No. 815,176. PATENTED MAR. 13, 1906.

A. E. KEITH & J. & C. J. ERICKSON.

AUTOMATIC TELEPHONE CONNECTOR SWITCH.

APPLICATION FILED APR. 21, 1905.

8 SHEETS—SHEET 1.

Fig. 3.

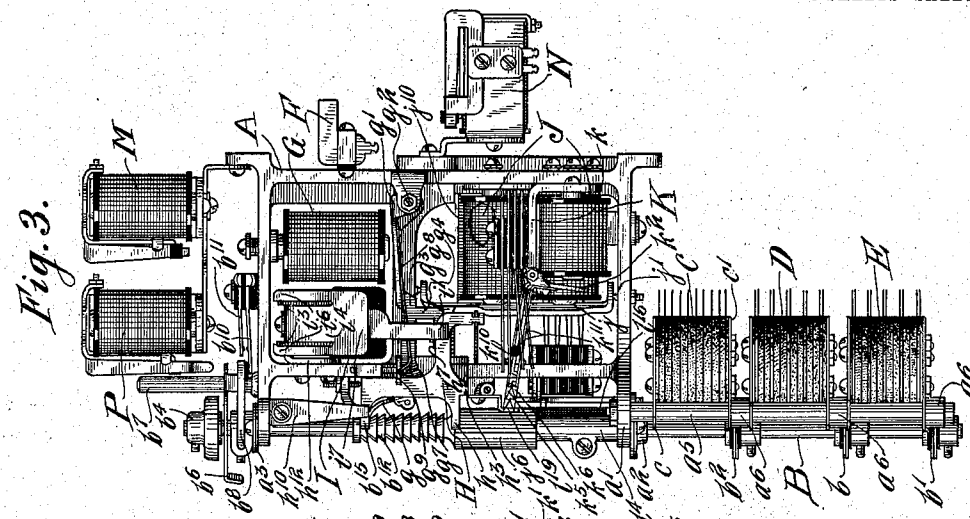


Fig. 2.

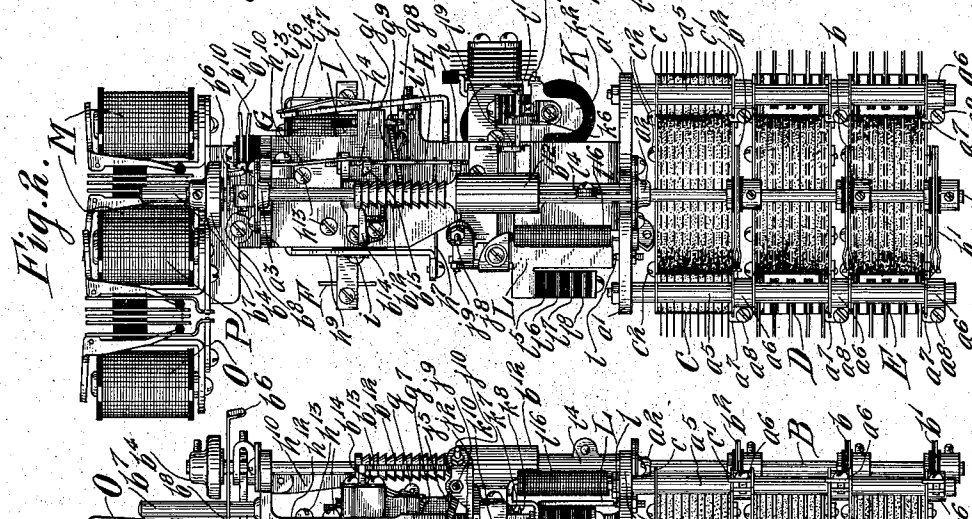
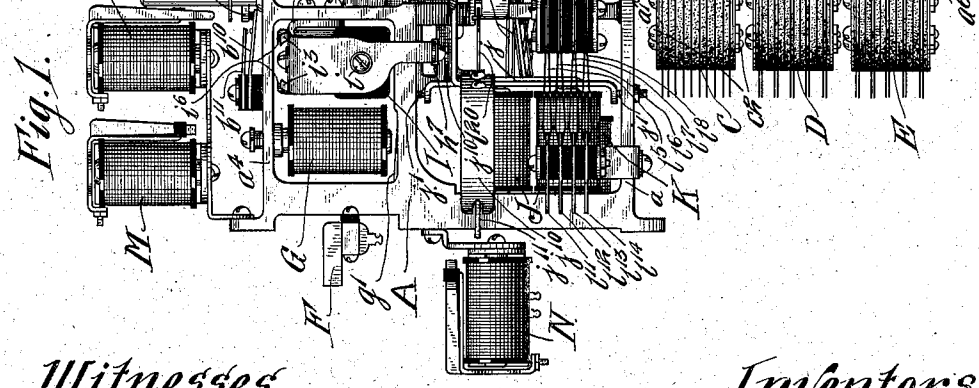


Fig. 1.



Witnesses.

R. H. Burfinds

A. Anderson

Inventors,

Alexander E. Keith,

John Erickson and

Charles J. Erickson

By Bakewell & Duncan

Attorneys.

No. 815,176. PATENTED MAR. 13, 1906.

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8 SHEETS—SHEET 2.

Fig. 4.

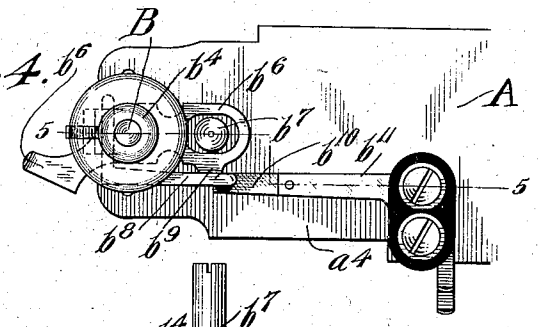
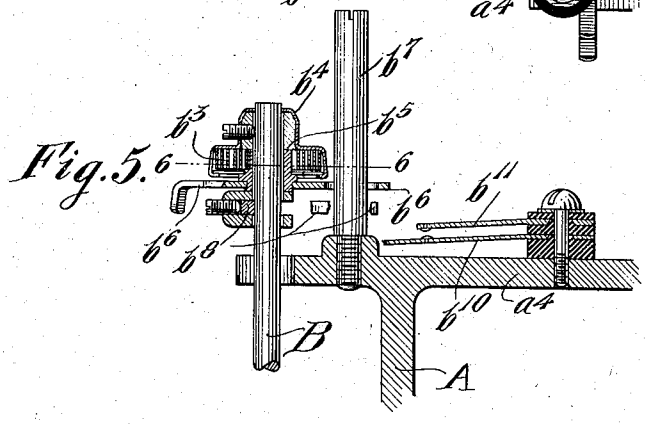


Fig. 5.



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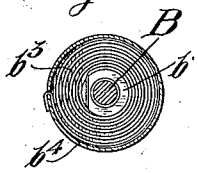

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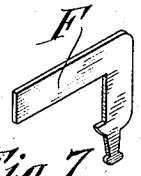
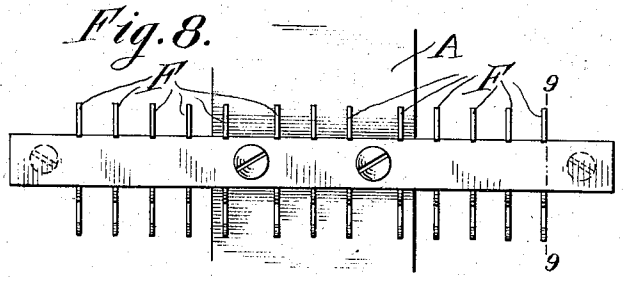


Fig. 8.



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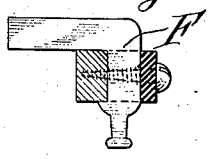


Fig. 10.

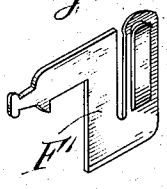


Fig. 12.

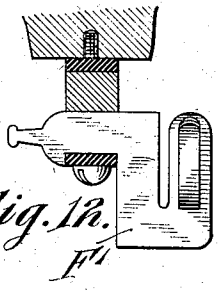


Fig. 11.

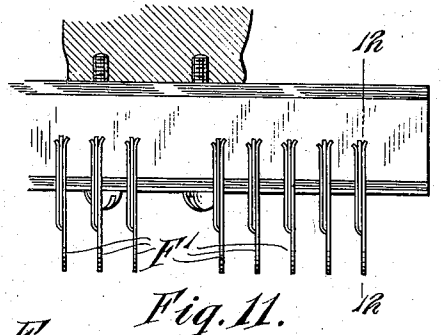
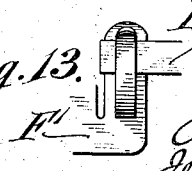


Fig. 13.



Witnesses.

R. H. Burpino

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Inventors:

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8 SHEETS—SHEET 3.

Fig. 14.

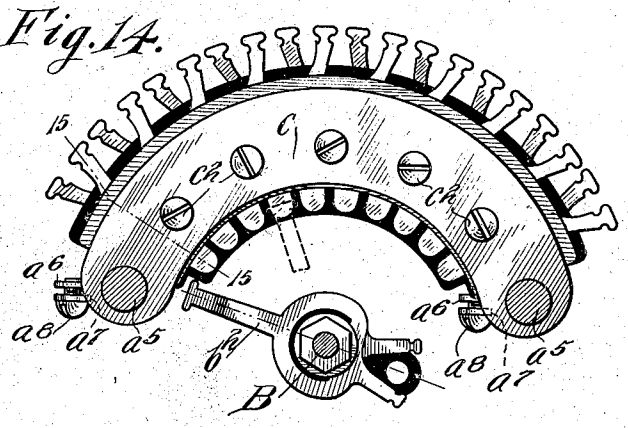


Fig. 16.

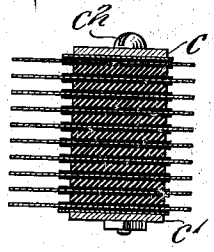


Fig. 18.

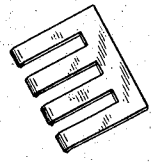
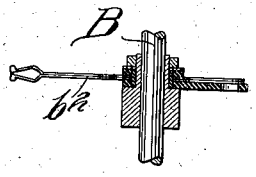


Fig. 19.



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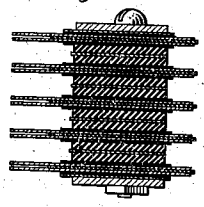


Fig. 17.

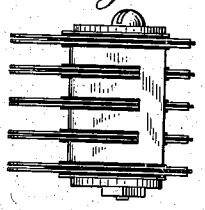


Fig. 20.

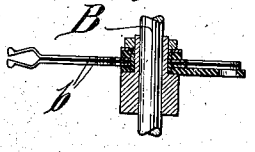
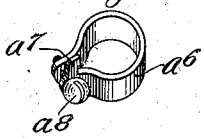


Fig. 21.



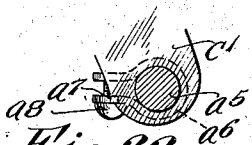
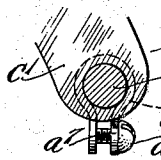


Fig. 22.

Fig. 23.



Witnesses.

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Inventors:

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Clinton J. Erickson

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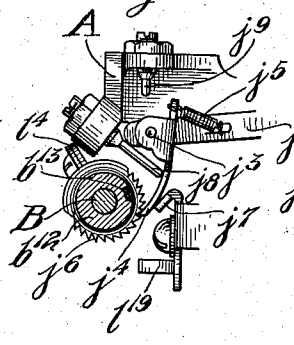
8 SHEETS—SHEET 4.

Fig. 26.



