No. 786,429. PATENTED APR. 4, 1905.

R. C. DEUBEN.

SELECTIVE SIGNALING SYSTEM.

APPLICATION FILED OCT. 2, 1903.

3 SHEETS—SHEET 1.

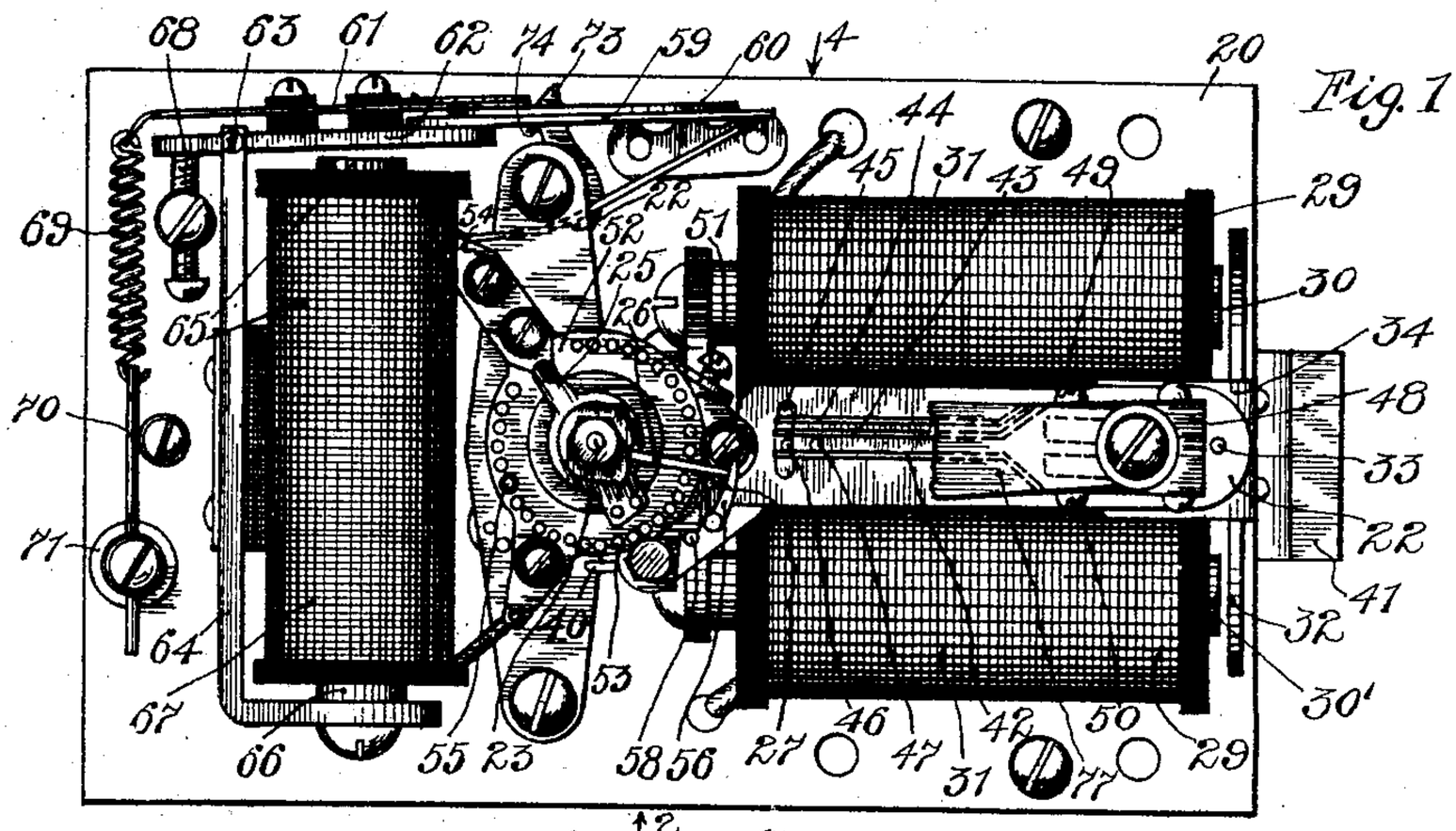

Fig. 1

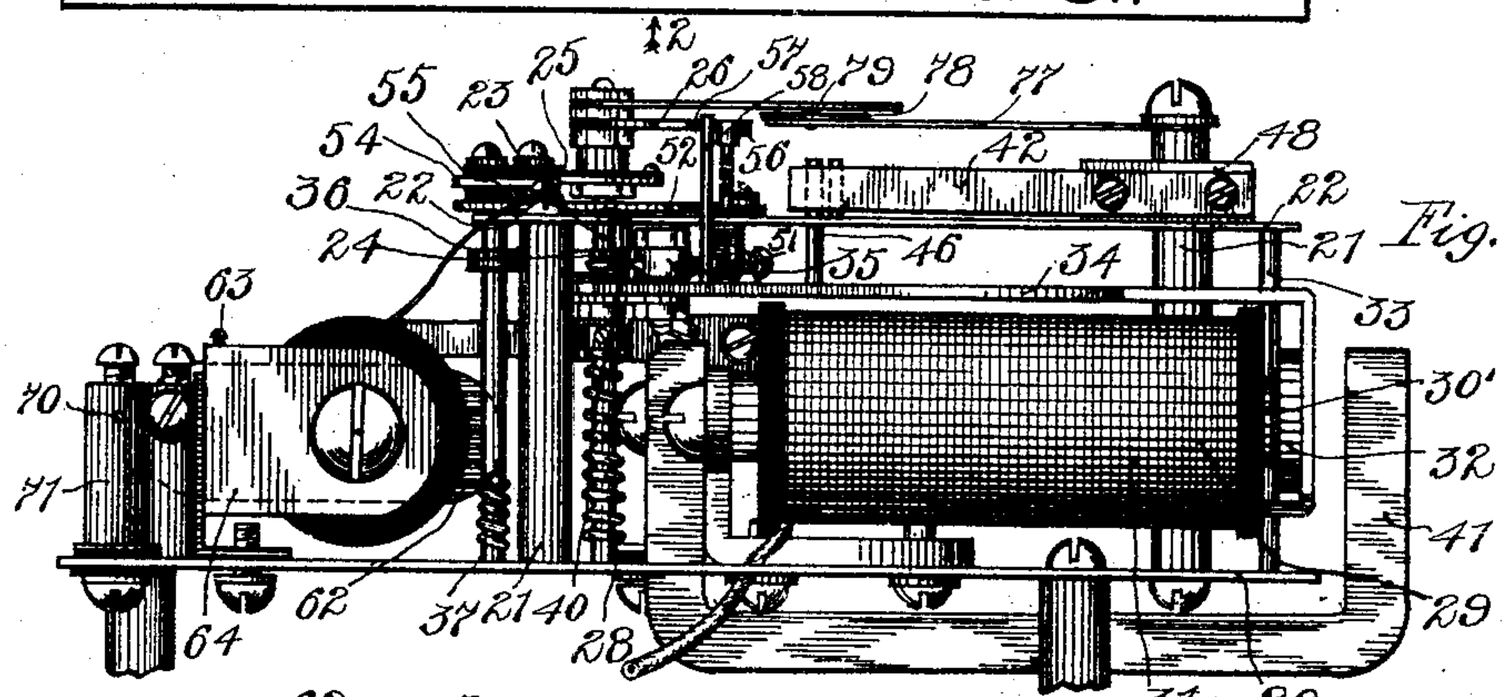

Fig. 2

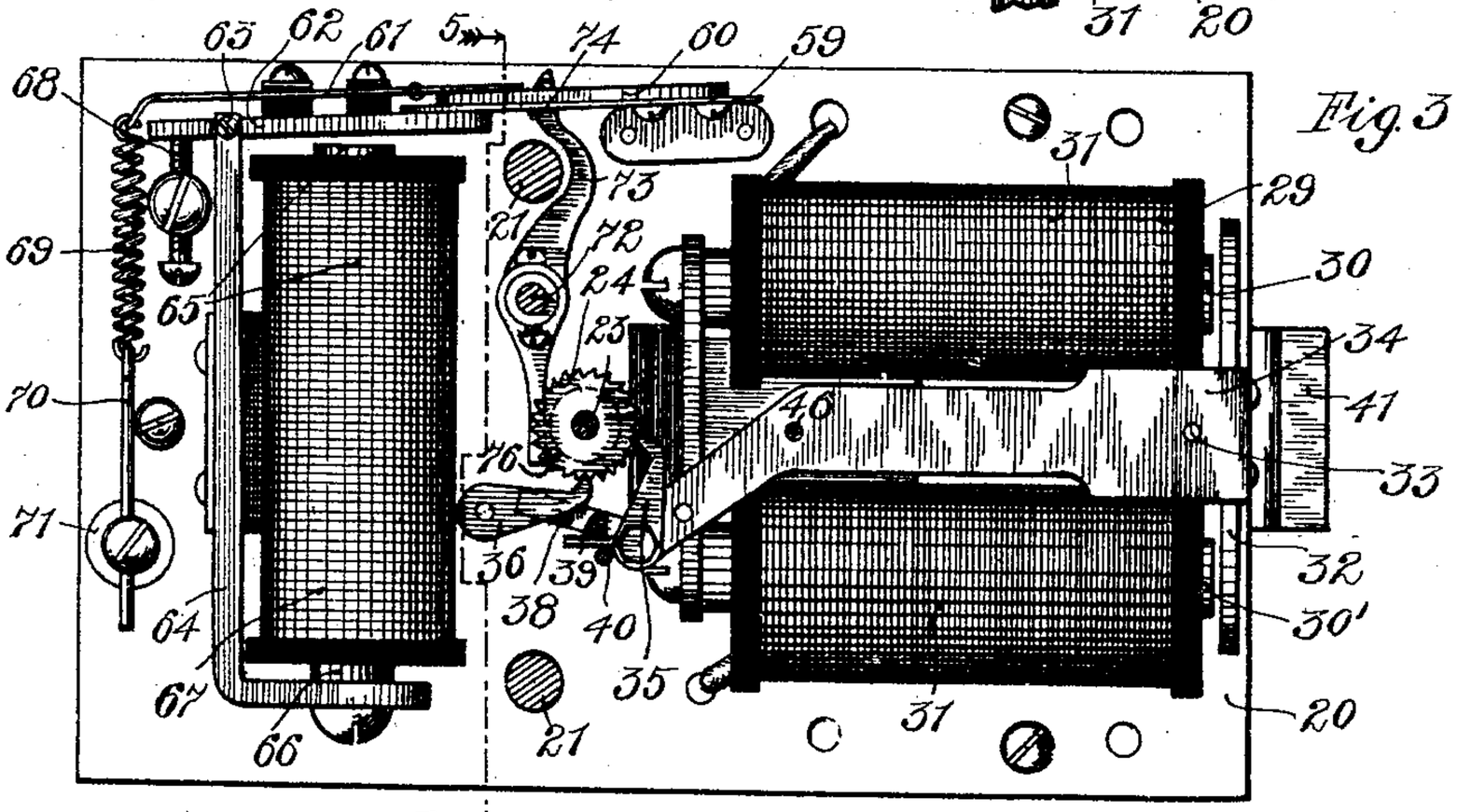

Fig. 3

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3 SHEETS—SHEET 2.

