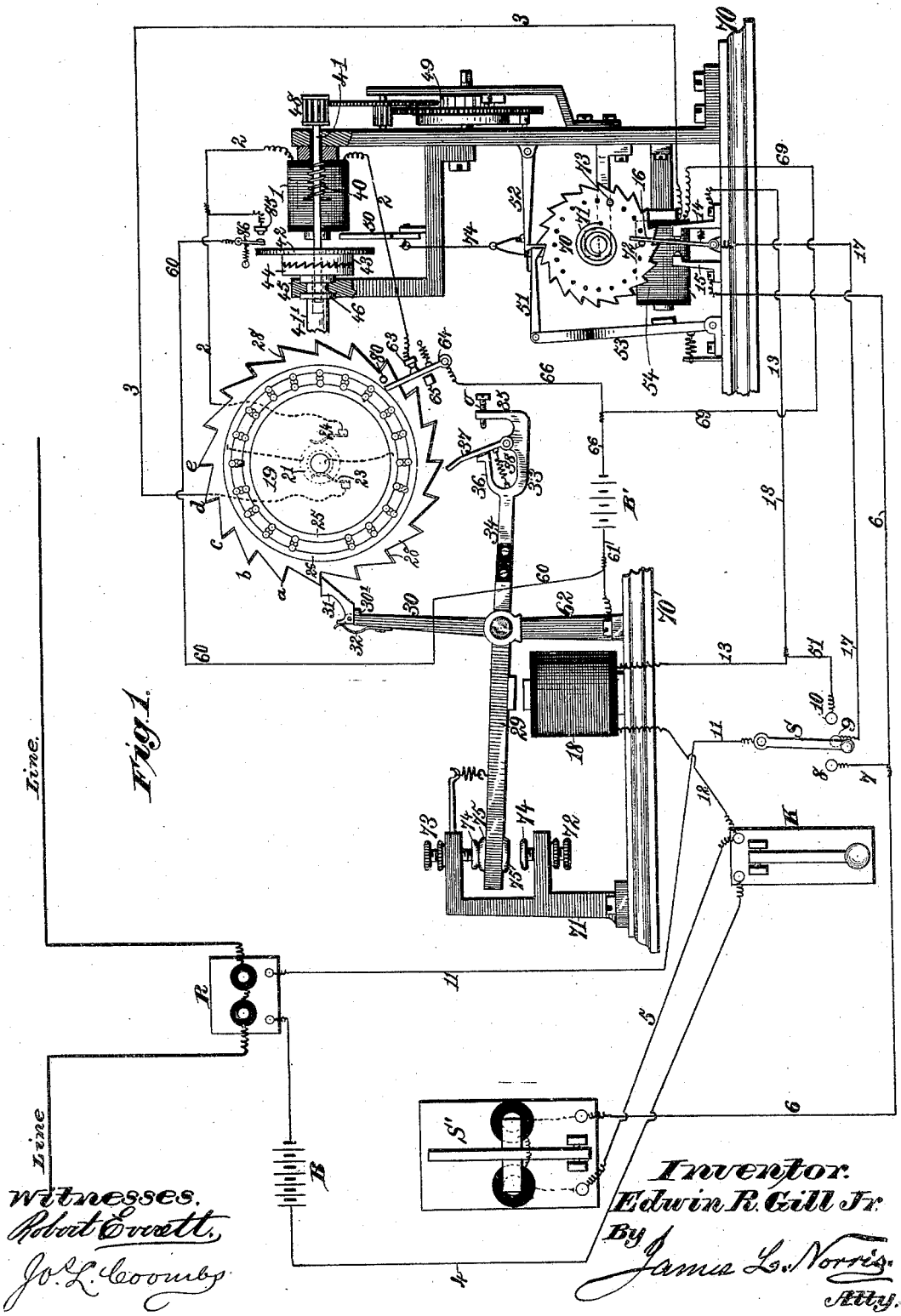
(No Model.) 2 Sheets—Sheet 1.

E. R. GILL, Jr.

AUTOMATIC ELECTRIC SIGNAL CONTROLLING APPARATUS.

No. 313,720. Patented Mar. 10, 1885.



N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 2 Sheets—Sheet 2.

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AUTOMATIC ELECTRIC SIGNAL CONTROLLING APPARATUS.

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Fig. 2.