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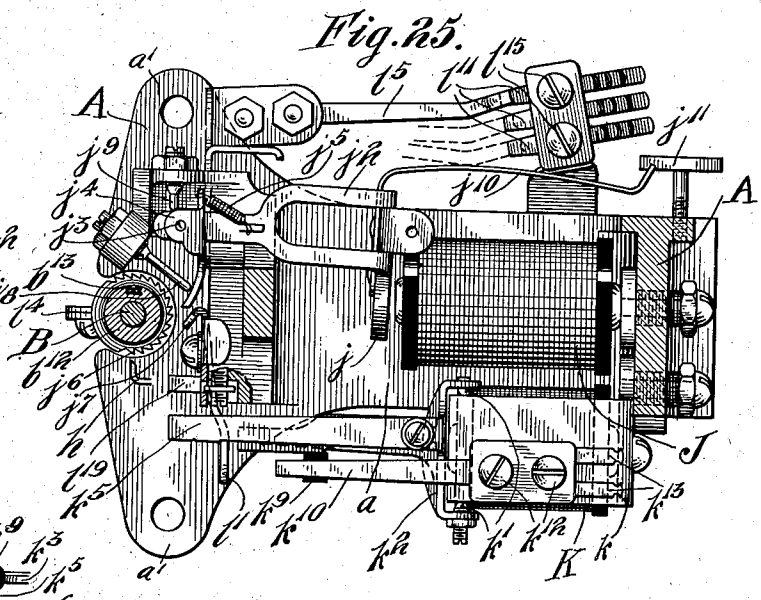

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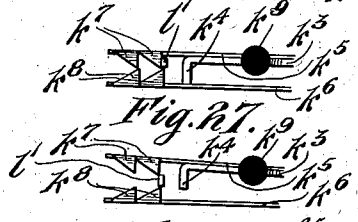
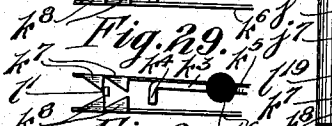


Fig. 28.

Fig. 29.



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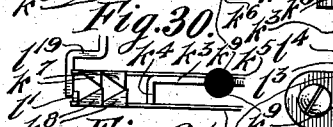

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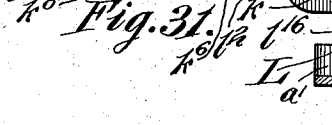

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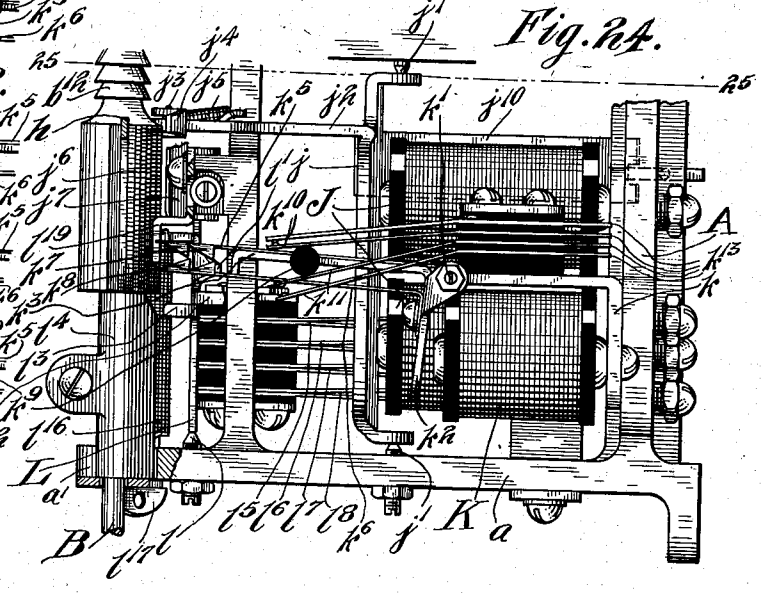

Witnesses.

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8 SHEETS—SHEET 5.

Fig. 32.

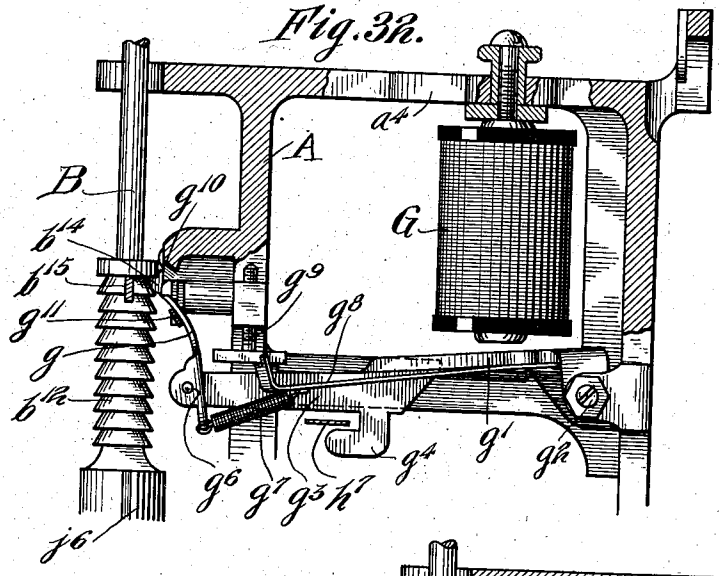


Fig. 33.

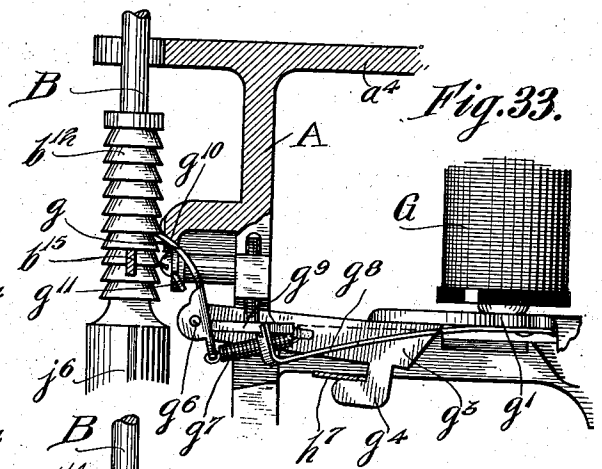
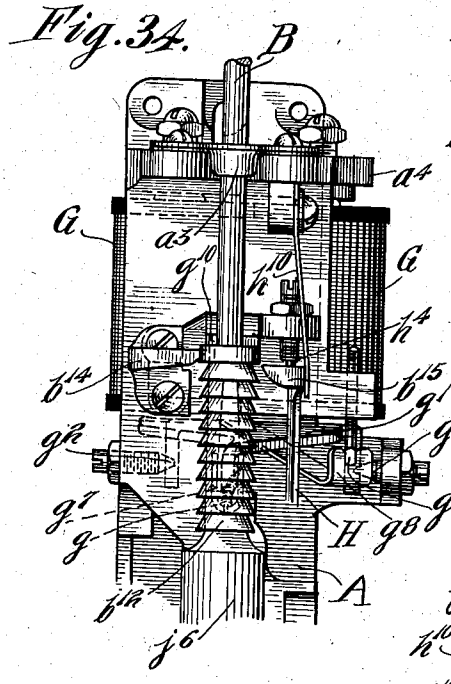


Fig. 34.



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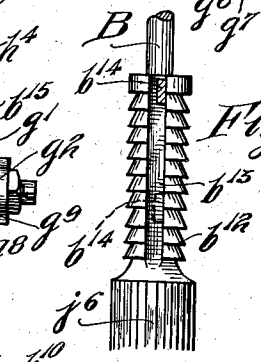


Fig. 36.

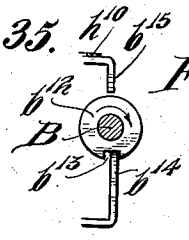
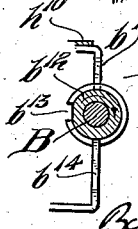


Fig. 37.



Witnesses.

R. H. Burfind

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AUTOMATIC TELEPHONE CONNECTOR SWITCH.

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8 SHEETS—SHEET 6.

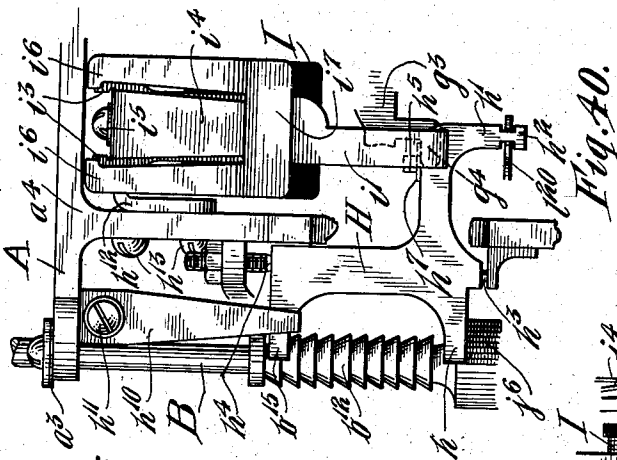


Fig. 40.

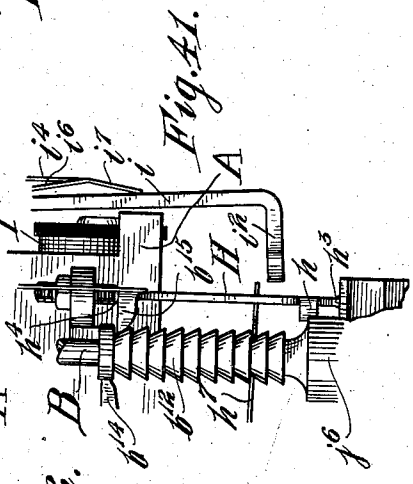


Fig. 41.

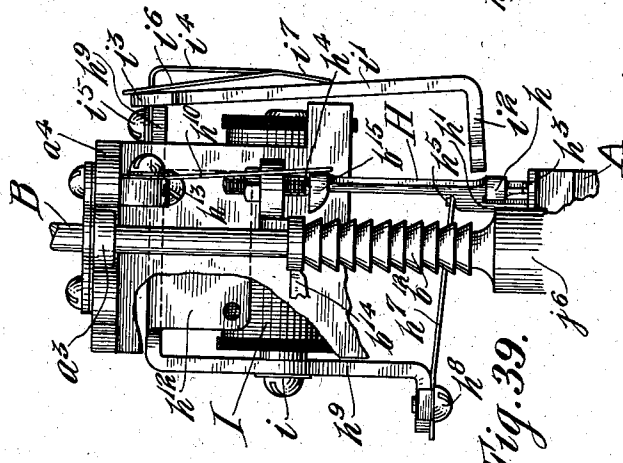
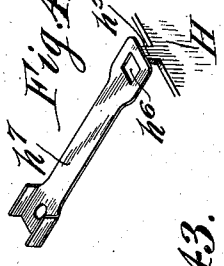


Fig. 39.



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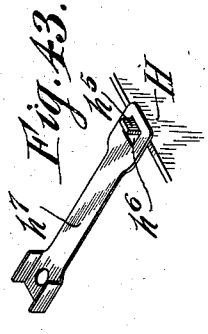

Fig. 43.

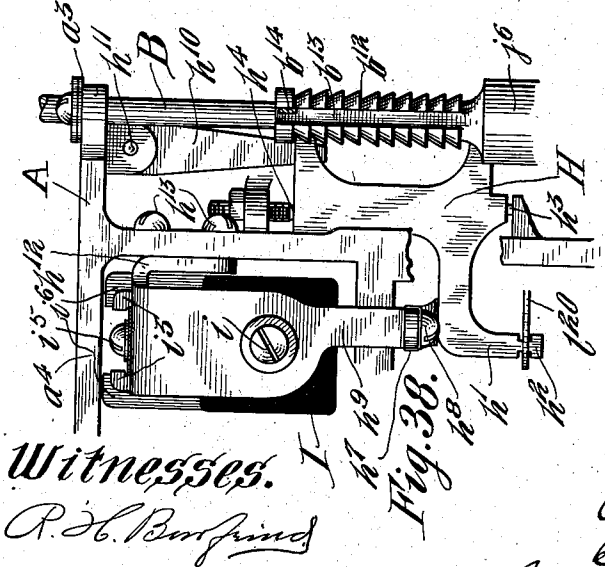

Fig. 38.

Witnesses.

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AUTOMATIC TELEPHONE CONNECTOR SWITCH.

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8 SHEETS—SHEET 7.

Fig. 44.