Fig. 4

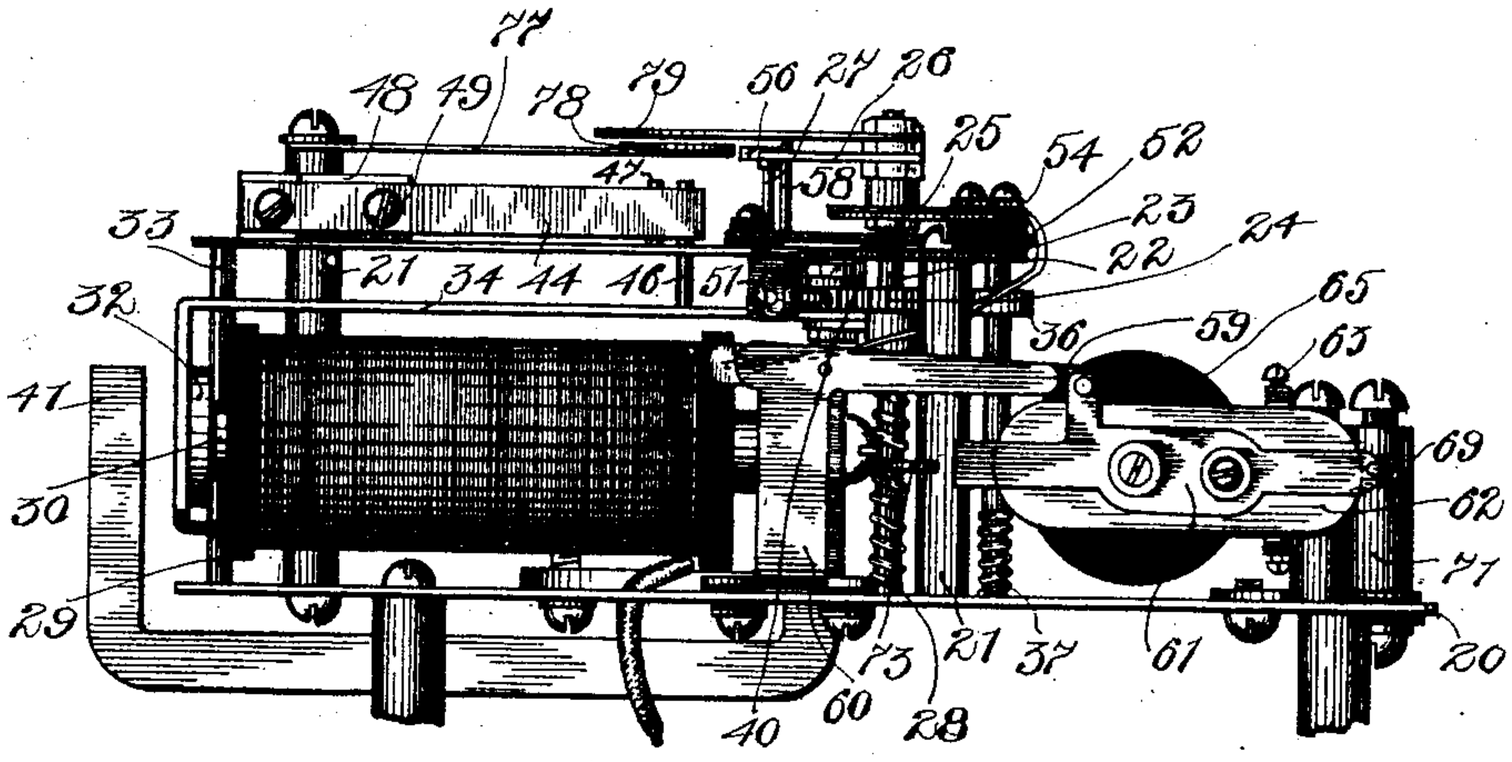
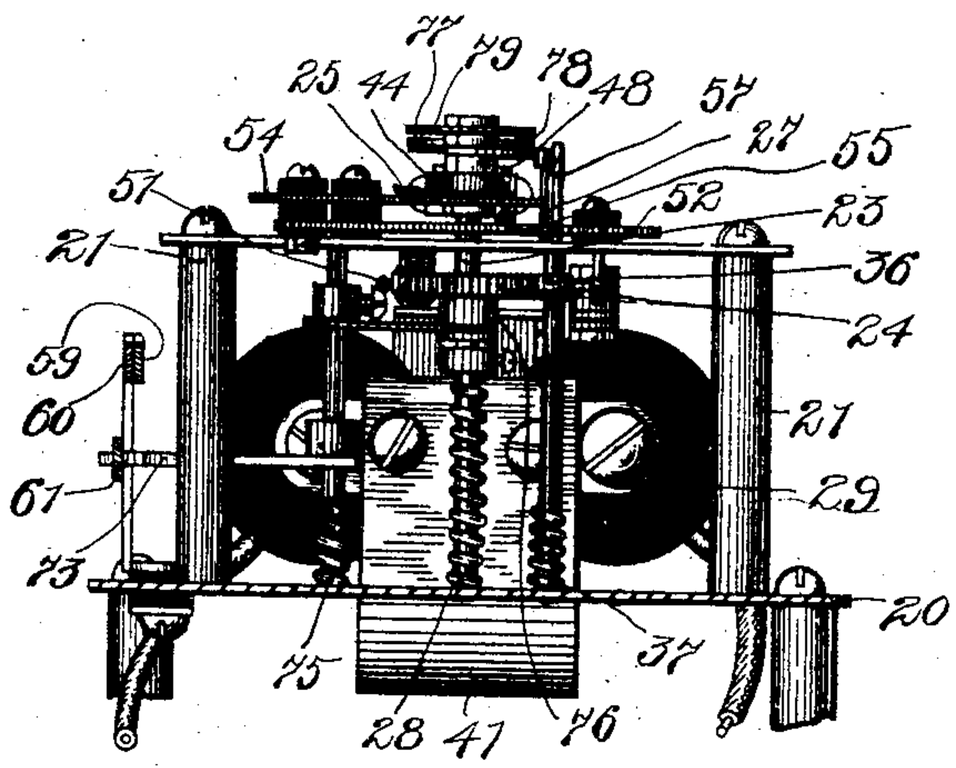


Fig. 5



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3 SHEETS—SHEET 3.

