays and magnets, a test relay, a cut-off relay and a driving magnet, a circuit for said test relay including a normally closed contact of said driving magnet, and a circuit for said driving magnet including a normally closed contact of said test relay.

28. A telephone system including a non-numerical automatic switch provided with wipers, a motor magnet for advancing said wipers, a test magnet, circuits for said motor magnet and said test magnet controlled by contacts of each other whereby when either of said magnets is energized it operates to de-energize the other of said magnets, a cut-off relay, and a circuit for said cut-off relay including a contact of said test relay.

29. A telephone system including a non-numerical automatic switch provided with wipers, a motor magnet for advancing said wipers, a test magnet, and circuits for said motor magnet and said test magnet controlled by contacts of each other whereby when one of said magnets energizes it operates to de-energize the other of said magnets, and a magnet for controlling the return of said wipers to normal, said last magnet also controlling the circuit of said test magnet.

30. A telephone system including a spring restored automatic switch, a test magnet, a motor magnet and a cut-off magnet for said switch, a circuit for said motor magnet including contacts of said test magnet, and a circuit for said test magnet including contacts of said motor magnet and said cut-off magnet, said last circuit adapted to be opened when either said cut-off magnet or said test magnet is energized.

31. An automatic individual trunking switch including a motor magnet and a test magnet, circuits for said magnets whereby when either of said magnets is energized it causes the other one to de-energize, and a cut-off relay adapted to be energized by said test magnet when said test magnet remains in its normal position for a predetermined period of time.

32. An automatic individual trunking switch including a motor magnet and a test magnet, and circuits for said magnets whereby when either of said magnets is energized it causes the other one to de-energize, when the last mentioned magnet de-energizes it causes the other magnet to energize, a cut-off relay, and a circuit for said cut-off relay including contacts of said test magnet.

33. A line switch comprising passive contacts, a wiper, means for advancing said wiper to successively engage said contacts, resilient means adapted for restoring said wiper, and a pair of holding members and a single associated electromagnet for controlling restoration of said wipers, one of said elements being normally in holding engagement and the other of said elements being normally out of holding engagement.

34. A line switch comprising sets of passive contacts, each set including line and test contacts, wipers for co-operation with each contact of said sets respectively, means for advancing said wipers to successively engage said sets of contacts, resilient means

adapted for restoring said wipers, a pair of check pawls for controlling the restoration of said wipers, and a cut-off relay for controlling said pawls.

35. A line switch comprising sets of passive contacts, each set including line and test contacts, wipers for co-operation with each contact of said sets respectively, means for advancing said wiper to successively engage said sets of contacts, resilient means adapted for restoring said wipers, a pair of check pawls for controlling the restoration of said wipers, one of said pawls being normally in holding engagement and the other of said pawls being normally out of holding engagement, and a single electromagnet for controlling said pawls.

36. A line switch comprising passive contacts, a wiper for co-operation therewith, means for advancing said wiper to successively engage said contacts, means adapted for restoring said wiper, a pair of holding members adapted to control the restoration of said wiper, one of said members being normally in holding engagement and the other of said members being normally out of holding engagement, and a single electromagnet for controlling said members.

37. A line switch comprising passive contacts, a wiper for co-operation therewith, means for advancing said wiper to engage said contacts, means adapted for restoring said wiper, a pair of check pawls for controlling the restoration of said wiper, one of said pawls being normally in holding engagement and the other of said pawls being normally out of holding engagement, and a single electromagnet for controlling said pawls.

38. A line switch comprising passive contacts, a wiper for co-operation therewith, a motor magnet for advancing said wiper to select one of said contacts, means adapted for restoring said wiper, a pair of check pawls for controlling the restoration of said wiper, and a cut-off relay for controlling both of said pawls.

39. An automatic switch comprising a mounting frame, a bank of contacts carried thereby, wipers for co-operation with said bank contacts, a shaft for said wipers suitably supported by said frame, a rotary armature, a ratchet and a co-operating pawl therefor carried by said armature, an electromagnet for operating said armature to advance the wipers over said contact bank, restoring means for the wipers, a pair of pawls for holding the wipers in advanced position and a single electromagnet for operating said holding pawls to permit said restoring means to return said wipers to normal.

40. An automatic switch comprising a mounting frame, a contact bank supported thereby, self-restoring wipers for co-operation with said contact bank, a shaft for said wipers suitably supported by said frame, an armature, a ratchet, a co-operating pawl therefor carried by the armature, an electromagnet supported by said frame and adapted for advancing said wipers, a pair of pawls for holding said wipers in an advanced position and for releasing the same from said advanced position, and a single electromagnet for controlling the said holding pawls.

41. An automatic telephone system including a traveling switch provided with only three operating magnets, an adjusting magnet for said switch, a magnet initially energized by current flowing over the talking circuit and thereafter operating in vibratory relation with the adjusting magnet, and test means operating when said switch engages an idle contact to stop the vibration.

42. A non-numerical automatic switch provided with only three operating magnets, a line magnet and an adjusting magnet of said operating magnets being in vibratory relation, said line magnet initially energized by current over the talking circuit and thereafter controlled by the test means of the switch, said means serving to stop the vibration when the switch engages idle contacts.

43. A telephone line, a traveling switch therefor provided with only three operating magnets, one of said magnets having its winding connected to said line and operated by current thereover, another of said magnets being an adjusting magnet for operating the switch, automatic means for placing said first magnet and said adjusting magnet in position to operate in vibratory relation, and a progressively movable test contact connected in circuit whereby said relation terminates when said test contact encounters an idle circuit.

44. A system of the character described including a traveling switch having an adjusting magnet, a relay initially energized by current flowing over a talking circuit and thereafter operating in vibratory relation with the magnet, test means operating when said switch engages an idle contact to stop the vibration, and a cut-off relay energized when said switch engages said idle contact.

45. A telephone system including a subscriber's telephone line, an automatic switch individual thereto provided with a line relay and an operating magnet, movable contacts for said switch, a circuit for said line relay including said subscriber's line, and other circuits including said relay and magnet in vibratory relation during the selection of an idle contact by said active contacts, and a cut-off relay adapted to be energized when an idle contact is found to connect the subscriber's line with some of said active contacts.

46. A telephone system including a subscriber's telephone line, a switch therefor provided with a relay and an adjusting

magnet, active contacts for said switch, a circuit for said relay including a subscriber's line, other circuits for said relay and said magnet whereby they may be included in a vibratory circuit arrangement to advance the active contacts of said switch, and a relay adapted to be energized when said active contacts engage idle contacts to connect said subscriber's line to said idle contacts.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 27th day of July, 1918.

HARRY H. IDE.