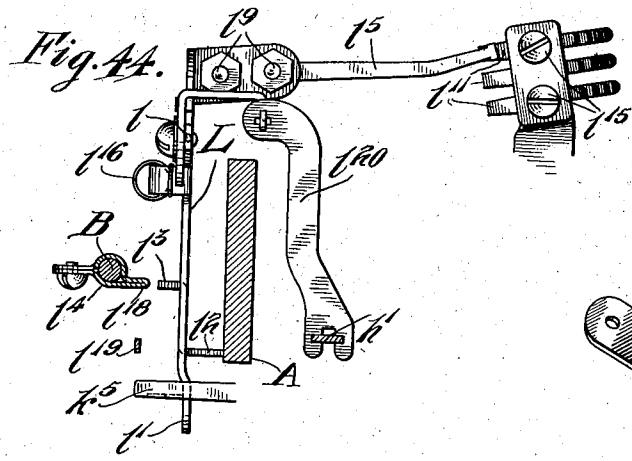
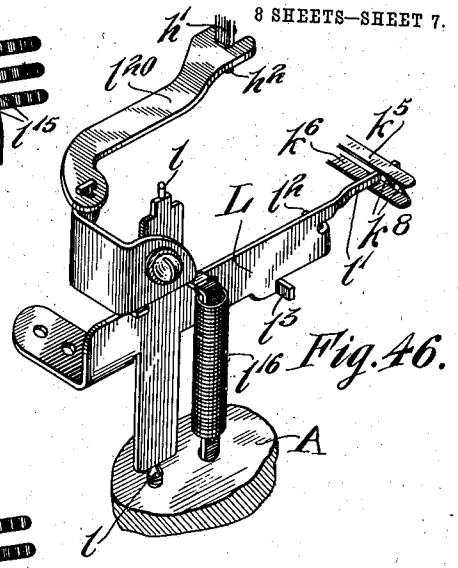


Fig. 46.



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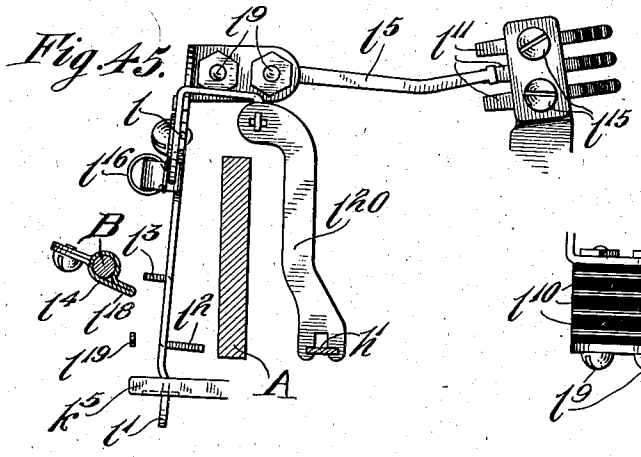

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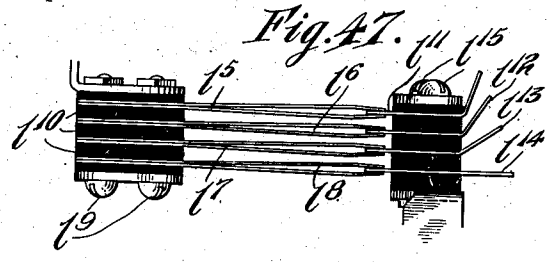

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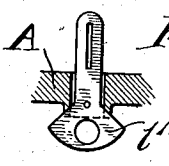

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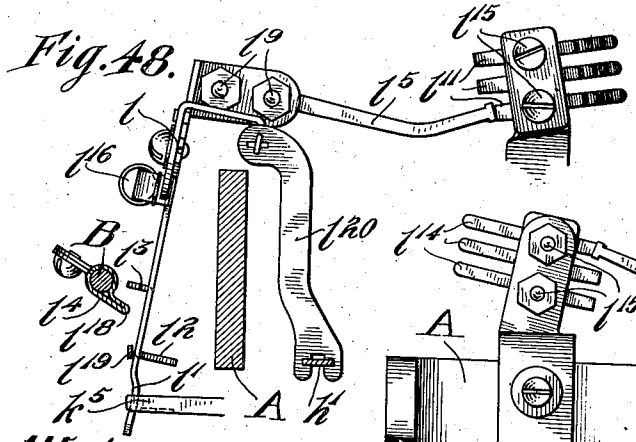
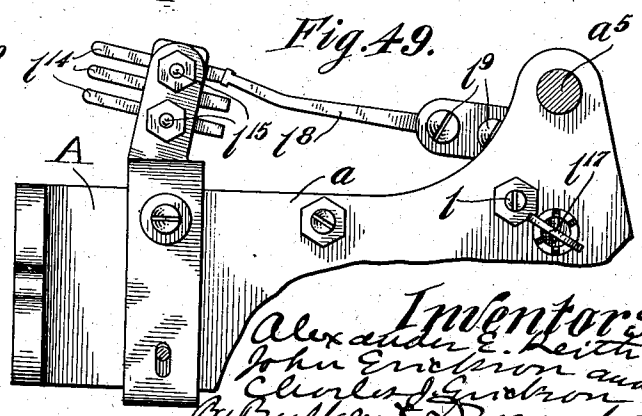


Fig. 49.



Witnesses.

R. H. Burgess

A. Anderson.

Inventors:

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John Erickson and

Charles J. Erickson

By Bulkley & Bulkley

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No. 815,176.

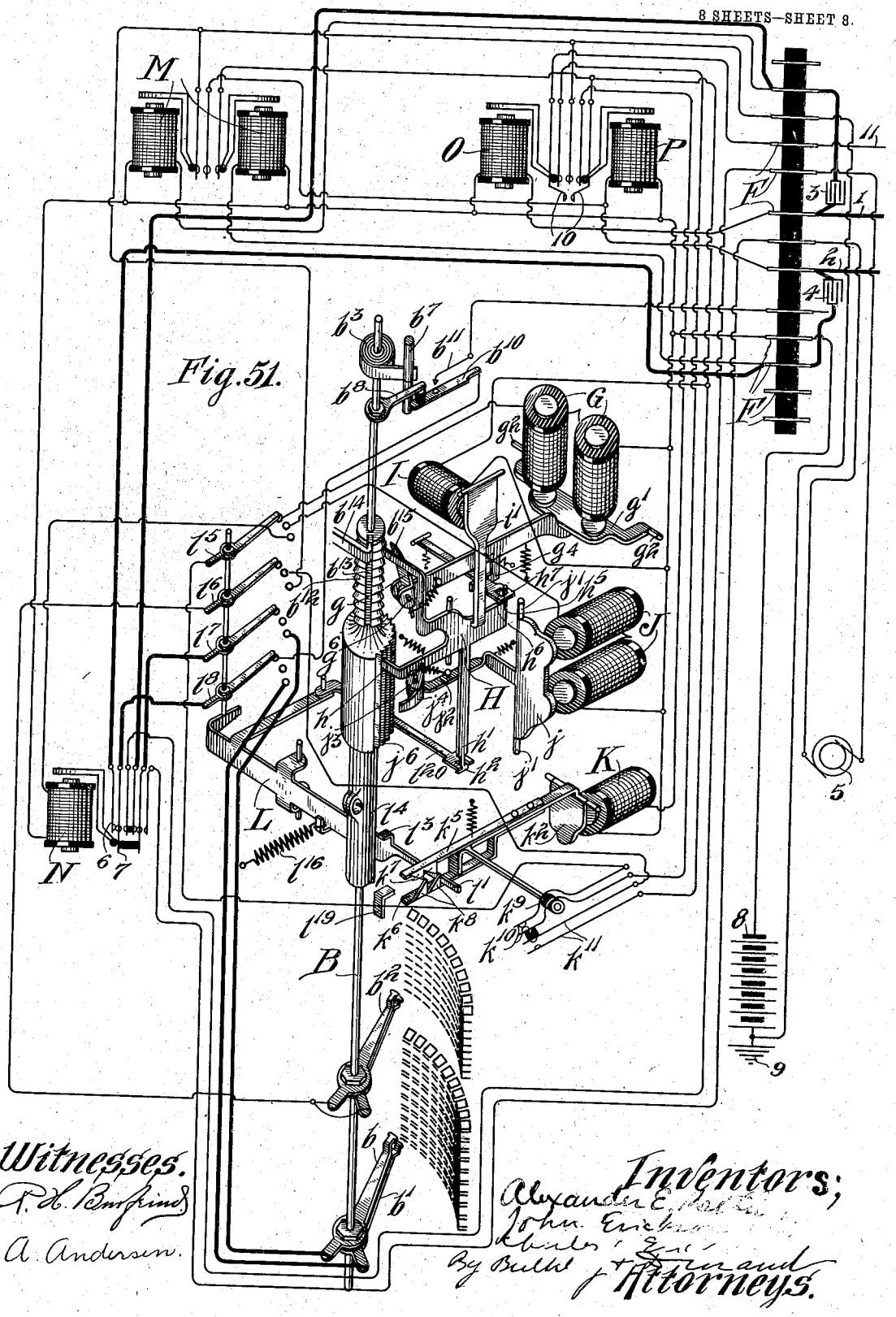
PATENTED MAR. 13, 1906.

A. E. KEITH & J. & C. J. ERICKSON.

AUTOMATIC TELEPHONE CONNECTOR SWITCH.

APPLICATION FILED APR. 21, 1905.

8 SHEETS—SHEET 8.



Witnesses.
P. L. Burkind
A. Andersen.

Inventors;
Alexander E. Keith
John Erickson
Charles J. Erickson
By Bullard & Brennand
Attorneys.

UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEPHONE CONNECTOR-SWITCH.

No. 815,176. Specification of Letters Patent. Patented March 13, 1906.

Application filed April 21, 1905. Serial No. 256,804.

To all whom it may concern:

Be it known that we, ALEXANDER E. KEITH, JOHN ERICKSON, and CHARLES J. ERICKSON, citizens of the United States of America, and residents of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Automatic Telephone Connector-Switches, of which the following is a specification.

Our invention relates to automatic switching-machines of that particular type in which a rotatable and endwise-movable switch-shaft is employed for operating the switch-contacts by which any one of a number of possible connections can be made, according to the number which the subscriber is calling, and in which electromagnetically-actuated means are employed for giving the shaft its step-by-step rotary and endwise movements. In this particular case our invention relates more particularly to automatic switching-machines of this character, which are employed as "connector-switches" and which are commonly known as "connectors."

In automatic telephone-exchanges the switches or switching-machines which receive number impulses and which automatically select an idle trunk-line are called "selectors;" but the switches, each of which is adapted to be employed by the calling subscriber for making the final connection directly with the called-subscriber's line, are known as "connectors." The step-by-step rotation of a "selector" is automatic in this respect that its switch-shaft rotates automatically until an idle trunk-line is found. As distinguished from this the rotation of a "connector" is only automatic in the sense that the operation does not require the services of a switchboard operator and is directly under the control of the calling subscriber. Consequently a calling subscriber sends the desired number of impulses for giving a connector the desired extent of vertical step-by-step movement and then sends one or more impulses for giving the switch-shaft of the connector the desired extent of step-by-step rotary motion, it being understood that a selector performs an operation corresponding to a single digit of the called number, while a connector performs a general operation composed of two distinct or successive operations representing the last two digits of the called number. A connector is desirably provided with means for establishing a guarding-potential at all switch-terminals connected with the line of the called subscriber—that is, the subscriber's line with which the connector makes the final connection—and in this way there is no danger of the said called-subscriber's line being seized by other subscribers while the calling and called subscribers are conversing or before the called subscriber answers. It is also evident, however, that while a selector is desirably provided with means for insuring an automatic rotation of its switch-shaft until an idle trunk-line is found a connector must as distinguished from this be provided with means whereby it will automatically release and resume its normal condition in case the called-subscriber's line is found busy—that is, already in use. Furthermore, a connector is also desirably provided with means whereby the calling subscriber in case the line which he is calling is busy will receive a busy signal as soon as he attempts to ring the bell at the called-subscriber's station. Again, both selectors and connectors are desirably provided with electromagnetically-operated release mechanism by which the switches can be released and the connections broken after the conversation is terminated; but in a connector we find it preferable to effect a release and restoration of the mechanism by the energizing of the "release-magnet"—that is, we find it preferable to release the mechanism upon the energizing of the release-magnet and before the latter is deënergized—while in a selector it is customary and preferable to so arrange the mechanism that the release and restoration of the selectors will not take place until the release-magnet of each selector is deënergized.

As stated, our present invention relates to automatic switching-machines for use as connectors, and the nature of these connectors and other distinctions between the same and the well-known selectors will hereinafter more fully appear.

Generally stated, the object of our invention is the provision of an improved, simplified, and highly efficient automatic switching machine adapted more particularly for use as a connector; to improve, modify, and adapt a switching-machine mechanism of

this particular character for use as a connector, and to provide certain details and features of improvement tending to increase the general efficiency and serviceability of a switching-machine of this particular type or construction.