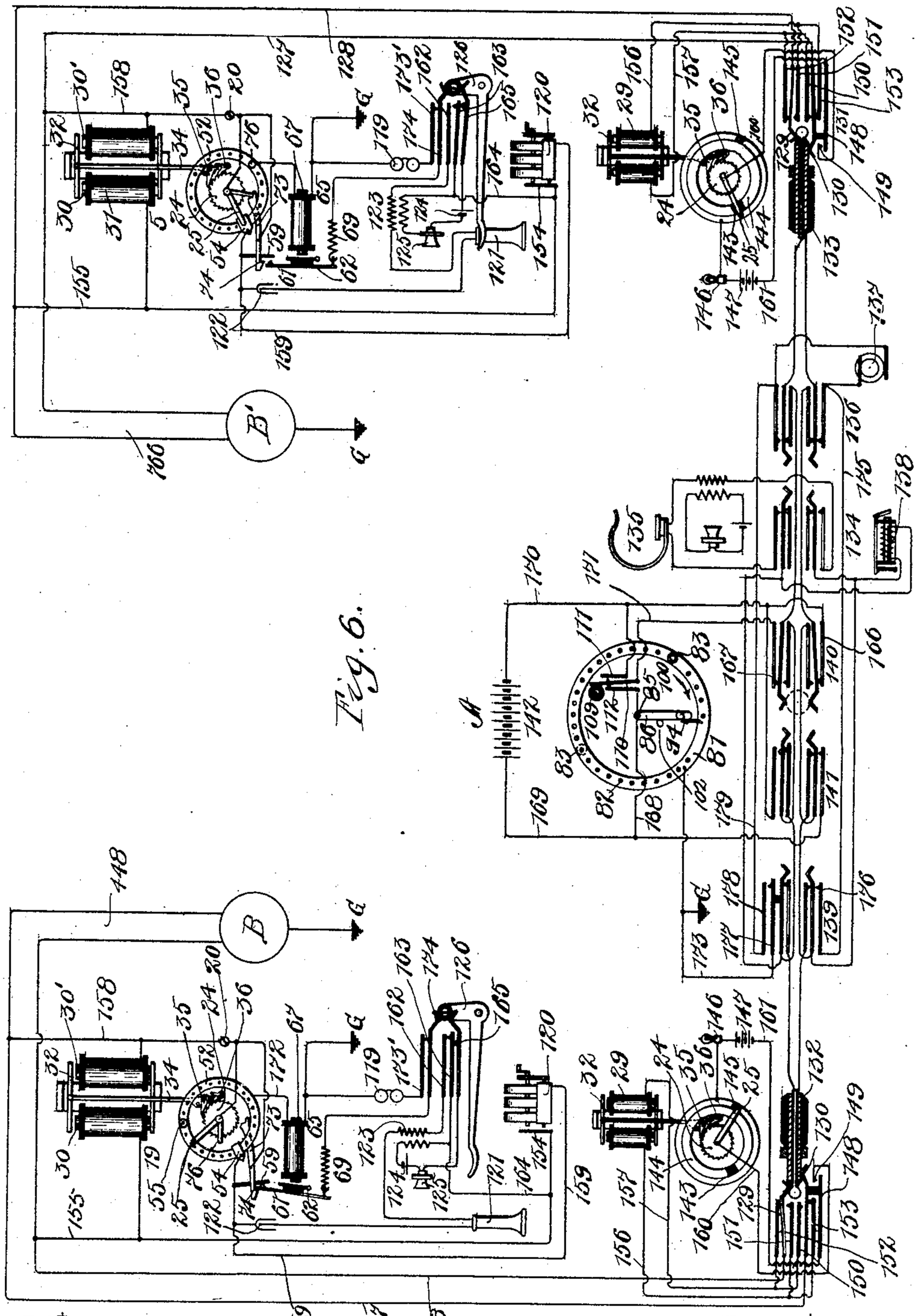

Fig. 6.

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No. 786,429. Patented April 4, 1905.

UNITED STATES PATENT OFFICE.

RUDOLPH C. DEUBEN, OF CHICAGO, ILLINOIS, ASSIGNOR TO STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

SELECTIVE SIGNALING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 786,429, dated April 4, 1905.

Application filed October 2, 1903. Serial No. 175,407.

To all whom it may concern:

Be it known that I, RUDOLPH C. DEUBEN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Selective Signaling Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to telephone systems, and more particularly to telephone systems employing multiparty-lines in which a large number of subscribers are connected with each party-line, any one of which subscribers may be selected for signaling and conversation.

My invention consists principally in the provision of certain improved substation selective apparatus, which will be hereinafter more particularly described.

The embodiment of my invention herein disclosed is particularly well adapted for use in conjunction with a multiparty-line telephone system described and claimed in Patent No. 763,351, issued June 28, 1904, to Garrison Babcock, and I shall describe my invention as applied to such a telephone system.

I have illustrated in the accompanying drawings the specific details of one embodiment of my invention and a party-line telephone system to which my invention may be applied.

In the drawings, Figure 1 is a plan view of the selective switching apparatus which is installed at each of the party-line substations. Fig. 2 is a side elevation of the same, taken in the direction of the arrow 2 of Fig. 1. Fig. 3 is a plan view with parts removed to more clearly indicate details of construction. Fig. 4 is a side elevation taken in the direction of the arrow 4 of Fig. 1. Fig. 5 is a cross-sectional view taken on line 5 5 of Fig. 3. Fig. 6 is a diagrammatic view illustrating the circuit connections to be used in electrically connecting and operating the devices illustrated in the other figures.

Referring more particularly to Figs. 1 to 5, inclusive, I have illustrated a base-plate 20, upon which the pillars 21 support the T-shaped frame-piece 22. There is rotatably mounted within the base 20 and frame-piece 22 a shaft 23, which carries a ratchet-wheel 24 below the frame-piece 22 and a spring switch-arm 25 above the frame-piece 22. The shaft 23 also carries a projecting arm 26, which is normally held in engagement with the stop-pin 27, due to the slight tension of a spring 28, coiled about the shaft 23, one end of the spring being fastened to the shaft and the other to the base-plate 20. There is mounted upon the base-plate 20 an electromagnet 29, having cores 30 30′ and coils 31 31. An armature 32 for this electromagnet is provided on the shaft 33. The armature is rigidly connected with the lever-arm 34, which carries near its extremity a pivoted pawl 35, which is held by a concealed spring in engagement with the teeth of the ratchet-wheel 24. A relatively stationary pawl 36 is held by the spring 37 in engagement with the ratchet-wheel 24. A projection 38, secured to the end of the lever 34, serves upon a movement of the lever away from the shaft 23 to disengage the pawl 36 from the teeth of the ratchet-wheel 24. This same movement of the lever 34 away from the ratchet-wheel 24 causes a pin 39, projecting from the pawl 35, to engage a stop-pin 40, carried by the T-shaped frame-piece 22, thereby causing a disengagement of the pawl 35 from the ratchet-wheel 24. A suitable opening in the base-plate 20 provides for the reception of the permanent magnet 41, which is fastened to the yoke of the electromagnet 29. This permanent magnet serves to polarize the armature 32, whereby the passage of a current through the electromagnet-coils 31 31 in one direction causes the attraction of the armature 32 to the pole-piece of the core 30, while the passage of a current through the electromagnet-coils in the reverse direction causes the attraction of the armature toward the pole-piece of the core 30′. The attraction of the armature toward the pole of the core 30′, due to the passage of a suitable current impulse, causes a movement of the lever 34 toward the switch-shaft 23 a sufficient distance to advance the ratchet-wheel

24 one tooth, the pawl 36 dropping into a succeeding tooth of the ratchet-wheel, thereby retaining it in its advanced position, while the pawl 35 may slip back over the advanced tooth to engage the succeeding tooth upon the discontinuance of the passage of the current through the electromagnet-coils. In order that the armature 32 and the lever 34 normally may be held and retained in the position shown in the figures, the flat springs 42, 43, and 44 are provided. An opening 45 is provided in the T-shaped frame-piece 22, through which opening there projects a pin 46, carried by the lever 34. A pin 47, secured to the frame-piece 22, limits the inward movement of the springs 42 and 43. A movement of the lever 34 toward the switch-shaft 23 acts against the tension first of the spring 43 and upon the further continued movement against the tension of the spring 44, the two springs being provided in order that the initial movement of the lever 34 and armature 32 shall not be opposed by a too great resisting force or spring tension. The two springs 43 and 44 act in unison to prevent the armature 32 or lever 34 from sticking or catching in their alternate or abnormal position when attracted by the pole of the core 30′ and repelled by the pole of the core 30. The pin 47 prevents the springs 43 or 44 from following up the movement of the pin 46 when it moves with the lever away from the switch-shaft 23. The spring 42 serves to restore the lever and its armature to the normal position shown after having been actuated by the attraction toward the pole of the core 30′. The pin 47, it will be seen, also serves to retain the armature and the lever carried thereby in exactly the proper normal position when not under the influence of the energization of the electromagnet 29. An attraction of the armature 32 by the pole-piece of the core 30 causes a movement of the lever 34 away from the switch-shaft 23, whereby both the pawls 35 and 36 are disengaged from the teeth of the ratchet-wheel 24, thereby permitting the spring 28 to cause the backward rotation of the shaft 23 and the parts carried thereby until the arm 26 comes into contact with the stop-pin 27, thereby arresting the movement of the switch-carrying mechanism to retain it in its normal position shown in the drawings. The springs 42, 43, and 44 are mounted upon a carrying-block 48, secured to the T-shaped frame-piece 22, there being provided adjusting-screws 49 and 50 for the purpose of regulating the tension of the springs, an adjusting-screw 51, carried on a downward projection of the frame-piece 22, providing a stop for limiting the movement of the pawl 35 to the space of one tooth of the ratchet-wheel 24. There is mounted upon the T-shaped frame-piece 22 a metal ring 52, this ring being insulated from the frame by suitable washers and bushings of hard rubber, as shown. The periphery of the ring is provided with a series of screw-threaded holes 53, the pitch of these holes corresponding with the pitch of the teeth of the ratchet-wheel 24. There is mounted upon a suitable projection of the ring 52 an insulated contact-piece 54. Within any of the screw-threaded holes 53 53 there may be screwed a contact-point 55. Thus in Figs. 1 to 5, inclusive, a contact-point 55 is shown in the seventh hole 53 of the ring 52. The pitch of the holes 53 and that of the teeth of the ratchet-wheel 24 being equal, it will be apparent that each step of the step-by-step rotation of the switch-arm 25 is equal to the arc distance between the successive holes 53. The normal position of the switch-arm 25 is, as shown in the figures, in contact with the insulated contact-piece 54. The first step of the movement of the switch-arm is desirably sufficient to remove the switch-arm from its contact with the contact-piece 54 and to bring the switch-arm half-way to the first holes 53 of the ring 52. The second step brings the switch-arm directly above the first hole 53. The next succeeding step brings the switch-arm above the second hole, and so on. Thus it will be seen that eight current impulses through the electromagnet-coils 31 31 in the proper direction will cause eight steps of the switch-arm 25 to bring it in contact with the contact-screw 55. Similarly, a proper number of current impulses through the electromagnet-coils will bring the switch-arm 25 into contact with a contact-screw 55, placed in any of the holes 53. The number of holes in the ring 52 is desirably made as great as the greatest number of substations which it will be desired at any time to connect with the single party-line, each substation connected with one party-line having a contact-screw 55 in some one of the holes 53 of the ring 52, the contact-screw for each substation being placed in a different hole from that of any other of the substations on the same line. As will hereinafter be more fully explained, the switch-arm 25 is during each selecting operation stepped around above the ring 52 a number of steps at least as great as the number of telephone-substations connected with the party-line plus two. Upon the completion of the conversation with a telephone subscriber it is necessary to restore the selecting apparatus to its normal condition, in which the switch-arm 25 makes contact with the contact-piece 54. In order to cause this restoration, a current impulse is sent through the coils of the electromagnet 29 in such a direction that the armature 32 is attracted toward the pole of the core 30, whereby the lever 34 is given a movement away from the shaft 23. This disengages both of the pawls 35 and 36 from the ratchet-wheel 24, whereupon the spring 28 causes a backward rotation of the shaft 23 and the parts carried thereby until the arm 26 engages the pin 27. In order that the shaft 23 and the rotating parts

carried thereby may not rebound upon striking the pin 27 and during such rebound be stopped by the reëngagement of the pawl 35 or 36, thereby leaving the switch-arm 25 out of electrical contact and connection with the contact-piece 54, I provide a pivoted detent 56, which is raised upon the backward movement of the arm 26, but which drops into position as shown to catch the arm 26, and thus prevent its forward rebound. The arm 26 is thus locked between the pin 27 and the catch of the detent 56. In order that the detent may be raised to permit a forward movement of the arm 26 upon the attraction of the armature 32 toward the pole of the core 30′, there is provided upon the detent 56 a projecting pin 57, adapted to be engaged by a stud 58, carried on the lever 34. An engagement of the pin 57 by the stud 58 upon the movement of the lever 34 toward the shaft 23 causes the detent 56 to rise, thereby disengaging the arm 26 to permit its forward movement, as hereinbefore described.

In order to connect the subscriber's telephone instruments in bridge of the metallic line-limbs, there is provided a telephone connecting-switch, comprising a spring-contact 59, carried upon an insulated support 60, and an insulated switch-arm 61, mounted upon the armature 62, which is pivotally mounted at 63 to the L-shaped iron yoke 64 of the electromagnet 65, whose core 66 carries the winding 67. An adjustable stop 68 serves to limit the retraction of the armature 62 from the pole of the core 66, due to the tension of the retracting-spring 69, the tension of this spring being adjustable by means of the rod 70 and its supporting-pillar 71. The electrical connection with the switch-arm 61, which will hereinafter be more fully explained, is desirably made through the supporting-pillar 71 and the spring 69, the pillar 71 being for this purpose insulated from the metal base 20.

There is mounted upon a suitable shaft 72 a detent-lever 73, having a catch 74 to engage the end of the switch-arm 61 to retain the switch-arm in its forward or attracted position after having been brought into this forward position by an energization of the electromagnet 65 and the consequent attraction of the armature 62. The shaft 72 is for this purpose provided with a spring 75, which tends to force the catch 74 into engagement with the end of the switch-arm 61. As will hereinafter more fully appear, it is desirable that at the time of releasing the switch-arm 25 of the selective apparatus to restore the same to its normal position in connection with the contact-piece 54 the telephone contact switch-arm 61 be released to break the contact which may have been made with the spring-contact 59.

There is provided upon the hub of the ratchet-wheel 24 a projection 76 in the nature of a cam-surface, this projection serving when in its normal position, with the switch-arm 25 in connection with the contact-piece 54, to engage the inner end of the lever 73 to trip the catch 74, thereby releasing the switch-arm 61, which may have been detained thereby. The first forward step of the ratchet-wheel 24 permits a disengagement of the inner end of the lever 73 by the projection or cam 76, whereupon the spring 75 gives the lever 73 a downward movement such that the catch 74 will be in position to engage and detain the switch-arm 61 upon its forward movement, due to the attraction of the armature 62.

While it does not in any manner form an essential part of my invention, I have illustrated a subscriber's busy-signal, which shall indicate to a subscriber whether or not the party-line with which his substation is connected is in use. There is supported by an arm 77, connected with one of the pillars 21, a colored disk 78, this disk being normally covered, and thereby protected from view, by a shutter 79, mounted upon the upper end of the shaft 23. It will be seen that a forward movement of the shaft 23 carries the shutter 79 in a forward direction, whereupon the disk 78 is exposed to view, thereby indicating that the party-line is in use. A release and restoration of the switch-arm 25 to its normal position returns the shutter 79 to its position above the disk 78.

While the precise method of operating the hereinbefore-described instruments will hereinafter more fully appear, it may be desirable to here state that the selective apparatus at the substations is adapted to be actuated in selecting and connecting the desired substation with the party-line by means of suitable current impulses in one direction through the coils of the electromagnet 29. The restoration of the apparatus to its normal condition is accomplished by the passage of a current impulse through the electromagnets 29 in a reverse direction. The operation of the telephone connecting-switch to connect the subscriber's telephone set in bridge of the metallic line-limbs is accomplished by sending at the proper instant a current impulse through the electromagnet 65.

In addition to the usual central-station apparatus required for the operation of a telephone system there is desirably provided at the central station automatic mechanism for controlling and directing the current impulses sent out over a party-line for the purpose of operating the selective apparatus, such mechanism being shown and described in detail in my copending application, Serial No. 157,591, filed May 18, 1903. This apparatus is diagrammatically shown in Fig. 6. A metallic ring 81 is provided with openings 82, in which contact-pins 83 are adapted for insertion. A central shaft 85 carries at its upper end a crank 86, provided with a contact arm or spring 94,

adapted when said crank is rotated to engage the contact-pins inserted in the openings 82. Spring mechanism (not shown) is provided for turning the crank to its initial position upon backward rotation thereof, while ratchet mechanism (not shown) affords driving connection between shaft 85 and a cam 109. This cam engages a contact-spring 110, adapted upon actuation of the cam to alternately engage with contact-springs 111 and 112. A stop 102 is also provided for limiting the backward rotation of the crank.

In Fig. 6 I have diagrammatically illustrated the method of electrically connecting the hereinbefore-described apparatus and the other devices well known to those skilled in the art and commonly employed in the operation of telephone systems. I have illustrated a central station A, from which the bimetallic telephone-lines 448 and 766 extend, each to a series of substations connected therewith. While the number of substations connected with those lines may be indefinite, I have illustrated in detail the apparatus for but one substation connected with each line, the circles B and B′ indicating that other substations may be similarly connected with the telephone-lines. The substation connected with line 448, and whose apparatus is diagrammatically illustrated in detail, may be station No. 19. The apparatus shown in detail connected with line 766 may be that at substation No. 5. There are provided at each of the substations a signal-bell 119 and a generator 120, adapted to supply an intermittent or pulsating direct current of one polarity, and a receiver 121, adapted to be connected in circuit only through the condenser 122, the circuit through the receiver including the secondary of an induction-coil 123, whose primary is connected through the local battery 124, and a transmitter 125. The hook-switch 126 is provided for the accommodation of the receiver 121 when not in use, there being associated with the hook-switch certain switch-contacts, which will hereinafter be more fully described. The line-limbs 127 and 128 lead from the substation to the central station, where they are connected one with the tip-spring 129 and the other with the sleeve-spring 130 of a line-jack 131, the jack-springs being adapted for connection with the tip and sleeve contacts of an answering-plug 132 or a calling-plug 133 of an operator's suitable cord connecting apparatus. There are associated with the tip and sleeve springs of the jack 131 other contact-springs, whose purpose will hereinafter more fully appear. Under normal conditions, such as are shown in the drawings, there is a continuous circuit through the tip-strand leading between the tip-contact of the answering and calling plugs and a continuous sleeve-strand between the sleeve-contacts of these plugs. The usual operator's ringing and listening keys are provided, the listening-key 134 serving to connect the operator's telephone set 135 in bridge of the cord-strands. The ringing-key 136 serves to connect the ringing-generator 137 with the cord-strands leading to the calling-plug 133. This common ringing-key 136 is employed only when the calling-plug is inserted within the jack of a bimetallic circuit in which the ringing-current traverses the two metallic line-limbs. It is provided for the reason that it is frequently desirable to connect a party-line subscriber with a subscriber who has an individual line. This key 136 performs no useful function and is not operated in any way when subscribers on two party-lines are connected one with the other, as will hereinafter be more particularly described. The clearing-out drop 138 may be connected in bridge of the cord-circuit, as shown. The cord-circuit is provided, in addition to the usual listening-key and the common ringing-key, with a selective ringing-key 139, which connects one terminal of the generator 137 with the sleeve-strand of the cord-circuit and the other terminal of the generator 137 with the ground G. The calling-key 140 connects the automatic selector with the cord-strands leading to the calling-plug. The releasing-key 141 serves to connect the operating-battery with the cord-strands leading to the calling-plug for the purpose of releasing and restoring the selective apparatus at the substations connected with a line to their normal condition. There is provided at the central station a battery or other source of current 142, adapted to supply current for the purpose of operating the selective apparatus. There is provided at the central station for each of the party-lines what may be called a "dummy subscriber's selective device," this selecting device comprising step-by-step switching mechanism which is identical with that hereinbefore described as installed at each of the subscribers' substations, the switch-arm 25 of the dummy set, however, normally resting on a hard-rubber insulator 143. When stepped forward from the normal position, the switch-arm makes contact with a continuous metal ring 144. The forward movement of the switch-arm 25 may be limited by a stop-pin 145. The line signal-lamp 146 and a serially-connected battery 147 includes in its circuit the ring 144, the switch-arm 25, and contacts 148 and 149, associated with the spring-jack 131, these contacts being normally in connection one with the other when the cord connecting-plug is not inserted within the jack. The insertion of a plug within the jack causes a break in the circuit between the contacts 148 and 149. The electromagnet 29 of the dummy selective apparatus at the central station is normally connected, by means of contact-springs 150 and 151, with the jack-springs connected with the line-limbs 127 and 128. An insertion of a cord connecting-plug with the jack 131 causes a connection with the

contact-springs 152 and 153, whereby the connection of the electromagnet with the line-limbs is reversed.