A special object is to provide, in connection with the other essential features of a "connector-switch" of this character, an improved releasing mechanism of such nature that the release and restoration of the switch to its normal condition will take place immediately upon the energizing of the release-magnet and without waiting for the release-magnet to be deënergized.

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

In the accompanying drawings, Figure 1 is a left-hand side elevation of a connector-switch embodying the principles of our invention. Fig. 2 is a front elevation of the same. Fig. 3 is a right-hand side elevation of the said automatic switching-machine or connector. Fig. 4 is a detail plan view of the top of the switching-machine. Fig. 5 is a vertical section on line 5 5 in Fig. 4. Fig. 6 is a horizontal section on line 6 6 in Fig. 5. Fig. 7 is a perspective of one of the jack-springs on the switching-machine. Fig. 8 is a face view of the jack-springs on the switching-machine. Fig. 9 is a section on line 9 9 in Fig. 8. Fig. 10 is a perspective of one of the jack-springs on the stationary frame or rack. Fig. 11 is a face view of some of the jack-springs on the rack or support. Fig. 12 is a section on line 12 12 in Fig. 11. Fig. 13 is a detail view showing the manner in which a jack-spring on the switching-machine engages a stationary jack-spring on the frame or supporting-rack. Fig. 14 is an enlarged plan view of one of the banks of "line-contacts." Fig. 15 is a section on line 15 15 in Fig. 14. Fig. 16 is a similar section through the "private bank." Fig. 17 is an end view of one of the "line-banks." Fig. 18 is a perspective of the end plates of the line-banks. Fig. 19 is a detail sectional view of the "private-bank wiper." Fig. 20 is a similar view of one of the "line-shaft wipers." Fig. 21 is a perspective of one of the rings or collars employed in securing the banks of contacts to their supporting rods or hangers. Figs. 22 and 23 are detail sectional views showing the method of applying the said rings to the rods or hangers on which the banks of contacts are supported. Fig. 24 is an enlarged side elevation of that portion of the switching-machine involving the so-called "private" and "rotary" magnets, the "rotary ratchet-teeth," and the "side switch." Fig. 25 is a plan of the devices shown in Fig. 24. Fig. 26 is a detail horizontal sectional view showing a different portion of the ratchet mechanism shown in Fig. 25. Figs. 27 to 31, inclusive, are detail views showing different positions of the saw-tooth or ratchet-like device for operating the side switch. Fig. 32 is an enlarged detail sectional view showing that portion of the switching-machine involving the so-called "vertical magnet" and "vertical ratchet-teeth" on the switch-shaft. Fig. 33 is a similar view showing the ratchet mechanism in a different position. Fig. 34 is a front elevation of the devices shown in Fig. 32. Fig. 35 is a detail side elevation of the grooved or channeled side of the vertical ratchet-teeth. Fig. 36 is a detail horizontal section just above the vertical ratchet-teeth. Fig. 37 is a similar view showing the parts in different positions. Fig. 38 is a detail side elevation of that portion of the switching-machine involving the so-called "release-magnet" and "locking-dogs." Fig. 39 is a front elevation of the devices shown in Fig. 38. Fig. 40 is a view of the other side of the mechanism shown in Fig. 38. Fig. 41 is a view similar to Fig. 39, but showing the parts in different positions. Fig. 42 is a perspective of the spring arm or link employed for normally holding the double locking-dog out of engagement with the vertical and rotary ratchet-teeth, showing the same disengaged from the projection carried by the locking-dog. Fig. 43 is a similar view showing the spring arm or link in engagement with the projection on the double locking-dog. Fig. 44 is a detail horizontal sectional view showing the side switch in plan. Fig. 45 is a similar view showing the side switch in a different position. Fig. 46 is a perspective of the side switch, operating-arm, and adjacent parts. Fig. 47 is a side elevation of the "side-switch wipers" and switch-contacts. Fig. 48 is a view similar to Figs. 44 and 45, but showing the side switch in a different position. Fig. 49 is a bottom view of that portion of the frame which supports the side switch, showing the side-switch wipers and contacts. Fig. 50 is a detail sectional view showing the key or device for regulating the tension of the "side-switch spring." Fig. 51 is a diagrammatic view showing the circuit arrangement of the connector and also showing certain parts of the connector mechanism in perspective, so as to give a clearer idea of the relation between the circuits and the mechanical parts or mechanism.

As thus illustrated, the switching-machine, commonly known as a "connector," comprises a cast frame or body A, preferably of non-magnetic material, and provided with a lower horizontal portion a, having a pair of forward and laterally-projecting ears or portions a'. The vertically-disposed and rotatable switch-shaft B is supported in a lower bearing a^2, secured to the said portion a', and in an upper bearing a^3, secured to the forward portions of the top or upper horizontal portion a^4 of the said frame or body. The

said shaft is provided with "line-wipers" b and b', and also with a so-called "private wiper" b^2. The said line-wipers are each preferably composed of a pair of spring fingers or arms, with insulation so applied that they are not only insulated from each other, but also from the switch-shaft upon which they are mounted. (See Fig. 20.) Referring to Fig. 19, however, it will be seen that the private wiper is composed of two similar spring fingers or arms; but in this case the same are not insulated from each other, although, of course, they are insulated from the switch-shaft. Any suitable means can be employed for securing these three wipers or swinging switch-arms to the endwise-movable and rotatable switch-shaft B. The supporting-rods or hangers a^5 have their upper ends secured to the portion a' of the frame or body and are of sufficient length to permit the upper or private bank C and also the lower or line banks D and E to be strung thereon and suitably secured in place by means of split collars or clamping-rings a^6. Referring to Fig. 16, it will be seen that the so-called "private bank" C—that is, the bank of switch-contacts known as "private contacts"—is composed of substantially one hundred terminals, each consisting of a single contact and all arranged in horizontal rows of ten terminals each. In this way there are ten levels at which the switch-shaft may operate, the different levels being separated from each other by suitable insulation, and it will also be understood, of course, that the insulation is so applied that the said terminals or private-bank contacts are insulated from each other. The private-bank contacts are all bound and held together by means of the upper and lower clamping-plates c and c' and by means of the bolts or screws c^2, extending downwardly therethrough. The forward ends of these private-bank contacts are adapted to be engaged by the said private wiper b^2, while their rear ends are adapted to serve as terminals for making the necessary connections with the wires or conductors for multiplying the said contacts or terminals with like contacts or terminals of all other connectors having line contacts or terminals corresponding to the line contacts or terminals of this particular connector. In Fig. 15 it will be seen that each line-bank comprises substantially fifty terminals arranged in horizontal rows of ten terminals each, and each terminal in this case, however, consisting of two contacts insulated from each other and from the balance of the structure. It will be seen that the relative arrangement is such that one set of line-wipers on the shaft will swing idly between two horizontal rows of "line-terminals," while the other line-wiper is traversing a horizontal row of line-terminals in the other bank. In this way the two line-banks really constitute but one bank of line-contacts—that is to say, but one bank of substantially one hundred line-terminals, each terminal being connected with a different subscriber's line. Consequently while one set of line-wipers is in use the other is out of use; but the private wiper on the shaft is always in use, no matter at what level the shaft is operating. For example, while the lower pair of line-wipers b' is traveling over a row of line-terminals in the bank E the upper pair of line-wipers b is traveling idly and out of contact with any of the terminals in the bank D; but should the shaft be given one more vertical step then the upper pair of line-wipers is brought into use and caused to travel upon a row of line-terminals in the bank D, while under such conditions the lower pair of line-wipers is traveling idly and out of contact with all terminals in the lower bank E. In this way the shaft at one level uses the lower pair of line-wipers and the lower bank of line-terminals and then at the next level it uses the upper pair of line-wipers and the upper bank of line-terminals. Consequently there are ten operative levels for the shaft and its contacts; but the line-wipers alternate, one pair being used at one level and the next pair being brought into use upon the stepping up of the shaft to the next level, and so on throughout the different levels at which the shaft is capable of rotating. As stated, however, the private wiper is always in use regardless of what level the shaft is operating in. It is found more satisfactory to divide the line-terminals into two banks and to use two pairs of line-wipers, for the reason that this arrangement involves less vertical movement on the part of the shaft than would be the case were the line contacts or terminals all arranged in one bank, for it will be seen that the line-terminals each consists of two contacts, one for each side of the "line-circuit," whereas the terminals in the private bank are of such character that each row or level consists simply of a series of single contacts. In this way it is possible to satisfactorily arrange the ten levels of the private bank in a single bank of contacts of the same general dimensions and the same height as a bank of line-terminals containing only five horizontal rows of terminals. It is evident, therefore, that with the arrangement shown the entire vertical movement of the switch-shaft may be substantially the same as the height or thickness of one of the banks of contacts, whereas if only one pair of line-wipers were employed in conjunction with a single bank of line-terminals the shaft would then be required to move up and down to an extent equal to the combined height or thickness of the two line-banks shown in Figs. 1, 2, and 3. It will be understood that the arrangement of bank-contacts is such that a calling subscriber may cause the switch-shaft to first rise to the desired level, so as to en-

able the connector to pick out the particular group of subscribers in which the called subscriber is included, and to then cause the switch-shaft to rotate in a step-by-step manner until the line-wiper in use picks out the particular terminal connected with the line of the called subscriber.

The split collars or clamping-rings a^6 are each provided with a hook-like lug a^7 and a clamping-screw a^8, said lug being adapted to engage the edge of the lower plate of one of the banks, as shown in Figs. 2 and 22. When tightened up, these clamping-rings not only keep the banks properly separated and permit them to be adjusted independently of each other, but also fasten the banks securely in place and in position to be properly engaged by the wipers or switch-arms on the shaft. The end of each line-bank is preferably provided with a brass end plate, such as the one shown in Figs. 17 and 18. The said switch-shaft is preferably returned to its normal position after it has been rotated by means of the clock-spring device b^3. (See Figs. 5 and 6.) One end of this spring is secured to the casing b^4, which latter is in turn secured to a hub b^5, having a suitable connection with an arm b^6. This arm is adapted to engage the normal post b^7 and to move up and down thereon in conformity to the vertical movements of the switch-shaft. Consequently when the shaft is rotated from its normal position the spring b^3 is wound up and given sufficient tension to restore the switch-shaft to its normal position when the connector is finally released. A so-called "normal post-arm" b^8 is secured to the shaft B and adapted to normally engage the stop b^9, carried by the arm b^6—that is, when the switch-shaft is in its normal position. It will also be seen that this normal post-arm is adapted to normally engage a switch-spring b^{10} for the purpose of keeping the latter normally out of contact with the switch arm or contact b^{11}.

At its back the frame or body of the connector is provided with a suitable number of jack-springs F, adapted when the connector is adjusted in place to engage the stationary jack-springs F′ on the frame or supporting-rack. In this way each connector can be readily adjusted in place on the frame or rack without the necessity of making or breaking any wire or solder connections, the mutual engagement of the stationary and movable jack-springs being sufficient to close all necessary circuit connections.