The operation of a telephone system utilizing the apparatus of my invention may be described as follows: The selective apparatus at the substations connected with line 448 being in their normal position, as illustrated in Figs. 1 to 5, inclusive—such, for instance, as the subscriber at station No. 19 on line 448, desiring a connection, examines the target busy-signal to ascertain if the line is not in use by other subscribers. He then manipulates his ringing-generator 120, this generator producing an intermittent or pulsating direct current in which the pulsations are all in one direction as distinguished from the well-known alternating generators in which the impulses are first in one direction and then in the reverse direction. He then removes his telephone from its switch-hook. The generator 120 is provided with a contact-switch 154, which makes a connection with the armature-winding only when the generator is being operated by means of the hand-crank provided. The plug 132 is normally not in the jack 131, as shown. A current therefore may be traced from the generator 120 through the following circuit: from the switch 154, through the conductor 155, to the line-limb 128, the tip-spring 129, the contact 151, the conductor 156, the coils of the electromagnet 29 of the dummy instrument at the central station, to the conductor 157, contact-spring 150, sleeve-spring 130, line-limb 127, conductor 158, to the frame 20 of the selective instrument at substation No. 19, through the frame 20 to the switch-arm 25, the contact-piece 54, and through conductor 159, to the other terminal of the generator 120. It will be noted that the coils 31 of the electromagnets 29 at all of the substations connected with line 448 are connected in bridge of the metallic line-limbs, the coils 31 at substation No. 19 being connected by way of the conductors 155 and 158. The polarization of the armatures 32 of the selective apparatus at all the substations is in the same direction, and the direction of the current impulses generated by the generator 120 is such as to cause an attraction of the armatures 32 toward the poles of the cores 30 of the electromagnets 29. The consequent movement of the levers 34, if there be any movement thereof, is in such a direction as to release the ratchet-wheel and cause a restoration of the switch 25 to its normal position. This effect, however, is merely incidental, as when the apparatus is properly operated all of the switches 25 will be normally in connection with their associated contact-pieces 54, whereupon no releasing or restoration of the switches is necessary at the time of signaling by means of the generator 120, located at any of the substations. Normally—that is, when the plug is out of the jack—the polarization of the dummy instrument at the central station and its direction of connection with the line-limbs 127 and 128 are such that the current from the generator 120, which tends to release and restore the selective apparatus at the substations, will cause a forward movement of the switch-arm 25 of this dummy instrument. The number of forward impulses given the switch-arm 25 of the dummy instrument is immaterial so long as there be sufficient impulses (one or more) to remove the switch-arm from the insulating-block 143. Upon this forward movement of the switch-arm 25 the following circuit through the lamp 146 may be traced: from the battery 147, through the lamp 146, to the metal ring 144, the switch-arm 25 of the dummy instrument, the conductor 160, the contact 149, the spring 148, which before the insertion of the plug of the cord connecting apparatus within the jacket is in electrical contact with the contact 149, thence through the conductor 161 to the other terminal of the battery 147. The line signal-lamp is thereupon caused to glow, thus giving the operator a visual signal to indicate that a subscriber on line 448 desires a telephonic connection with some other subscriber. The dummy selective instrument placed at the central station thus serves the purpose of the line relay, which is commonly employed to control the illumination of a line signal-lamp. The operator answers the signal produced by the illumination of the lamp 146 by inserting the calling-plug 133 within the answering-jack 131. The insertion of the plug within the jack 131 causes a break in the contact between the contacts 148 and 149, thus interrupting the circuit through the lamp 146, whereupon the lamp is extinguished, indicating that the signal has been answered by the operator. At the same time the insertion of the plug within the jack 131 changes the direction of connection of the electromagnets 29 of the dummy instrument at the central station with the line-limbs 127 and 128, whereupon the movements of the armature 32 of the dummy instrument are made to correspond with the movements of the armatures 32 of the selective apparatus connected in bridge of the corresponding line. The operator thereupon manipulates her listening-key 134 to connect her telephone set in bridge of the cord-strands connected with the line-limbs 127 and 128, whereupon she may converse with the subscriber at substation No. 19 on line 448 over the following circuit: from the condenser 122 at the subscriber's substation, through the receiver 121, the secondary winding of the induction-coil 123, the closed contact-springs 162 and 163, associated with the switch-hook 126, the conductor 164, the conductor 155, the line-limb 128, tip-spring 129, the tip-strand of the cord-circuit leading to the tip-contact of the plug 133, the operator's telephone set, the sleeve-strand of

the cord-circuit leading to the sleeve-contact of plug 133, the sleeve-spring 130, line-limb 127, conductor 158, frame 20, switch-arm 25, contact 54, and condenser 122. The subscriber may impress voice-currents upon this circuit through the condenser 122 by means of a local circuit through the transmitter and primary of the induction-coil 123, this local circuit including the spring 165, associated with the switch-hook 126 and the local battery 124. The operator at the central station learns from the calling subscriber, first, the party-number of his own substation, (in this case No. 19,) and, secondly, the number of the substation with which the calling subscriber desires connection. Supposing the called substation to be No. 5, the operator first inserts a pin in hole No. 19 of the ring 81 of the automatic selector at the central station. She then turns the crank 86 in the direction indicated by arrow 100 until stopped by the stop 102, and the crank upon release will be returned to its normal position. The consequent revolution of the cam 109 causes the intermediate contact-spring 110 to make contact first with the spring 112 and thereafter alternately with springs 111 and 112. Before releasing the crank 86 the operator manipulates her calling-key 140, thereupon breaking the cord-circuit connection with the plug 132 and connecting the strands of the cord-circuit leading to plug 133 with contact-springs 166 and 167. During the first quarter-revolution of the cam 109 the springs 110 and 112 are brought into contact with each other, whereupon the following circuit may be traced: from the spring 112, through the conductors 168 and 169, the battery 142, the conductor 170, the contact-spring 166, the sleeve-strand of the cord-circuit leading to the sleeve-contact of plug 133, the sleeve-spring of the jack 131, within which this plug has been inserted, the line-limb 127, conductor 158, electromagnet-coils 31 of all the selective apparatus connected in bridge of the line 448, conductor 155, line-limb 128, tip-spring 129, the tip-strand of the cord-circuit, contact-spring 167, conductor 171, to contact-spring 110. The current-flow through this circuit is in such a direction that the armatures 32 of all the selective apparatus are attracted toward the cores 30′, thereby advancing the switch-arms 25 of all the selective apparatus associated with line 448 through one step. The cessation of the flow of current through this circuit due to its interruption on account of the break in the contact between springs 110 and 112 permits the armatures 32 and associated levers 34 to resume their intermediate position, due to the tension of the springs 42 and 43. Upon the continued revolution of the cam 109 connection is made between the springs 110 and 111, this connection serving to short-circuit the cord-strands leading to the plug 133, whose contacts are connected with the line-limbs 127 and 128. This cycle of connections is repeated for each revolution of the cam 129. Each time there is an electrical connection made between the springs 110 and 112 a current impulse is sent over the line and through the electromagnets 29 of the selective apparatus in such a direction as to cause for each impulse one forward step of the switch-arms 25 at all of the substations connected with the party-line which is being set up for conversation. Each time there is an electrical connection made between the spring 110 and 111 the two metallic line-limbs are short-circuited at the central station. The purpose of this short-circuit connection between the metallic line-limbs between succeeding current impulses through the electromagnets of the selective apparatus is for the purpose of discharging any static charge to which the line may have been subjected during the preceding current impulse. I have found that this means for preventing static accumulations of electricity in the metallic line-limbs is of great advantage in preventing the false operation of the selective or signaling apparatus. There is one revolution of the cam 109 for each hole 82 passed by the plunger-connecting switch of the crank 86 and there will be in the present instance twenty-three current impulses sent over the metallic line-limbs. The first of these impulses desirably brings all of the switch-arms 25 to their first position in advance of the contact-pieces 54, there desirably being provided for this position no hole 53 in the ring 52. Each succeeding impulse brings the switch-arms 25 above succeeding holes in the ring 52. Substation No. 19 on line 448 is provided with a contact-point 55 in hole 19 in the ring 52. Thus after twenty forward impulses of the switch-arm 25 due to the passage of twenty current impulses through the electromagnets 29 the switch-arms 25 at all of the substations will have been brought to a position above the holes No. 19 in the rings 52. Each substation having its contact-point 55 inserted in a different hole of the ring 52, there will be but one substation (No. 19) which has its contact-point 55 inserted in hole No. 19. Thus upon reaching this point the switch-arm 25 at substation No. 19 will make an electrical connection between the frame 20 and the insulated metal ring 52. Before reaching its position above the hole No. 19 the switch-arm 25 will have successively made contact with a contact-point 55, inserted in a preceding hole at some one of the other substations connected with line 448; but at the time of the closing of the circuit between the frame 20 and the ring 52 at substation No. 19 there will be no similar circuit through any other of the substations connected with the same line. It will be remembered that a pin has been inserted by the operator within hole No. 19 in the ring 81 of the automatic selector at the central