The mechanism for giving the switch-shaft a vertical step-by-step movement consists of vertical ratchet-teeth b^{12} on the switch-shaft and of a so-called "vertical magnet" G, adapted to operate a "vertical ratchet-pawl" g. It will be seen that these ratchet-teeth b^{12} are sufficient in number and of such character as to permit the shaft to be actuated ten times in a vertical or endwise direction, so as to raise the shaft to the desired level of bank-contacts. The so-called "vertical magnet" G can be secured to the frame or body in any suitable manner. As shown, the said vertical magnet comprises two cores and two windings provided with a single armature g'. This armature, it will be seen, is pivoted at g^2 and is therefore adapted to vibrate or swing up and down about a horizontal axis. The arm g^3, which is rigid with the said armature, is provided with an L-shaped lug g^4, adapted to reach under the flexible arm or locking device h^7, as will hereinafter more fully appear. At its end the said arm g^3 is pivotally connected at g^6 with the said ratchet-pawl g. It will be seen that the said pawl is subject to the tension of a spring g^7, by which the same is pressed into yielding engagement with the vertical ratchet-teeth on the shaft. The return movement of the armature is accomplished by the use of a retracting-spring g^8, having one end portion secured to the said armature and the other end thereof provided with a notch adapted to engage the head of the T-shaped and rotary screw-threaded adjusting member g^9. In this way the tension of the spring g^8 can be varied or regulated by rotating the thumb-screw or rotary threaded adjusting device g^9, the latter being screwed into a threaded socket in the body-frame, and thus adapted for up-and-down adjustment. The said pawl g is guided into and out of engagement with the ratchet-teeth by means of the guides g^{10} and g^{11}, the latter being adjustably secured to the body-frame, while the former is shown as being integral with the said body-frame. In this way the alternate energizing and deënergizing of the said vertical magnet produces a vibratory movement of its armature and a consequent step-by-step vertical movement of the switch-shaft, due to the reciprocating ratchet-like action of the pawl g. By referring to Fig. 33 it will be seen that the stop or guide g^{10} serves as a means for enabling the pawl g to positively lock the shaft against upward movement after the pawl has reached the limit of its upward movement. In this way the shaft stops promptly in its upward movement each time it reaches the end of an upward step, as it cannot move upward while the pawl g is held tight against the top of the next tooth by the stop g^{10}. Normally the vertical groove or channel b^{13}, extending throughout the series of vertical ratchet-teeth b^{12}, is engaged by the stationary supporting-dog or rest b^{14}, the same being suitably secured to the body-frame A. Consequently the shaft B can only move up and down while the wipers thereon are out of engagement with the bank-contacts, and when the shaft begins to revolve it is then supported by the rest b^{14}, it being understood that the latter is adapted to engage the under side of the an-

nular vertical ratchet-teeth b^{12}. With this arrangement the shaft can be elevated to the desired position and may then be rotated at the level to which it has been adjusted, and during such rotation and as a means of preventing a return or downward movement of the shaft while the locking-dogs are out of engagement with the ratchet-teeth thereon the rest b^{14} will perform its function of engaging and serving as a thrust-bearing for the bottom surface of the particular tooth with which it must engage in order to support the shaft at the desired level. As stated, therefore, the shaft can only move up and down while the rest or supporting-dog b^{14} is in engagement with the vertical groove or channel b^{13} and cannot be restored to its normal level until after the shaft has been released and allowed to rotate sufficiently to carry the shaft-wipers clear of the line and private banks. During the vertical movement of the switch-shaft and between the step-by-step movements in this direction the shaft is supported by the "vertical locking-dog" b^{15}. Figs. 38 to 43 illustrate the said double locking-dog and also the release-magnet and its armature and connections with said double locking-dog. It will be seen that the double locking-dog H is not only provided with the vertical locking-dog b^{15}, but is also provided with the "rotary locking-dog" h. This double locking-dog is also provided with an arm h', having a T-shaped end portion h^2. The bearings h^3 and h^4 are adapted to provide a vertically-disposed axis, about which the rigid double dog may swing or vibrate. In addition the said double dog is provided with a projection h^5, which is normally engaged by an opening h^6 in the end of the flexible arm of spring catch device h^7, the latter having its other end portion secured by a screw h^8 to the magnet-bracket h^9. With this arrangement the two locking-dogs of the said double dog are held normally out of engagement with their respective ratchet-teeth on the switch-shaft B. It will be seen, however, that the said double dog is at all times subject to the pressure or tension of the flat spring h^{10}, the latter being suitably secured to the body-frame by a screw h^{11}. In this way the said double dog can force its two locking-dogs into engagement with their respective ratchet teeth as soon as the projection h^5 is released from the apertured end portion of the flexible arm or spring catch device h^7. During the vertical movement of the switch-shaft the double dog is of course released and the vertical locking-dog b^{15} allowed to perform its function of engaging the vertical ratchet-teeth, serving to prevent a downward or back movement of the switch-shaft.

The release-magnet I is horizontally disposed and provided with a core having one end portion thereof secured to the magnet-bracket h^9 by means of a screw i. The other end of said release-magnet is, it will be seen, arranged to act upon the swinging armature i', the latter being hung at its upper end and provided at its lower end with a finger i^2, adapted to engage the arm h' of the double dog. Preferably the said armature i' is provided at its upper end with a couple of engaging portions i^3, adapted to engage and hang upon the opposite edge portions of the retracting-spring i^4. It will be seen that the upper horizontal end portion of this retracting-spring is suitably secured in place upon the top of the magnet-bracket h^9 by means of a screw i^5 and that the two upwardly-projecting side portions i^6 of said spring are adapted to engage the two portions i^3 of the armature and to thus hold the latter securely in place against the end portion of the bracket h^9. The lower end portion i^7 of the said retracting-spring is adapted to bear upon the intermediate vertical portion of the said armature and to thereby act as a stop for limiting the outward movement of the latter. When the said armature is attracted, its inward or forward movement is yieldingly opposed by the pressure of the spring portions i^6 against the upper end or engaging portions i^3 of the armature. As illustrated, the bracket h^9 is composed of horizontal and vertical portions, the upper horizontal portion being provided with a lug or ear h^{12}, adapted to be secured by screws h^{13} to the adjacent vertical portion of the body-frame. When the release-magnet I is energized, it attracts its armature i' and in so doing causes the finger i^2 to engage the double dog and force the two locking-dogs out of engagement with their respective ratchet-teeth. When thus restored to its normal or inoperative position, the said double dog is locked in place by reason of the automatic engagement of the apertured end portion of the spring-catch h^7 with the lug h^5.

Figs. 24, 25, and 26 show the mechanism for giving the shaft a step-by-step rotary motion. It will be seen that the so-called "rotary magnet" J is preferably composed of two cores and two windings suitably secured to the adjacent vertical portion of the body-frame A. These two electromagnets constituting the so-called "rotary magnet" are arranged in a horizontal position one above the other and with their free ends in position to act upon the vibratory armature j. This armature is pivotally mounted at j', preferably by means of cone-bearings secured to the body-frame, and is thereby adapted to vibrate or swing about a vertically-disposed axis. As illustrated, this "rotary magnet-armature" is provided with an arm j^2, having its end portion pivotally connected at j^3 with the "rotary ratchet-pawl" j^4. This ratchet-pawl is subject to the tension of a spring j^5, which tends to force it into engagement with the rotary ratchet-teeth

j^6 on the switch-shaft B. The adjustable guides j^7 and j^8 are employed for guiding or directing the said pawl into and out of engagement with the rotary ratchet-teeth on the shaft, each tooth extending vertically and lengthwise of the shaft. Preferably the stop or guide j^7 serves as a means for enabling the pawl j^4 to positively lock the shaft against further rotary motion after the pawl reaches the limit of its forward motion. With this arrangement the shaft cannot rotate while the pawl is in the position shown in Fig. 26, as the stop j^7 holds the pawl tightly against the beveled surface of the next tooth. An adjustable stop j^9 limits the outward or return movement of the arm j^2 under the pressure or action of the retracting-spring j^{10}. This retracting-spring is secured at one end to the armature j and provided in its other end with a notch adapted to engage the head of a T-shaped rotary screw-threaded adjusting device j^{11}, which latter is screwed into a threaded socket in the body-frame. In this way the said adjusting device can be rotated, and thereby given an endwise movement in a horizontal direction for the purpose of changing or varying the tension of the spring j^{10}, employed for retracting the rotary armature to its normal position.

Figs. 24 and 25, 27 to 31, inclusive, and 44 to 50, inclusive, illustrate the so-called "side switch"—that is, the switch which is operated by the so-called "private magnet" K. It will be seen that this private magnet is horizontally disposed and secured at one end to the bracket k, the latter being in turn secured to the adjacent portion of the body-frame A. At its other end the bracket k is pivotally connected at k' with the swinging or vibratory armature k^2. This armature is provided with a horizontal and forwardly-extending arm k^3, having a downwardly-bent end portion k^4. Upon this arm are mounted the upper and lower flat springs k^5 and k^6, the same being separated the desired distance by the end portion k^4. These springs are provided with upper and lower ratchet or saw teeth k^7 and k^8, the upper teeth being slightly out of line with the lower teeth. A piece of insulation k^9 is secured to the said arm and adapted to project between the switch-springs k^{10} and k^{11}, it being observed that the former are normally closed and the latter normally open. These switch-springs are, together with suitable strips or pieces of insulation, secured to the top of the bracket k by means of screws k^{12}. The rear ends or terminals k^{13} of these switch-springs are arranged in convenient positions for making the necessary connections with the circuit-wires. The side switch L is pivotally mounted at l, and thus adapted to swing or vibrate about a vertically-disposed axis. At one end this side-switch arm or body is provided with a finger l', adapted to normally project between the two springs k^5 and k^6, as shown in Fig. 27. The said side-switch arm or body is also provided with a couple of lugs l^2 and l^3, adapted, respectively, to engage the body-frame and the cam l^4 on the switch-shaft. At its other end the said side-switch arm or body is provided with four spring-wipers l^5, l^6, l^7, and l^8, all suitably secured in place by means of screws l^9 and insulated from each other and from the side-switch arm or body by means of the interposed strips of insulation l^{10}. The contact-making end portions of these wipers are adapted to engage the stationary contacts l^{11}, l^{12}, l^{13}, and l^{14}, the said contacts being suitably secured to the body-frame by means of screws l^{15}, each contact or terminal being suitably insulated from the frame and also from the other contacts. In this way the said side switch has three operative positions, and in each position the wipers are all in contact with certain of the stationary contacts. In other words, the uppermost side-switch wiper is adapted to coöperate with three stationary contacts, and each of the other wipers are adapted to coöperate with three similar contacts, there being twelve contacts in all. The movement of the side switch is directly accomplished by the positive pressure or tension of the spring l^{16}, the same having its lower end secured to the key or tension-regulating device l^{17}. With this arrangement the finger l' of the side switch normally occupies the position shown in Fig. 24; but when the private magnet K is energized the arm k^3 is then depressed and the finger l' made to occupy the position shown in Fig. 27—that is, the said finger shifts from its normal position in engagement with the innermost lower tooth into engagement with the innermost upper tooth. When the private magnet is then deënergized, the finger l' impinges on the point of the innermost lower tooth k^8, causing the spring k^6 to flex or bend in the manner shown in Fig. 28. These two flat springs by the time the private armature regains its normal position will be separated enough for the finger l' to clear the upper rearmost tooth. This permits the spring l^{16} to actuate the side switch from first to second position with the lug l^3 resting against the inner edge l^{18} of the cam l^4, as shown in Fig. 45, and leaving the finger l' nearly in engagement with the foremost lower tooth, as shown in Fig. 29. Then when the shaft is rotated the cam l^4 leaves the lug l^3 and said finger l' falls against the foremost lower tooth. When the private magnet is again energized and deënergized, the finger l' passes from second to third position, as shown in Figs. 30 and 31, in a manner similar to that when it passes from first to second position. The first time the side switch is released its movement is limited by reason of the lug l^3 engaging the projection or edge l^{18} of the cam l^4, as shown in Fig. 44. The next time the side switch is

actuated, however, the shaft B has partially rotated the said cam, as shown in Fig. 48, so that the final outward movement of the side switch is limited by reason of the finger l' engaging the stationary stop l^{19}, the latter being suitably secured to the body-frame. It will be observed that each time the private magnet is energized its armature is pulled down against the tension of the springs k^{11}, these springs then returning the armature to its normal position when the private magnet is deënergized. In this way a spring-switch of suitable character, but preferably composed of the two switch-springs shown in Fig. 24, provides the means for retracting the armature of the so-called "private magnet." When the release-magnet I is energized, it not only thereby releases the switch-shaft, but it also restores the side switch. This is accomplished by providing the double dog H with the previously-mentioned T-shaped end portion h^2 and by connecting this end portion with the side switch by means of a restoring-link l^{20}, the latter being shown more clearly in Fig. 46. The connection between this release-link and the double dog is of such nature that the double dog can be released from its normal position and allowed to move into engagement with the ratchet-teeth without moving the side switch; but after the connector has been operated in the desired manner and the subscribers are through talking the energizing of the release-magnet then draws the double dog out of engagement with the ratchet-teeth and in so doing causes the link l^{20} to move the side switch back to its normal or original position, and at this juncture it will be seen that the double dog is drawn out of engagement with the teeth on the switch-shaft at the time the release-magnet is energized and that the releasing of the connector is therefore accomplished promptly upon the closing of the circuit through the release-magnet—that is, the release is accomplished without waiting for the deënergizing of the release-magnet. The said method of releasing the switch-shaft and allowing it to return to its normal position and the manner of supporting the release-magnet and adjacent parts constitutes one of the features which distinguish a connector from a selector. For example and as another distinction it will be seen that the herein-described connector has a private magnet which constitutes the sole and only magnet for advancing the side switch. With the construction set forth the calling subscriber may perform a switching operation for the purpose of actuating the switch-shaft to the desired level and must then perform a further switching operation in order to make the switch-shaft rotate in a step-by-step manner and in order to bring the shaft-wipers into engagement with the bank-contacts corresponding to the line of the called subscriber. It will also be seen, by referring to Fig. 51, that the herein-described connector is provided with the "back release-relays" M and a ringer-relay N, as well as with the so-called "vertical" and "rotary" relays O and P, it being desirable that the connector be provided with means whereby the called subscriber may effect a release of the different switches in case the calling subscriber fails to make the release and also, of course, whereby the calling subscriber may after establishing the desired connection between his line and the line of the called subscriber then operate a switch and cause the ringing-current to be projected onto the circuit through the connector and out over the called-subscriber's line to the bell at the latter's station, and the calling subscriber after using the connector may release the same.

The circuit arrangement of the connector thus constructed may be changed or varied to suit the conditions of different cases or requirements; but with the parts connected up in the manner shown in Fig. 51 the electrical and mechanical operations of the connector are as follows: The impulse or impulses transmitted over the "vertical trunk-line conductor" 1 in the usual or any desired manner cause the so-called "vertical relay" O to become energized as many times as there are impulses and to thereby in turn energize the vertical magnet G, causing the latter to attract its armature and bring about the operations already described—that is, the release of the double dog H and the raising of the switch-shaft B to the desired level. A single impulse then transmitted over the "rotary trunk-line conductor" 2 results in the energizing of the so-called "rotary relay" P and in the consequent energizing of the private magnet K. This private magnet when energized causes the side switch to move from first to second position for the reasons and in the manner already described. This switches the magnet-switching wiper l^5 from the vertical magnet to the rotary magnet J and puts the latter in condition to be energized when the calling subscriber again energizes the vertical relay O. It will also be seen that the movement of the side switch from first to second position causes the "private side-switch wiper" l^6 to establish open connection between the "private-shaft wiper" b^2 and the release-magnet I through the medium of the normally open switch-springs k^{11}. The impulse or impulses then again transmitted over the "vertical line conductor" energize the vertical relay, and the latter then brings about the energizing of the rotary magnet J, causing the latter to rotate the shaft B in a step-by-step manner and as many times as there are impulses transmitted through the "vertical line-relay." This causes the shaft and its line and private wipers to rotate in such manner as to bring

the said wipers to the desired position—that is, into position where they can engage the bank-contacts corresponding to the line of the called subscriber. Another impulse transmitted over the "rotary line conductor" again energizes the "rotary line-relay" P, thus again energizing the private magnet K, and if the called-subscriber's line is not busy the side switch is thereby shifted from second to third position and with the result that the vertical and rotary side-switch wipers l^7 and l^8 establish connection between the vertical and rotary shaft-wipers b and b' and the condensers 3 and 4, the latter being located in the line-circuit and positioned between the bridges normally existing across the said circuit. It will be seen that one of said bridges includes the two "line-relays" O and P, while the other bridge includes the so-called "back release-relays" M. The calling subscriber then energizes the ringer-relay N in the usual manner and over a circuit including the side-switch wiper l^5, the switch-springs k^{10}, and the line-relay contacts, which are closed together by the energizing of the line-relay O when the called subscriber throws current on this side of the circuit for the purpose of initiating the ringing of the called-subscriber's bell. The energizing of the ringer-relay opens the line-circuit and bridges the ringing-generator 5 across that part of the circuit extending to the called-subscriber's station. However, should the called-subscriber's line be found busy the circuit completed from ground through the private-bank contact of the called-subscriber's line and through the private wiper b^2 through the private side-switch wiper l^6, it being remembered that the side switch is still in second position, through the switch-springs k^{11}, through the release-magnet I, and thence to the non-grounded pole of the battery automatically brings about a release and restoration of the connector to its normal position, it being also remembered that the springs k^{11} will be brought together by the calling subscriber as soon as the rotary line-relay P is energized for the last time in an attempt to bring the side switch from second to third position. Then when the calling subscriber attempts to ring the bell at the called-subscriber's station the single impulse employed for this purpose only energizes the veritcal line-relay O, and thereby only accomplishes a single actuation of the switch-shaft in a vertical direction. This, however, is sufficient to bring the normally open switch-springs b^{10} and b^{11} together and to thereby connect a busy-signal machine of any suitable construction with the "rotary line side-switch wiper" l^8, and thence through the ringer-relay contacts 6 and 7 with the rotary line conductor 2, the latter at this time being in communication with the calling-subscriber's equipment. Through the said equipment connection is then completed with the vertical line conductor l, through the vertical relay O, with the lead to the non-grounded terminal of battery, and thence with the other terminal of the busy-machine. In this way if the selected bank-contacts are found busy the final energizing of the private magnet simply effects a release of the connector, and the calling subscriber in then attempting to ring the called subscriber will do nothing more than close the connections necessary for giving the busy-signal. It will be understood, of course, that the battery 8 is preferably grounded at 9 and is suitable for furnishing current to the line-circuits for energizing the line-relays and to the internal circuits for energizing the different magnets of the connector. This in general is the operation of the connector when wired or employed in a circuit arrangement of the character shown; but it is obvious, as previously stated, that the wiring and the circuit arrangement can be varied and changed in accordance with the conditions and requirements of different situations and without departing from the spirit of our invention.

With further reference to the release-magnet, it will be seen that the same is mounted upon a bracket, which also carries the release-armature and its retracting-spring and also the flexible arm or spring-catch for normally holding the double dog out of engagement with the ratchet-teeth on the shaft. In this way the release-magnet, its armature, and the said spring-catch, together with the retracting-spring for the armature, can all be readily removed as a unit from the connector. Furthermore, the screw i^5 can by inserting it through a slot in the spring be employed as the means whereby the spring can adjusted or moved on its support for the purpose of varying or changing the spring tension.

With further respect to the operation of the connector it will be seen that the arrangement is such that a release of the connector after the subscribers have finished their conversation can be brought about by the calling subscriber by simply energizing both of the line-relays through the medium of any suitable means, and in case the calling subscriber fails to make such a release the called subscriber can then release the connector by energizing the back release-relays M. The circuit arrangement shown is, it will be seen, of such character that either method of releasing may be carried out in the usual and well-understood manner. In any event, however, we employ the novel and advantageous feature of releasing the connector immediately upon the energizing of the release-magnet, rather than upon the deënergizing of such magnet. In this way the connector will release instantly and without waiting for the circuit of the release-magnet to be opened.

In Fig. 51 some of the mechanical parts are

shown in a somewhat-different manner from that employed for illustrating them in the other figures of the drawings, inasmuch as this figure is diagrammatic and merely for the purpose of showing the circuits and illustrating the operations. For example, in Fig. 51 only two banks of contacts are shown—that is, all of the line-contacts are shown in one bank, rather than in two banks, as previously described and illustrated. It will be readily understood, however, that the mechanical construction is preferably of the character shown in Figs. 1 to 50, inclusive, and as previously described.

As shown, the different relays are mounted upon the body-frame of the switching-machine, and when thus employed they constitute a part of the connector; but it is obvious that these relays may be located on any suitable support.

The purpose of the spring-switch which is operated by the private magnet and which serves to retract the armature of said magnet is as follows: The upper or normally closed switch-springs are opened to prevent the energizing of the vertical magnet or the rotary magnet or the ringer-relay when the release is made by the calling subscriber, according to the condition of the connector and the position of the side switch. In other words, these upper and normally closed springs are adapted to control the circuits of the vertical and rotary magnets and the ringer-relay and to prevent energization thereof when the calling subscriber makes a release, according to how far the calling operation has progressed. The lower or normally open springs are adapted to close when the connector releases automatically—that is, when the connector is employed in an attempt to call a busy subscriber's line. In other words, the said lower or normally open switch-springs control the circuit of the release-magnet and are therefore desirably closed together when it becomes necessary to obtain an automatic release. The busy release-circuit brought about by the engagement of the private-shaft wiper with a charged or busy private-bank contact extends from ground in the manner explained, through the said normally open switch-springs, and through the release-magnet and directly to the non-grounded pole of the battery. The release-circuit brought about by the releasing of the connector by the calling subscriber, in the usual manner, extends from the non-grounded pole of the battery, through the release-magnet, through the "line-relay springs" 10, which are brought together by the simultaneous energizing of the line-relays, and thence out over the "release trunk line conductor" 11 to some point where it can pass to ground and thence back to the grounded pole of the battery.

It will be understood, of course, that in this patent we have claimed only those novel features and combinations which constitute our joint invention, that we have only claimed those features and combinations not disclosed or found in a selector, and tnat this patent is therefore more or less subordinate to our joint patent of even date herewith.

What we claim as our invention is—

1. A "connector" for automatic telephone systems, comprising a rotatable and endwise-movable switch-shaft having "vertical" and "rotary" ratchet-teeth, an electromagnetically-actuated pawl for engaging the "vertical ratchet-teeth" and thereby giving the said shaft a step-by-step vertical movement, an electromagnetically-actuated pawl for engaging the said "rotary ratchet-teeth" and thereby giving the said shaft a step-by-step rotary motion, a double dog having portions adapted to engage said "vertical" and "rotary" ratchet-teeth to prevent back movement of the shaft during its operation, a "release-magnet," and a "release-armature" adapted when attracted by the said magnet to positively draw the said double dog out of engagement with said ratchet-teeth, and to thereby allow the switch-shaft to restore itself to its normal position, and means for catching and holding the said double dog in its normal position out of engagement with the said ratchet-teeth.

2. A "connector" for automatic telephone systems, comprising an electromagnetically-actuated switch-shaft, switch-contacts operated thereby, a locking device for holding the shaft against back movement during its operation, a "release-magnet," and a "release-armature" adapted when attracted to draw the said locking device into position to release the said shaft, said locking device consisting of a "double dog" adapted when released from its normal position to prevent both endwise and rotary motion of the shaft in a backward direction and there being a line-circuit provided with a pair of bridged line-relays having normally open contacts which control the energizing of said release-magnet and which can only be closed together by the simultaneous energization of said relays.

3. A "connector" for automatic telephone systems, comprising electromagnetically-operated switching means for making the desired connection, a locking device for holding the switching means against back movement, a "release-magnet," and a "release-armature" adapted when attracted by the said magnet to move the said locking device into position to release the said switching means and thereby permit the latter to resume its normal condition, said locking device consisting of a "double dog" adapted when released from its normal position to prevent both endwise and rotary motion of the switching means in a backward direction and there

being a line-circuit provided with a pair of bridged line-relays having normally open contacts which control the energizing of said release-magnet and which can only be closed together by the simultaneous energization of said relays.

4. A "connector" for automatic telephone systems, comprising switch-contacts, a shaft by which the contacts are operated, step-by-step mechanism for operating said shaft, means for locking the switch-contacts in different positions, so as to temporarily maintain any one of a number of possible connections, a "release-magnet," a "release-armature" adapted when attracted by said magnet to withdraw said locking means and thereby release the means for operating the switch-contacts, and spring means for automatically restoring the switch-contacts to normal position upon the energizing of said magnet, said locking means consisting of a "double dog" adapted when released from its normal position to prevent both endwise and rotary motion of the shaft in a backward direction and there being a line-circuit provided with a pair of bridged line-relays having normally open contacts which control the energizing of said release-magnet and which can only be closed together by the simultaneous energization of said relays.

5. A "connector" for automatic telephone systems, comprising switching-contacts, means for operating said contacts, locking means for maintaining the switching-contacts in any desired position so as to temporarily establish any one of a number of possible connections, a "release-magnet," a "release-armature" hung at its upper end and having its lower end adapted to engage the said locking means, spring means for keeping the said armature normally retracted, means for keeping said locking means normally retracted, and for automatically releasing said locking means upon starting the operation of said switching-contacts, the said armature being adapted when attracted by the magnet to withdraw the said locking means and thereby effect a release of the switching-contacts, and automatic means for restoring the released switching-contacts to normal position.

6. A "connector" for automatic telephone systems, comprising switching-contacts and means for operating the same, a locking device for insuring against back movement of the contacts during their operation, a "release-magnet," a flat spring having one end portion suitably mounted and held in a horizontal position, a "release-armature" having its upper end provided with engaging portions by which the armature is hung upon the opposite edge portions of the horizontal portion of the spring, said spring having a couple of side portions adapted to engage the upper end of the armature at points above the axis about which the latter swings, and the spring also having a lower portion adapted to act as a stop to limit the movement of the armature away from the magnet, said armature being adapted when attracted by the magnet to withdraw the said locking device and thereby effect a release of the switching-contacts, together with automatic means for restoring the released switching-contacts to normal position.