station. Thus a plunger switch-arm 94 upon reaching the hole No. 19 in the ring 81 will, in connection with the switch-arm 25, close the following circuit through the electromagnet 65: from the battery 142, through conductor 170, contact-spring 166, the sleeve-strand of the cord-circuit leading to the sleeve-contact of the plug 133, sleeve-spring 130 of the jack associated with line 448, line-limb 127, conductor 158, frame 20, switch-arm 25, contact-point 55, ring 52, through conductor 172, connected with the insulated ring 52, electromagnet-coil 67, ground G, through the ground to the grounded conductor 173 at the central station, ring 81, the pin inserted in hole No. 19, the plunger 94, the crank 86, conductors 168 and 169, back to the other side of the battery 142. The current-flow through this circuit causes the attraction of the armature 62, thereby causing a movement of the switch-arm 61 to make connection with the spring-contact 59, the catch 74 of the detent-lever 73 springing into position to catch and retain the telephone-connecting switch-arm 61 in connection with the contact 59. It will be remembered that the movement of the lever 73 to catch the switch-arm 61 will now be possible, as the cam projection 76 will be prevented from interfering on account of its rotation away from the normal position due to the advancement of the ratchet-wheel 24, with which it is associated. It will be seen that the controlling-circuit through the electromagnet-coil 67 is jointly controlled by a connection through the switch-arm 25 and a connection through the plunger 94 of the automatic selector at the central station. A completed circuit through the electromagnet-coil 67 can only occur when the switch-arm 25 makes connection with the contact-point 55 and when at the same time the plunger switch-arm 94 makes connection with a pin 83, inserted in one of the holes 82 of the ring 81 of the automatic selector. Thus while the switch-arms 25 will have successively made contact with the contact-points 55 inserted in one of the holes at each of the substations connected with the line which is being set up there will at the same time have been no connection afforded through the crank 86 and the plunger switch-arm 94 for the reason that there will have been no pin inserted in any of the holes of the ring 81, corresponding with these other positions assumed by the switch-arms 25 of the selective apparatus at the substations. Thus while the crank of the automatic selector returns from its initial position to its normal position there will have been a circuit closed through but one electromagnet 65, whereupon the telephone-connecting switch-arm 61 at but a single substation (substation No. 19) will have been actuated and detained by the catch 74. The switch-arms 25 at all of the substations will have been removed during this operation from their normal position in connection with the contact-pieces 54 to a position in the neighborhood of the hole 22, it being assumed that there are not more than twenty-one stations connected with the party-line. It will be remembered that the circuit through which the subscriber signaled the central operator by an actuation of a generator 120 included a connection between the contact-piece 54 and the switch-arm 25. This connection having been broken, it is apparent that no substation is in a condition whereby the actuation of the generator 120 may signal the central station or effect the release of the selective apparatus at the substations connected with the same line. In the same manner the circuit which was traced through the telephone instruments of the calling substation in notifying the central operator of the connection desired included a connection between the contact-piece 54 and the switch-arm 25. This circuit having been broken, as hereinbefore described, there is no means by which the other substations connected with the same line may obtain telephonic communication either with the central operator or with each other. Thus there is provided a simple, efficient, and very effective lock-out by reason of which the use of the telephone party-line by any subscriber cannot be interfered with by any other subscriber connected with the same party-line. The telephone-circuit for substation No. 19 may now be traced as follows: from the sleeve-spring 130 of the line-jack 131, through line-limb 127, conductor 158, frame 20, detent-lever 73, switch-arm 61, contact 59, condenser 122, telephone-receiver 121, the secondary of the induction-coil 123, contact-spring 162, contact-spring 163, conductor 164, conductor 155, and line-limb 128, to the tip-spring 129 of the line-jack at the central station. The operator after having thus connected the telephone-set of substation No. 19 of line 448 with the metallic line-limbs and having locked out all the other subscribers connected with the same line thereupon removes the plug 133 from the jack 131 and inserts the answering-plug proper, 132, within this jack and removes the pin 83 from hole No. 19 of ring 81. Connection being desired with substation No. 5 on line 766, the operator inserts her calling-plug 133 in the line-jack 131 of this line 766. She inserts a pin 83 within hole No. 5 of the ring 81. The calling key 140 is then manipulated, thus breaking the connection to that part of the cord-strands leading to the answering-plug and connecting the springs 166 and 167, which are the terminal springs of the automatic selector, with the part of the cord-strands leading to the contacts of plug 133. As has already been described in connection with substation No. 19 of line 448, the current impulses sent out from the automatic selector upon the return of the crank 86 from its initial to its normal position cause a step-by-step advance-

ment of the switch-arms 25 of all the selective apparatus connected with line 766 and of the switch-arm 25 of the dummy instrument associated with line 766 at the central station. The switch-arm 25 at substation No. 5 on line 766 in passing the contact 55 in the ring 52 causes, in connection with the plunger switch-arm 94 at the central station, the closure of a circuit from the battery 124 through the electromagnet 65, whereupon the telephone-connecting switch-arm 61 is attracted. As in the case of the substations connected with line 448, the other substations connected with line 766 will have been locked out by this setting-up operation, whereupon the telephone set at substation No. 5 will alone have been connected in bridge of the line-limbs 127 and 128 for the reason that a pin 83 has been inserted in but the single hole No. 5 of the ring 81. The line signal-lamp 146 associated with the called line will not glow upon the forward movement of the switch-arm 25 of the dummy instrument for the reason that the lamp-circuit through contacts 148 and 149 will have been broken by the insertion of the plug 133. After having thus caused the actuation of the telephone-connecting switch-arm 61 to connect the subscriber's telephone set in bridge of the line-limbs the operator manipulates her selective ringing-key 139, whereby the ringing-generator 137 is connected in circuit through the bell 119 at substation No. 5 on line 766 through the following circuit: from one terminal of the generator 137, through conductor 175, to contact-spring 176, to the sleeve-strand of the cord-circuit leading to the sleeve-contact of plug 133, through sleeve-spring 130 of the line-jack, line-limb 127 of line 766, conductor 158, frame 20, lever 73, switch-arm 61, spring 69, contact-spring 174, contact-spring 173′, through the bell 119, the ground connection G at substation No. 5, through the ground to the ground connection G at the central station, through conductor 173, to the contact-spring 177, to contact-spring 178, and through conductor 179 to the other terminal of the generator 137. The alternating or intermittent current traversing this circuit causes an actuation of the signal-bell 119, whereupon the subscriber at substation No. 5 is signaled. The subscriber upon answering the signal removes his telephone-receiver 121 from the switch-hook 126, thereupon interrupting the normally closed circuit at the substation through the signal-bell 119 and serving to complete the connection by way of contact-springs 162, 163, and 165 through the subscriber's telephone set, as hereinbefore described for substation No. 19 on line 448. The desired subscribers now having their telephones respectively connected in circuit, the operator restores her calling-key 140 to its normal condition, thereby closing a continuous circuit through the cord-strands to connect the subscriber at substation No. 19 on line 448 with substation No. 5 on line 766 for conversation. Upon the completion of the conversation by the subscribers either one or both replaces his receiver upon the switch-hook 126, thereby opening the local circuit through the transmitter, opening the telephone-circuit through the receiver 121 and secondary of the induction-coil 123, and closing a connection through the signal-bell 119 between the ground and the line-limb 127, this circuit being traced as follows: from the ground G, through signal-bell 119, contact-spring 173′, contact-spring 174, spring 69, switch-arm 61, lever 73, frame 20, to line-limb 127, this circuit being subsequently broken. Either subscriber may notify the operator at the central station of the desired disconnection by a slight rotation of the armature of the generator 120. The generator of each of the subscribers who have been connected for conversation may be connected in bridge of the telephone line-limbs. A disconnect signaling-current may be traced from the generator at substation No. 19 on line 448 as follows: from the contact 154, through conductor 155, line-limb 128, tip-spring 129, tip-strand of the cord-circuit, through the disconnect-drop 138, connected in bridge of the cord-strands, the sleeve-strand leading to the sleeve of the plug 132, the sleeve-spring 130, the line-limb 127, frame 20, lever 73, switch-arm 61, contact 59, conductor 159, to the other terminal of the generator 120. The current-flow over this circuit causes an actuation of the supervisory drop 138, thereby notifying the operator that the connected lines may be restored to their normal condition and interconnection between the lines removed. It will be remembered that the connection of the generator 120 with the line-limbs is in such a direction that the current impulses from this generator will tend to release and restore the selecting apparatus at the various substations connected with the same line. As I may not wish to rely, however, upon this method for restoring the selective apparatus at the various substations to its normal condition, I provide, therefore, at the central station a special releasing-key 141, a manipulation of which causes a disconnection with the cord-strands leading to the answering-plug 132 and serves to connect the battery 142 across the cord-strands leading through the plug 133 to the line-limbs of line 766. It will be seen that the connection of the battery 142 with the telephone-line is upon the manipulation of the releasing-key 141 in a direction the reverse of that established by a manipulation of the calling-key 140 and the automatic selector. Thus while the actuation of the calling-key and the automatic selector caused current impulses to be sent out over the line in such a direction as to cause a forward step-by-step movement of the switch-arms 25 the manipulation of the releasing or restoring key 141 causes a connection in the

reverse direction with the line-limbs, whereupon the armatures 32 of the selective apparatus at the various substations connected with a line which is being restored are attracted toward the cores 30 of their electromagnets 29, whereupon their levers 34 are actuated to disengage the pawls 35 and 36 from the ratchet-wheels 24, whereupon the springs 28 cause a restoration of the switch-arms 25 to their normal position in connection with the contact-pieces 54. In the same manner the switch-arm 25 of the dummy instrument at the central station, connected with line 766, is restored to its normal position above the hard-rubber insulator 143. The operator thereupon removes the plug 133 from the jack connected with line 766 and also removes the plug 132 from the line associated with the line 448. In order to restore the selective apparatus connected with line 448 to its normal position, the operator then inserts the calling-plug 133 within the line-jack associated with this line and manipulates her releasing-key 141 to connect the terminals of the battery 142 across the line-limbs 127 and 128 of line 448, whereupon the flow of current through the associated electromagnets 29 causes the attraction of the armatures 32 toward the cores 30, thereby disengaging the pawls 35 and 36 from the ratchet-wheels 24 to permit the restoration of the switch-arms 25 to their normal position in connection with the contact-pieces 54. The removal of the calling-plug 133 from the line-jack associated with line 448 completes the operation, whereupon the connected lines are in connection either to transmit a calling-signal to the central station or to be set up for the purpose of signaling and telephonically connecting any of the substations on the line.

One of the provisions of my invention is a positive signal to notify the operator in case of her failure to restore a line to its normal condition before removing the plug of her cord connecting apparatus from the line-jack. It will be remembered that upon setting up a line for conversation and lockout purposes the switch-arm 25 of the dummy instrument at the central station is stepped around to make electrical connection with the metal ring 144. The proper restoration of the line to its normal condition causes the restoration of the switch-arm 25 of this dummy instrument to its position in connection with the insulated block 143, whereupon the removal of the plug from the jack cannot cause the illumination of the lamp 146; but in case the plug is removed from the jack without first having restored the switch 25 to its normal position in connection with the insulating-block 143 there will upon the removal of the plug from the jack be a closed circuit through the lamp 146, this circuit being traced through the connection between the ring 144 and the switch-arm 25 and through the connection between the contacts 148 and 149. The illumination of this lamp 146 upon the removal of a plug from the associated jack gives the operator a positive signal to indicate that she has not previously restored the line to its normal condition. Upon noting the illumination of the lamp 146, therefore, the operator again inserts her calling-plug 133 and manipulates her releasing-key 141 to restore the selective apparatus to its normal condition.

If, as may frequently happen, a connection is desired between a substation on any one party-line with another substation on the same party-line, the operator upon ascertaining by telephonic communication with the calling subscriber the number of the substation with which he desires connection inserts two pins within the ring 81 of the automatic selector. One of the pins corresponds in the number of the hole within which it is inserted with the party number of the calling substation, and the other pin corresponds in the number of the hole within which it is inserted with the party number of the called substation. The calling-plug 133 of her cord connecting apparatus being inserted in the line-jack 131, associated with the given party-line, the operator manipulates her calling-key 140 and thereupon rotates the crank 86 of the automatic selector into its initial position near the stop 102. Upon releasing the crank 86 current impulses are sent over the given party-line, there being a circuit established through the electromagnet 65 of the calling-substation as the plunger switch-arm 94 makes electrical connection with the pin 83, inserted in the corresponding hole of the ring 81, and there being a circuit established through the electromagnet 65 at the called substation as the plunger switch-arm 94 passes the pin inserted in the hole corresponding in number with the number of the called party. Thus the energization of the electromagnets 65 at both the calling and called substations will cause an actuation of the telephone connecting switch-arms 61 to connect the telephone instruments at both the calling and the called substations in bridge of the same bimetallic party-line. As in the case of the setting-up operation hereinbefore more particularly described all the other substations on the same party-line will have been locked out by the removal of their switches 25 from the normal contact-pieces 54, whereupon the conversation between the proper calling and called subscribers may not be interfered with by other subscribers connected on the same line. In the same manner the central operator may connect at the same time any number or indeed all of the telephone sets at all of the substations on any one line in bridge of the bimetallic line-limbs. Thus the central operator may communicate simultaneously with all of the subscribers on any one line, or any one subscriber may simultaneously talk to all the other subscribers connected on the same line.

If for any reason the actuation of the releasing-key 141 has failed to properly restore some one or any of the switches 25 to their proper normal position, the subsequent actuation of a generator 120 in attempting to signal the central operator will cause an impulse to flow through the electromagnets 29 to cause a restoration of the associated switches 25 to their normal position before the succeeding setting-up operation will have been begun by the central operator. If for any reason the switch 25 at some one substation shall have got out of synchronism or step with the switches 25 at all the other substations on the same party-line, no serious difficulty can ensue, and the proper operation of the line will not be affected except that it may happen that two subscribers will be signaled when it was intended that only one subscriber should be signaled, and, furthermore, each time the party-line is restored to its normal condition by an actuation of the releasing-key 141 or by an operation of the generator 120, the switches 25 at all of the substations will be returned to their normal positions in electrical connection with the contact-pieces 54. This feature of the operation of my invention is a great improvement over selective party-line systems heretofore proposed in which it has been necessary to send a lineman or repairman from the central station to some or all of the substations to set the step-by-step mechanism properly in synchronism if for any reason due to defective operation the exact and proper step-by-step and synchronous relation between the step-by-step mechanisms at the various substations shall have been interfered with.

It will be seen that my invention provides means whereby the central operator may by a single or by repeated manipulations of her releasing-key 141 establish the proper synchronous and in step relation of the selective apparatus in case this relation should for any reason be interfered with.

For purposes of simplicity in explanation I have herewith illustrated and described a form of cord connecting apparatus more particularly designed for use in answering calls coming in over single lines and for calling and signaling substations connected with party-lines such as herein described.

By means well understood by those skilled in the art cord connecting apparatus may be provided such that the reversal of the plugs, as hereinbefore described, may be dispensed with, suitable keys being provided in such instances, whereby the automatic selector may be connected either with the answering or with the calling plug, as desired.

While I have herein shown and described one preferred embodiment of my invention, it will be apparent that many modifications may be employed without departing from the spirit thereof. I do not, therefore, wish to limit myself to the precise disclosures herein set forth; but,

Having described my invention, I claim as new and desire to secure by Letters Patent—

1. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, the pin 46, springs 42 and 43 adapted upon a deënergization of said electromagnet to return said lever to its normal intermediate position, and a spring 44 adapted upon a deflection of spring 43 to act in conjunction therewith.

2. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, the pin 46, springs 42 and 43 adapted upon a deënergization of said electromagnet to return said lever to its normal intermediate position, pin 47 adapted to limit the movement of said springs, and a spring 44 adapted upon a deflection of spring 43 to act in conjunction therewith.

3. In a device of the class described, the combination with the electromagnet 29, of the pivoted armature 32, the lever 34, the pin 46, springs 42 and 43 adapted upon a deënergization of said electromagnet to return said lever to its normal intermediate position, and a spring 44 adapted upon a deflection of spring 43 to act in conjunction therewith.

4. In a device of the class described, the combination with the electromagnet 29, of the pivoted armature 32, the lever 34, the pin 46, springs 42 and 43 adapted upon a deënergization of said electromagnet to return said lever to its normal intermediate position, pin 47 adapted to limit the movement of said springs, and a spring 44 adapted upon a deflection of spring 43 to act in conjunction therewith.

5. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergization of said electromagnet to return said lever to its normal intermediate position, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, a relatively stationary pawl 36 adapted normally to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel and means for allowing actuation of said ratchet-wheel only upon actuation of said lever.

6. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, a

rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, a relatively stationary pawl 36 adapted normally to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel and means for preventing rotation of said ratchet-wheel except when said lever is actuated.

7. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergization of said electromagnet to return said lever to its normal intermediate position, a rotatably-mounted ratchet-wheel 24, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, a relatively stationary pawl 36 adapted normally to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel and means for preventing forward actuation of said ratchet-wheel except upon actuation of said lever.

8. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, a relatively stationary pawl 36 adapted normally to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel and means normally preventing said ratchet-wheel from being rotated.

9. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergization of said electromagnet to return said lever to its normal intermediate position, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, a relatively stationary pawl 36 adapted to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel and means for preventing actuation of said ratchet-wheel when said lever is in its normal position.

10. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, a relatively stationary pawl 36 adapted to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel and means for preventing actuation of said ratchet-wheel until said lever is actuated.

11. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergization of said electromagnet to return said lever to its normal intermediate position, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, a relatively stationary pawl 36 adapted normally to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl to engage said ratchet-wheel to cause a step-by-step forward rotation thereof, means whereby the passage of electric currents through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel and means for locking said ratchet-wheel when said lever is in its intermediate normal position.

12. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, a relatively stationary pawl 36 adapted normally to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of electric currents

through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a step-by-step forward rotation thereof, means whereby the passage of electric currents through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel and means for normally preventing a forward rotation of said ratchet-wheel.

13. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergization of said electromagnet to return said lever to its normal intermediate position, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, a relatively stationary pawl 36 adapted to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a step-by-step forward rotation thereof, means whereby the passage of electric currents through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel and means for locking said ratchet-wheel when said lever is in its normal position.

14. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, a relatively stationary pawl 36 adapted to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a step-by-step forward rotation thereof, means whereby the passage of electric currents through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel, and means for normally preventing the forward rotation of said ratchet-wheel.

15. In a device of the class described, the combination with the electromagnet 29, of a polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergization of said electromagnet to return said lever to its normal position, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a step-by-step forward rotation thereof, means whereby the passage of an electric current through said electromagnet in a reverse direction causes said pawl to disengage said ratchet-wheel, and means for locking said ratchet-wheel when said lever is in its normal position.

16. In a device of the class described, the combination with the electromagnet 29, of a polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergization of said electromagnet to return said lever to its normal position, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a step-by-step forward rotation thereof, means whereby the passage of an electric current through said electromagnet in a reverse direction causes said pawl to disengage said ratchet-wheel, and means for normally preventing a forward rotation of said ratchet-wheel.

17. In a device of the class described, the combination with the electromagnet 29, of a polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergization of said electromagnet to return said lever to its normal position, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in a reverse direction causes said pawl to disengage said ratchet-wheel, and automatic means for preventing actuation of said ratchet-wheel when said lever is in its normal position.

18. In a device of the class described, the combination with the electromagnet 29, of a polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergization of said electromagnet to return said lever to its normal position, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in a reverse direction causes said pawl to disengage said ratchet-wheel, and automatic means for normally preventing forward rotation of said ratchet-wheel.

19. In a device of the class described, the combination with the electromagnet 29, of a polarized pivoted armature 32, the lever 34, a

rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a step-by-step forward rotation thereof, means whereby the passage of an electric current through said electromagnet in a reverse direction causes said pawl to disengage said ratchet-wheel, and means for allowing rotation of said ratchet-wheel only after actuation of said lever.

20. In a device of the class described, the combination with the electromagnet 29, of a polarized pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in a reverse direction causes said pawl to disengage said ratchet-wheel, means for normally preventing rotation of said ratchet-wheel, and means upon actuation of said lever for allowing rotation of said ratchet-wheel.

21. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergization of said electromagnet to return said lever to its normal intermediate position, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, an adjustable stop-screw 51 to limit the motion of said pawl 35, a relatively stationary pawl 36 adapted normally to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel, means for normally locking said ratchet-wheel against forward rotation, and means upon actuation of said lever for releasing said ratchet-wheel.

22. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, an adjustable stop-screw 51 to limit the motion of said pawl 35, a relatively stationary pawl 36 adapted normally to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel, locking means for normally preventing forward rotation of said ratchet-wheel, and automatic means associated with said lever for releasing said ratchet-wheel upon actuation of said lever.

23. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergization of said electromagnet to return said lever to its normal intermediate position, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, an adjustable stop-screw 51 to limit the motion of said pawl 35, a relatively stationary pawl 36 adapted to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel, locking means for normally preventing forward rotation of said ratchet-wheel, and automatic means associated with said lever for releasing said ratchet-wheel upon actuation of said lever.

24. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, an adjustable stop-screw 51 to limit the motion of said pawl 35, a relatively stationary pawl 36 adapted to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a step-by-step forward rotation thereof, means whereby the passage of electric currents through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel, locking means for normally preventing forward rotation of said ratchet-wheel, and automatic means associated with said lever for releasing said ratchet-wheel upon actuation of said lever.

25. In a device of the class described, the combination with the electromagnet 29, of a polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergiza-

tion of said electromagnet to return said lever to its normal position, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, an adjustable stop-screw 51 to limit the motion of said pawl 35, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a step-by-step forward rotation thereof, means whereby the passage of an electric current through said electromagnet in a reverse direction causes said pawl to disengage said ratchet-wheel, means for normally locking said ratchet-wheel against rotation, and automatic means actuated upon actuation of said lever for releasing said ratchet-wheel.

26. In a device of the class described, the combination with the electromagnet 29, of a polarized pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, an adjustable stop-screw 51 to limit the motion of said pawl 35, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in a reverse direction causes said pawl to disengage said ratchet-wheel, said ratchet-wheel being normally locked against rotation, and means whereby actuation of said lever automatically effects the release of said ratchet-wheel.

27. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, a relatively stationary pawl 36 adapted normally to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel, detent mechanism normally acting to prevent a forward rotation of said ratchet-wheel, and means whereby an actuation of said armature to cause a forward step of said ratchet-wheel causes a release of said detent mechanism.

28. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, a relatively stationary pawl 36 adapted to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel, detent mechanism normally acting to prevent a forward rotation of said ratchet-wheel, and means whereby an actuation of said armature to cause a forward step of said ratchet-wheel causes a release of said detent mechanism.

29. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, a relatively stationary pawl 36 adapted normally to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a step-by-step forward rotation thereof, means whereby the passage of electric currents through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel, detent mechanism normally acting to prevent a forward rotation of said ratchet-wheel, and means whereby an actuation of said armature to cause a forward step of said ratchet-wheel causes a release of said detent mechanism.

30. In a device of the class described, the combination with the electromagnet 29, of a polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergization of said electromagnet to return said lever to its normal position, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a step-by-step forward rotation thereof, means whereby the passage of an electric current through said electromagnet in a reverse direction causes said pawl to disengage said ratchet-wheel, detent mechanism normally acting to prevent a forward rotation of said ratchet-wheel, and means whereby an actuation of said armature to cause a forward step of said ratchet-wheel causes a release of said detent mechanism.

31. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergization of said electromagnet to return said lever to its normal intermediate position, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, an adjustable stop-screw 51 to limit the motion of said pawl 35, a relatively stationary pawl 36 adapted to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel, detent mechanism normally acting to prevent a forward rotation of said ratchet-wheel, and means whereby an actuation of said armature to cause a forward step of said ratchet-wheel causes a release of said detent mechanism.

32. In a device of the class described, the combination with the electromagnet 29, of a polarized pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, an adjustable stop-screw 51 to limit the motion of said pawl 35, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in a reverse direction causes said pawl to disengage said ratchet-wheel, detent mechanism normally acting to prevent a forward rotation of said ratchet-wheel, and means whereby an actuation of said armature to cause a forward step of said ratchet-wheel causes a release of said detent mechanism.

33. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, spring mechanism adapted upon a deënergization of said electromagnet to return said lever to its normal intermediate position, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, an adjustable stop-screw 51 to limit the motion of said pawl 35, a relatively stationary pawl 36 adapted normally to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of electric currents through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward step-by-step rotation thereof, means whereby the passage of an electric current through said electromagnet in the reverse direction causes said pawls to disengage said ratchet-wheel to permit the backward rotation thereof due to the tension of said spring 28, an arm 26 mounted to rotate with said ratchet-wheel, a stop-pin acting in conjunction with said arm to limit the backward rotation of said ratchet-wheel, a detent adapted normally to catch and detain said arm when in engagement with said stop-pin, and means whereby said detent is tripped upon an energization of said electromagnet to cause a forward rotation of said ratchet-wheel, thereby releasing said arm 26 to permit a forward rotation of said ratchet-wheel.

34. In a device of the class described, the combination with the electromagnet 29, of the pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, a relatively stationary pawl 36 adapted to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in a reverse direction causes said pawls to disengage said ratchet-wheel to permit a backward rotation thereof, an arm 26 mounted to rotate with said ratchet-wheel, a stop-pin 27 acting in conjunction with said arm to limit the backward rotation of said ratchet-wheel, a detent adapted normally to catch and detain said arm when in engagement with said stop-pin 27, and means whereby said detent is tripped upon a movement of said lever to cause the forward rotation of said ratchet-wheel.

35. In a device of the class described, the combination with the electromagnet 29, of the pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted to engage said ratchet-wheel, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in a reverse direction causes said pawls to disengage said ratchet-wheel to permit a backward rotation thereof, an arm 26 mounted to rotate with said ratchet-wheel, a stop-pin 27 acting in conjunction with said arm to limit the backward rotation

of said ratchet-wheel, a detent adapted normally to catch and detain said arm when in engagement with said stop-pin 27, and means whereby said detent is tripped upon a movement of said lever to cause the forward rotation of said ratchet-wheel.

36. In a device of the class described, the combination with the electromagnet 29, of the polarized pivoted armature 32, the lever 34, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, a relatively stationary pawl 36 adapted normally to engage said ratchet-wheel to prevent a backward rotation thereof, means whereby the passage of an electric current through said electromagnet in one direction causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, means whereby the passage of an electric current through said electromagnet in the reverse direction causes said pawl to disengage said ratchet-wheel, a detent 56, an arm 26 connected with the ratchet-wheel and normally engaged by said detent whereby said ratchet-wheel is prevented from forward rotation, a pin 57 extending from said detent 56, and a stud 58, extending from the lever 34 for engaging said pin whereby upon forward movement of said lever said detent is released from said arm 26, whereby said ratchet-wheel may rotate.

37. In a device of the class described, the combination with electromagnet 29, of the pivoted armature 32, the lever 34 extending forwardly from the armature, a rotatably-mounted ratchet-wheel 24, a spring 28 tending to cause a backward rotation of said ratchet-wheel, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, a relatively stationary pawl 36 adapted normally to engage said ratchet-wheel to prevent the backward rotation thereof, means whereby the passage of an electric current through said electromagnet causes said pawl 35 to engage said ratchet-wheel to cause a forward rotation thereof, locking means associated with said lever and with said ratchet-wheel whereby said ratchet-wheel is prevented from forward rotation from its initial position, and means upon actuation of said armature and lever whereby said locking means is automatically released to allow forward actuation of said ratchet-wheel.

38. In a device of the class described, the combination with an electromagnet, of an armature therefor, a lever extending forwardly from said armature, a rotatably-mounted ratchet-wheel disposed near the end of said lever, a pawl 35 on said lever adapted normally to engage said ratchet-wheel, energization of said electromagnet causing the actuation of said armature and lever to cause forward actuation of said ratchet-wheel, means for locking said ratchet-wheel against rotation from its initial position, and means associated with said lever and said ratchet-wheel for automatically releasing said ratchet-wheel upon actuation of said armature.

39. In a device of the class described, the combination with the electromagnet 29, of the pivoted armature 32, the lever 34, the rotatably-mounted ratchet-wheel 24, a pawl 35 on said lever, adapted normally to engage said ratchet-wheel to cause a forward rotation thereof upon actuation of said armature, the pivoted lever 73, the switch member 61 adapted to be engaged by the end 74 of said lever 73, a projection 76 connected with said ratchet-wheel and normally engaging said lever 73 to prevent connection thereof with said switch member 61, actuation of said ratchet-wheel causing disengagement of said projection from said lever, and a spring for moving said lever into engagement with the switch member 61.

40. In a device of the class described, the combination with electromagnet 29 of the armature 32, the lever 34 extending forwardly from said armature, a rotatably-mounted ratchet-wheel 24, a pawl 35 at the end of said lever for engaging said ratchet-wheel to cause forward rotation thereof upon actuation of said armature, the electromagnet 65, an armature 62 therefor, a spring 69 for normally maintaining said armature away from said electromagnet, a switch member 61 carried by said armature, a lever 73, a projection 76 connected with said ratchet-wheel for normally holding said lever 73 to prevent engagement of the end 74 with the switch member 61, and a spring tending to move the lever 73 toward the switch member 61, forward actuation of said ratchet-wheel causing said projection 76 to release said lever 73 whereby the end 74 is moved toward the switch member 61 and whereby said lever 61 upon attraction of the armature 62 is engaged by the end 74.

41. In a device of the class described, the combination with electromagnet 29, of the armature 32, the lever 34 extending forwardly from said armature, a rotatably-mounted ratchet-wheel 24, a pawl 35 at the end of said lever for engaging said ratchet-wheel to cause a forward rotation thereof upon actuation of said armature, the electromagnet 65, an armature 62 therefor, a spring 69 for normally maintaining said armature away from said electromagnet, a switch member 61 carried by said armature, a lever 73, a projection 76 connected with said ratchet-wheel for normally holding said lever 73 to prevent engagement of the end 74 with the switch member 61, a spring tending to move the lever 73 toward the switch member 61, forward actuation of said ratchet-wheel causing said projection 76 to release said lever 73, whereby the end 74 is moved toward the switch member 61 and

whereby said lever 61 upon attraction of the armature 62 is engaged by the end 74, a spring 28 tending to cause a backward rotation of said ratchet-wheel, and means for moving said lever 34 to release said ratchet-wheel, whereby said ratchet-wheel is returned to its normal position by the spring 28, and whereby the projection 76 again engages the lever 73 to disconnect said lever from the switch member 61.

In witness whereof I hereunto subscribe my name this 30th day of September, A. D. 1903.

RUDOLPH C. DEUBEN.

Witnesses:

CHARLES J. SCHMIDT,

JOHN STAHR.