7. A "connector" for automatic telephone systems, comprising switching-contacts, and suitable means for operating the same, a bracket having a vertically-disposed lower portion and an upper horizontal portion, a locking device for preventing back movement of the switching-contacts during their operation, a "release-magnet" having one end suitably secured to the vertical portion of said bracket, a flat spring secured to the upper horizontal portion of the bracket, a "release-armature" hung on said spring and normally held away from the magnet by the same, said armature being adapted when attracted to withdraw the said locking device and thereby effect a release of the switching-contacts, and spring means for automatically restoring the released switching-contacts to normal position.

8. A "connector" for automatic telephone systems, comprising switching-contacts and means for operating the same, a locking device for preventing back movement of the switching-contacts during their operation, a spring-catch for normally holding said locking device in an inoperative condition, means for automatically disengaging said catch and releasing the said locking device upon starting the operation of the switching-contacts, a "release-magnet," and a "release-armature" adapted when attracted to withdraw said locking device and thereby effect a release of the switching-contacts, together with spring means for automatically restoring the released switching-contacts to normal position.

9. A "connector" for automatic telephone systems, comprising switching-contacts mounted on the shaft, a "side switch," a locking device for preventing back movement of the shaft during the operation of the "connector," means for normally holding said locking device in an inoperative condition, means for operating the said shaft and the "side switch," automatic means for releasing the said locking device upon starting the operation of the "connector," a "release-magnet," a "release-armature" adapted when attracted by said magnet to withdraw the said locking device, and suitable connections whereby the energizing of said magnet is also accompanied by a restoration of said "side switch" together with a line-circuit, and a pair of line-relays bridged across said line-circuit, said line-relays being provided with a pair of normally separated switch-contacts which control the

energizing of the release-magnet and which can only be closed together by the energizing of both relays.

10. A "connector" for automatic telephone systems, comprising a switch-shaft, means for operating said shaft, a locking device for preventing back movement of the shaft during its operation, a spring-catch for normally holding said locking device in an inoperative position, a "release-magnet," means for automatically throwing said locking device into action upon starting the operation of the "connector," a "release-armature" adapted when attracted by said magnet to withdraw said locking device, a "side switch," and a connection between said "side switch" and locking device whereby the energizing of said magnet and the attraction of said armature is necessarily accompanied by a restoration of both the said shaft and the said "side switch."

11. A "connector" for automatic telephone systems, comprising a switch-shaft provided with "vertical" and "rotary" ratchet-teeth, a double dog having portions adapted to engage both the "vertical" and "rotary" ratchet-teeth to prevent back movement of the shaft during its operation, a stationary support, a spring-catch having one end suitably secured to said support and its other end adapted to engage said double dog and thereby normally hold the latter in an inoperative condition, electromagnetically-actuated means for automatically disengaging said catch and thereby releasing the said double dog upon starting the operation of the "connector," and electromagnetically-operated means for restoring said double dog to its normal position and thereby releasing the shaft, together with spring means for automatically returning the released shaft to its normal position.

12. A "connector" for automatic telephone systems, comprising switching-contacts and means for operating the same, a locking device for preventing back movement of the switching-contacts during their operation, a catch for normally holding the said locking device in an inoperative condition, means for automatically disengaging said catch and releasing the locking device upon starting the operation of the "connector," and electromagnetically-operated means for positively withdrawing said locking device and moving it back into its normal position in engagement with said catch.

13. A "connector" for automatic telephone systems, comprising a rotatable and endwise-movable switch-shaft, locking means for preventing back movement of the shaft during its operation, a device for normally maintaining said locking means in an inoperative condition, means for automatically throwing the said locking means into operation upon starting the operation of the "connector," a "side switch," a "private magnet" having an armature constituting the sole means for electromagnetically setting the "side switch" in motion, a "release-magnet," a "release-armature" adapted when attracted to restore the said locking means to normal condition and thereby effect a release of the switch-shaft, suitable connections whereby the energizing of said "release-magnet" is also accompanied by a restoration of said "side switch" to its normal position, and spring means for restoring the released shaft to its normal position.

14. A "connector" for automatic telephone systems, comprising switching-contacts and means for operating the same, normally inoperative locking means adapted to prevent back movement of the switching-contacts during the operation of the "connector," and after the said contacts have been moved to the desired position, a "side switch," a "private magnet" provided with an armature and constituting the sole means for electromagnetically setting the "side switch" in motion, a "release-magnet," means whereby the said "release-magnet" when energized effects a restoration of said locking means to normal position, suitable connections whereby the energizing of said "release-magnet" is also accompanied by a restoration of the "side switch" to normal position, and a spring-switch for retracting the armature of the "private magnet."

15. A "connector" for automatic telephone systems, comprising switching means and means for locking the same in position to temporarily maintain any one of a number of possible connections, a "release-magnet," a flat spring having its upper horizontal portion adjustably mounted, a "release-armature" having its upper end removably hung upon the edges of the said horizontal portion of the spring, said spring having upwardly-projecting side portions adapted to engage the upper end portions of the armature at points above the axis about which the latter tilts or swings, and the spring also having a lower end portion adapted to act as a stop to limit the movement of the armature away from the magnet, said armature being thereby adapted when attracted to restore the said locking means to normal condition and thus effect a release of the switching means, together with spring means for restoring the switching means when released to normal position.

16. A "connector" for automatic telephone systems, comprising a rotatable and endwise-movable switch-shaft having "vertical" and "rotary" ratchet-teeth, an electromagnetically-actuated pawl for engaging the "vertical ratchet-teeth" and thereby giving the said shaft a step-by-step vertical movement, an electromagnetically-actuated pawl for engaging the said "rotary ratchet-

teeth" and thereby giving the said shaft a step-by-step rotary motion, a double dog having portions adapted to engage said "vertical" and "rotary" ratchet-teeth to prevent back movement of the shaft during its operation, a "release-magnet," and a "release-armature" adapted when attracted by the said magnet to positively draw the said double dog out of engagement with said ratchet-teeth, and to thereby allow the switch-shaft to restore itself to its normal position, and means for catching and holding the said double dog in its normal position out of engagement with the said ratchet-teeth, together with a line-circuit, the "connector" as a whole comprising also a pair of "line-relays" bridged across the line-circuit, means whereby the relays are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

17. A "connector" for automatic telephone systems, comprising an electromagnetically-actuated switch-shaft, switch-contacts operated thereby, a locking device for holding the shaft against back movement during its operation, a "release-magnet," and a "release-armature" adapted when attracted to draw the said locking device into position to release the said shaft, together with a line-circuit, the "connector" as a whole comprising also a pair of "line-relays" bridged across the line-circuit, means whereby the same are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

18. A "connector" for automatic telephone systems, comprising electromagnetically-operated switching means for making the desired connection, a locking device for holding the switching means against back movement, a "release-magnet," and a "release-armature" adapted when attracted by the said magnet to move the said locking device into position to release the said switching means and thereby permit the latter to resume its normal condition, together with a line-circuit, the "connector" as a whole comprising also a pair of "line-relays" bridged across the line-circuit, means whereby the same are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

19. A "connector" for automatic telephone systems, comprising switch-contacts, step-by-step mechanism for operating said contacts, means for locking the switch-contacts in different positions so as to temporarily maintain any one of a number of possible connections, a "release-magnet," a "release-armature" adapted when attracted by said magnet to withdraw said locking means and thereby release the means for operating the switch-contacts, and spring means for automatically restoring the switch-contacts to normal position upon the energizing of said magnet, together with a line-circuit, the "connector" as a whole comprising also a pair of "line-relays" bridged across the line-circuit, means whereby the same are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

20. A "connector" for automatic telephone systems, comprising switching-contacts, means for operating said contacts, locking means for maintaining the switching-contacts in any desired position so as to temporarily establish any one of a number of possible connections, a "release-magnet," a "release-armature" hung at its upper end and having its lower end adapted to engage the said locking means, spring means for keeping the said armature normally retracted, means for keeping said locking means normally retracted, and for automatically releasing said locking means upon starting the operation of said switching-contacts, the said armature being adapted when attracted by the magnet to withdraw the said locking means and thereby effect a release of the switching-contacts, and automatic means for restoring the released switching-contacts to normal position, the "connector" as a whole comprising also a pair of "line-relays" and means whereby the same are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

21. A "connector" for automatic telephone systems, comprising switching-contacts and means for operating the same, a locking device for insuring against back movement of the contacts during their operation, a "release-magnet," a flat spring having one end portion suitably mounted and held in a horizontal position, a "release-armature" having its upper end provided with engaging portions by which the armature is hung upon

the opposite edge portions of the horizontal portion of the spring, said spring having a couple of side portions adapted to engage the upper end of the armature at points above the axis about which the latter swings, and the spring also having a lower portion adapted to act as a stop to limit the movement of the armature away from the magnet, said armature being adapted when attracted by the magnet to withdraw the said locking device and thereby effect a release of the switching-contacts, together with automatic means for restoring the released switching-contacts to normal position, the "connector" as a whole comprising also a pair of "line-relays" and means whereby the same are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

22. A "connector" for automatic telephone systems, comprising switching-contacts, and suitable means for operating the same, a bracket having a vertically-disposed lower portion and an upper horizontal portion, a locking device for preventing back movement of the switching-contacts during their operation, a "release-magnet" having one end suitably secured to the vertical portion of said bracket, a flat spring secured to the upper horizontal portion of the bracket, a "release-armature" hung on said spring and normally held away from the magnet by the same, said armature being adapted when attracted to withdraw the said locking device and thereby effect a release of the switching-contacts, and spring means for automatically restoring the released switching-contacts to normal position, the "connector" as a whole comprising also a pair of "line-relays" and means whereby the same are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

23. A "connector" for automatic telephone systems, comprising switching-contacts and means for operating the same, a locking device for preventing back movement of the switching-contacts during their operation, a spring-catch for normally holding said locking device in an inoperative condition, means for automatically disengaging said catch and releasing the said locking device upon starting the operation of the switching-contacts, a "release-magnet," and a "release-armature" adapted when attracted to withdraw said locking device and thereby effect a release of the switching-contacts, together with spring means for automatically restoring the released switching-contacts to normal position, the "connector" as a whole comprising also a pair of "line-relays" and means whereby the same are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

24. A "connector" for automatic telephone systems, comprising switching-contacts mounted on the shaft, a "side switch," a locking device for preventing back movement of the shaft during the operation of the "connector," means for normally holding said locking device in an inoperative condition, means for operating the said shaft and the "side switch," automatic means for releasing the said locking device upon starting the operation of the "connector," a "release-magnet," a "release-armature" adapted when attracted by said magnet to withdraw the said locking device, and suitable connections whereby the energizing of said magnet is also accompanied by a restoration of said "side switch," together with a line-circuit, the "connector" as a whole comprising also a pair of "line-relays" bridged across the line-circuit, means whereby the same are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

25. A "connector" for automatic telephone systems, comprising a switch-shaft, means for operating said shaft, a locking device for preventing back movement of the shaft during its operation, a spring-catch for normally holding said locking device in an inoperative position, a "release-magnet," means for automatically throwing said locking device into action upon starting the operation of the "connector," a "release-armature" adapted when attracted by said magnet to withdraw said locking device, a "side switch" and a connection between said "side switch" and locking device whereby the energizing of said magnet and the attraction of said armature is necessarily accompanied by a restoration of both the said shaft and the said "side switch," the "connector" as a whole comprising also a pair of "line-relays" and means whereby the same are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

26. A "connector" for automatic telephone systems, comprising a switch-shaft provided with "vertical" and "rotary" ratchet-teeth, a double dog having portions adapted to engage both the "vertical" and "rotary" ratchet-teeth to prevent back movement of the shaft during its operation, a stationary support, a spring-catch having one end suitably secured to said support and its other end adapted to engage said double dog and thereby normally hold the latter in an inoperative condition, electromagnetically-actuated means for automatically disengaging said catch and thereby releasing the said double dog upon starting the operation of the "connector," and electromagnetically-operated means for restoring said double dog to its normal position and thereby releasing the shaft, together with spring means for automatically returning the released shaft to its normal position, the "connector" as a whole comprising also a pair of "line-relays" and means whereby the same are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

27. A "connector" for automatic telephone systems, comprising switching-contacts and means for operating the same, a locking device for preventing back movement of the switching-contacts during their operation, a catch for normally holding the said locking device in an inoperative condition, means for automatically disengaging said catch and releasing the locking device upon starting the operation of the "connector," and electromagnetically-operated means for positively withdrawing said locking device and moving it back into its normal position in engagement with said catch, the "connector" as a whole comprising also a pair of "line-relays" and means whereby the same are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

28. A "connector" for automatic telephone systems, comprising a rotatable and endwise-movable switch-shaft, locking means for preventing back movement of the shaft during its operation, a device for normally maintaining said locking means in an inoperative condition, means for automatically throwing the said locking means into operation upon starting the operation of the "connector," a "side switch," a "private magnet" having an armature constituting the sole means for electromagnetically setting the "side switch" in motion, a "release-magnet," a "release-armature" adapted when attracted to restore the said locking means to normal condition and thereby effect a release of the switch-shaft, suitable connections whereby the energizing of said "release-magnet" is also accompanied by a restoration of said "side switch" to its normal position, and spring means for restoring the released shaft to its normal position, together with a line-circuit, the "connector" as a whole comprising also a pair of "line-relays" bridged across the line-circuit, means whereby the same are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

29. A "connector" for automatic telephone systems, comprising switching-contacts and means for operating the same, normally inoperative locking means adapted to prevent back movement of the switching-contacts during the operation of the "connector," and after the said contacts have been moved to the desired position, a "side switch," a "private magnet" provided with an armature and constituting the sole means for electromagnetically setting the "side switch" in motion, a "release-magnet," means whereby the said "release-magnet" when energized effects a restoration of said locking means to normal position, suitable connections whereby the energizing of said "release-magnet" is also accompanied by a restoration of the "side switch" to normal position, and a spring-switch for retracting the armature of the "private magnet," together with a line-circuit, the "connector" as a whole comprising also a pair of "line-relays" bridged across the line-circuit, means whereby the same are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

30. A "connector" for automatic telephone systems, comprising switching means and means for locking the same in position to temporarily maintain any one of a number of possible connections, a "release-magnet," a flat spring having its upper horizontal portion adjustably mounted, a "release-armature" having its upper end removably hung upon the edges of the said horizontal portion of the spring, said spring having upwardly-projecting side portions adapted to engage the upper end portions of the armature at points above the axis about which the latter tilts or swings, and the spring also having a

lower end portion adapted to act as a stop to limit the movement of the armature away from the magnet, said armature being thereby adapted when attracted to restore the said locking means to normal condition and thus effect a release of the switching means, together with spring means for restoring the switching means when released to normal position, the "connector" as a whole comprising also a pair of "line-relays" and means whereby the same are controllable by a calling subscriber and operative to cause the "connector" to establish connection with the called-subscriber's line, and means whereby said relays are also controllable by a calling subscriber and operative to effect the release and restoration of the "connector" to normal position.

31. A "connector" for automatic telephone systems, comprising a rotatable and endwise-movable switch-shaft having "vertical" and "rotary" ratchet-teeth, an electromagnetically-actuated pawl for engaging the "vertical ratchet-teeth" and thereby giving the said shaft a step-by-step vertical movement, an electromagnetically-actuated pawl for engaging the said "rotary ratchet-teeth" and thereby giving the said shaft a step-by-step rotary motion, a double dog having portions adapted to engage said "vertical" and "rotary" ratchet-teeth to prevent back movement of the shaft during its operation, a "release-magnet," and a "release-armature" adapted when attracted by the said magnet to positively draw the said double dog out of engagement with said ratchet-teeth, and to thereby allow the switch-shaft to restore itself to its normal position, and means for catching and holding the said double dog in its normal position out of engagement with the said ratchet-teeth, together with a line-circuit provided with a pair of bridged line-relays having normally separated contacts which control the energizing of the release-magnet and which can only be closed together by the energizing of both relays, said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

32. A "connector" for automatic telephone systems, comprising an electromagnetically-actuated switch-shaft, switch-contacts operated thereby, a locking device for holding the shaft against back movement during its operation, a "release-magnet," and a "release-armature" adapted when attracted to draw the said locking device into position to release the said shaft, together with a line-circuit provided with a pair of bridged line-relays having normally separated contacts which control the energizing of the release-magnet and which can only be closed together by the energizing of both relays, said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

33. A "connector" for automatic telephone systems, comprising electromagnetically-operated switching means for making the desired connection, a locking device for holding the switching means against back movement, a "release-magnet," and a "release-armature" adapted when attracted by the said magnet to move the said locking device into position to release the said switching means and thereby permit the latter to resume its normal condition, together with a line-circuit provided with a pair of bridged line-relays having normally separated contacts which control the energizing of the release-magnet and which can only be closed together by the energizing of both relays, said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

34. A "connector" for automatic telephone systems, comprising switch-contacts, step-by-step mechanism for operating said contacts, means for locking the switch-contacts in different positions so as to temporarily maintain any one of a number of possible connections, a "release-magnet," a "release-armature" adapted when attracted by said magnet to withdraw said locking means and thereby release the means for operating the switch-contacts, and spring means for automatically restoring the switch-contacts to normal position upon the energizing of said magnet, together with a line-circuit provided with a pair of bridged line-relays having normally separated contacts which control the energizing of the release-magnet and which can only be closed together by the energizing of both relays, said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

35. A "connector" for automatic tele-

phone systems, comprising switching-contacts, means for operating said contacts, locking means for maintaining the switching-contacts in any desired position so as to temporarily establish any one of a number of possible connections, a "release-magnet," a "release-armature" hung at its upper end and having its lower end adapted to engage the said locking means, spring means for keeping the said armature normally retracted, means for keeping said locking means normally retracted, and for automatically releasing said locking means upon starting the operation of said switching-contacts, the said armature being adapted when attracted by the magnet to withdraw the said locking means and thereby effect a release of the switching-contacts, and automatic means for restoring the released switching-contacts to normal position, said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

36. A "connector" for automatic telephone systems, comprising switching-contacts and means for operating the same, a locking device for insuring against back movement of the contacts during their operation, a "release-magnet," a flat spring having one end portion suitably mounted and held in a horizontal position, a "release-armature" having its upper end provided with engaging portions by which the armature is hung upon the opposite edge portions of the horizontal portion of the spring, said spring having a couple of side portions adapted to engage the upper end of the armature at points above the axis about which the latter swings, and the spring also having a lower portion adapted to act as a stop to limit the movement of the armature away from the magnet, said armature being adapted when attracted by the magnet to withdraw the said locking device and thereby effect a release of the switching-contacts, together with automatic means for restoring the released switching-contacts to normal position, said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

37. A "connector" for automatic telephone systems, comprising switching-contacts, and suitable means for operating the same, a bracket having a vertically-disposed lower portion and an upper horizontal portion, a locking device for preventing back movement of the switching-contacts during their operation, a "release-magnet" having one end suitably secured to the vertical portion of said bracket, a flat spring secured to the upper horizontal portion of the bracket, a "release-armature" hung on said spring and normally held away from the magnet by the same, said armature being adapted when attracted to withdraw the said locking device and thereby effect a release of the switching-contacts, and spring means for automatically restoring the released switching-contacts to normal position, said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

38. A "connector" for automatic telephone systems, comprising switching-contacts and means for operating the same, a locking device for preventing back movement of the switching-contacts during their operation, a spring-catch for normally holding said locking device in an inoperative condition, means for automatically disengaging said catch and releasing the said locking device upon starting the operation of the switching-contacts, a "release-magnet," and a "release-armature" adapted when attracted to withdraw said locking device and thereby effect a release of the switching-contacts, together with spring means for automatically restoring the released switching-contacts to normal position, said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

39. A "connector" for automatic telephone systems, comprising switching-contacts mounted on the shaft, a "side switch," a locking device for preventing back movement of the shaft during the operation of the "connector," means for normally holding said locking device in an inoperative condition, means for operating the said shaft and the "side switch," automatic means for releasing the said locking device upon starting the operation of the "connector," a "release-magnet," a "release-armature" adapted when attracted by said magnet to withdraw the said locking device, and suitable connections whereby the energizing of said armature is also accompanied by a restoration of said "side switch," together with a line-circuit provided with a pair of bridged line-re-

lays having normally separated contacts which control the energizing of the release-magnet and which can only be closed together by the energizing of both relays, said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

40. A "connector" for automatic telephone systems, comprising a switch-shaft, means for operating said shaft, a locking device for preventing back movement of the shaft during its operation, a spring-catch for normally holding said locking device in an inoperative position, a "release-magnet," means for automatically throwing said locking device into action upon starting the operation of the "connector," a "release-armature" adapted when attracted by said magnet to withdraw said locking device, a "side switch," and a connection between said "side switch" and locking device whereby the energizing of said magnet and the attraction of said armature is necessarily accompanied by a restoration of both the said shaft and the said "side switch," said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

41. A "connector" for automatic telephone systems, comprising a switch-shaft provided with "vertical" and "rotary" ratchet-teeth, a double dog having portions adapted to engage both the "vertical" and "rotary" ratchet-teeth to prevent back movement of the shaft during its operation, a stationary support, a spring-catch having one end suitably secured to said support and its other end adapted to engage said double dog and thereby normally hold the latter in an inoperative condition, electromagnetically-actuated means for automatically disengaging said catch and thereby releasing the said double dog upon starting the operation of the "connector," and electromagnetically-operated means for restoring said double dog to its normal position and thereby releasing the shaft, together with spring means for automatically returning the released shaft to its normal position, said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

42. A "connector" for automatic telephone systems, comprising switching-contacts and means for operating the same, a locking device for preventing back movement of the switching-contacts during their operation, a catch for normally holding the said locking device in an inoperative condition, means for automatically disengaging said catch and releasing the locking device upon starting the operation of the "connector," and electromagnetically-operated means for positively withdrawing said locking device and moving it back into its normal position in engagement with said catch, said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

43. A "connector" for automatic telephone systems, comprising a rotatable and endwise-movable switch-shaft, locking means for preventing back movement of the shaft during its operation, a device for normally maintaining said locking means in an inoperative condition, means for automatically throwing the said locking means into operation upon starting the operation of the "connector," a "side switch," a "private magnet" having an armature constituting the sole means for electromagnetically setting the "side switch" in motion, a "release-magnet," a "release-armature" adapted when attracted to restore the said locking means to normal condition and thereby effect a release of the switch-shaft, suitable connections whereby the energizing of said "release-magnet" is also accompanied by a restoration of said "side switch" to its normal position, and spring means for restoring the released shaft to its normal position, together with a line-circuit provided with a pair of bridged line-relays having normally separated contacts which control the energizing of the release-magnet and which can only be closed together by the energizing of both relays, said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

44. A "connector" for automatic telephone systems, comprising switching-contacts and means for operating the same, nor-

mally inoperative locking means adapted to prevent back movement of the switching-contacts during the operation of the "connector," and after the said contacts have been moved to the desired position, a "side switch," a "private magnet" provided with an armature and constituting the sole means for electromagnetically setting the "side switch" in motion, a "release-magnet," means whereby the said "release-magnet" when energized effects a restoration of said locking means to normal position, suitable connections whereby the energizing of said "release-magnet" is also accompanied by a restoration of the "side switch" to normal position, and a spring-switch for retracting the armature of the "private magnet," together with a line-circuit provided with a pair of bridged line-relays having normally separated contacts which control the energizing of the release-magnet and which can only be closed together by the energizing of both relays, said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

45. A "connector" for automatic telephone systems, comprising switching means and means for locking the same in position to temporarily maintain any one of a number of possible connections, a "release-magnet," a flat spring having its upper horizontal portion adjustably mounted, a "release-armature" having its upper end removably hung upon the edges of the said horizontal portion of the spring, said spring having upwardly-projecting side portions adapted to engage the upper end portions of the armature at points above the axis about which the latter tilts or swings, and the spring also having a lower end portion adapted to act as a stop to limit the movement of the armature away from the magnet, said armature being thereby adapted when attracted to restore the said locking means to normal condition and thus effect a release of the switching means, together with spring means for restoring the switching means when released to normal position, said "connector" as a whole comprising also a ringer-relay having a normally open circuit provided with a plurality of switch-points whereof one is normally open but closed while the "connector" is in use and then reopened immediately upon the energizing of the said electromagnetic means provided for effecting a restoration of the "connector" to normal position.

Signed by us at Chicago, Cook county, Illinois, this 17th day of April, 1905.

ALEXANDER E. KEITH.
JOHN ERICKSON.
CHARLES J. ERICKSON.

Witnesses:
W. LEE CAMPBELL,
R. C. GIFFORD.