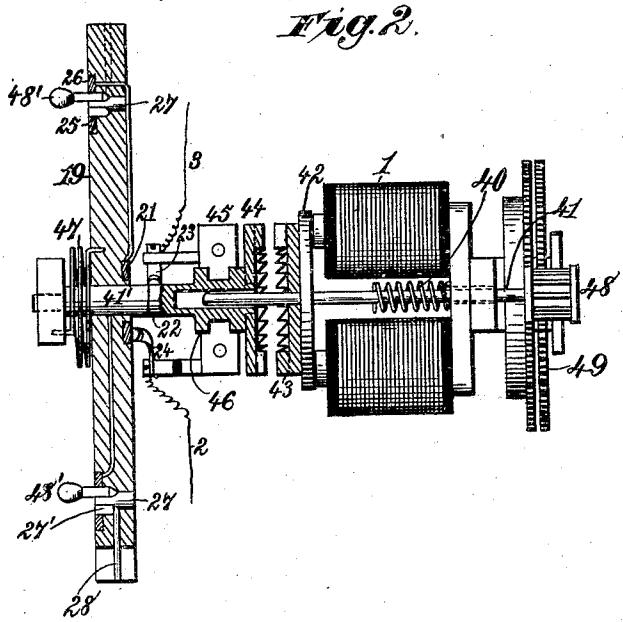
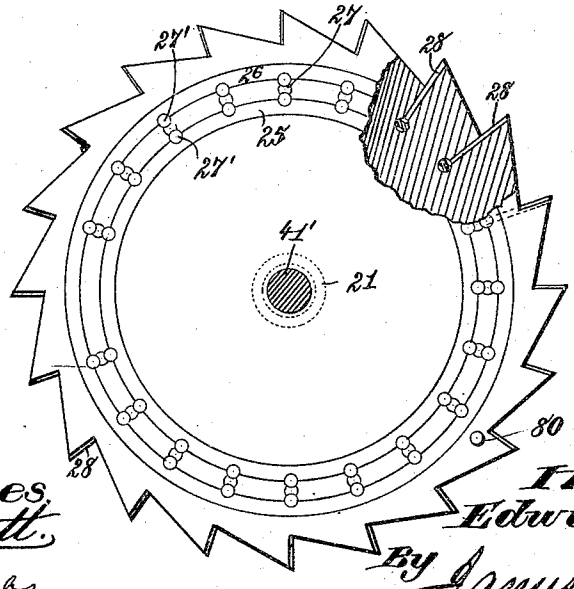


Fig. 3.



Witnesses.
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UNITED STATES PATENT OFFICE.

EDWIN R. GILL, JR., OF PLEASANT HILL, MISSOURI, ASSIGNOR OF ONE-HALF TO JOHN T. RUSSELL, WILLIAM A. SYMINGTON, AND JAMES M. CHANEY, ALL OF SAME PLACE.

AUTOMATIC ELECTRIC SIGNAL-CONTROLLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 313,720, dated March 10, 1885.

Application filed August 2, 1884. (No model.)

To all whom it may concern:

Be it known that I, EDWIN R. GILL, JR., a citizen of the United States, residing at Pleasant Hill, Cass county, Missouri, have invented new and useful Improvements in Automatic Electric Signal-Controlling Apparatus, of which the following is a specification.

In lines for electric intercommunication, as now constructed and used, whether telegraphic or telephonic, it is customary to connect in one series a large number of stations or signaling apparatus. The result is, in telephonic circuits, that whenever any one subscriber is called all signal-instruments on that circuit are actuated and all the subscribers not wanted annoyed by the calls intended for others. In telegraphic circuits many of the offices are minor offices and do comparatively a small business, yet the calls for all and the messages for any and all offices pass through such as well as through the more important offices, keeping up a constant clatter of sounders all along the line and revealing to all the offices on the circuit the messages or business intended for only one.

In view of these facts it seems desirable that some means be provided whereby the receiving apparatus of the office or station or subscriber alone wanted by any other office, station, or subscriber can be thrown into circuit at the will of the transmitter. If such means be provided, the subscriber or station wanted on a telephone-circuit alone hears the signal and is automatically thrown into circuit, the noise and confusion to others of signals being avoided, while on a telegraphic line only the office needed is called up and its sounder or register thrown in to call the attention of the operator thereto, while in all other offices the sounders would be inactive and the offices quiet for the transaction of other business.

The object of my invention is to furnish such means—means whereby any station or office can call up any other desired station or office upon the line, while the others remain quiescent. This I accomplish by the means hereinafter described and claimed, and typified in the drawings, in which—

Figure 1 is a view, mainly diagrammatic, illustrating the invention; while Figs. 2 and 3 are views of details involved therein.

Fig. 1 is supposed to represent any local station on a line through which the main line marked "line" passes. The same arrangement would be used at the terminal stations, only in such a case the main battery and proper ground or return circuit connections well known in the art would be shown. At such station R, S′, and K are the ordinary relays, sounder, and key, respectively, while S is an ordinary switch having three connecting anvils or points, 8 9 10. The usual local battery, B, is placed in the local circuit controlled by the relay. The sounder S′ is here used as typical only of any desired or known form of communicating-instrument, as the operation of the devices forming the invention is the same whether it be an ordinary Morse sounder or a call-bell, or a visual signal, while the relay, key, and switch are of any of the common constructions. In addition thereto, there is provided the apparatus for accomplishing the desired ends, as hereinafter described. This is mounted upon any suitable base, 70, here, for convenience, shown as broken into two and the parts lying in different planes. Upon 70 is seated an electro-magnet, 18, having an armature, 29, pivoted in a standard, 62. Its free or outer end takes between limiting and adjusting screws 72 73 in an ordinary standard, 71. In order that its operation may be noiseless, the heads of 72 and 73 are covered with some elastic or non-vibratory substance, as rubber, leather, or fibrous material, while the portions 75 of 29, which take thereon, are similarly covered. This construction deadens if not entirely obviating the noise between the back-stops, and is useful, as I have found, for the same purpose upon the back or limiting stops of many other forms of magnetic apparatus—for instance, sounders, relays, escapement and printing magnets, &c. Upon its other end, and at right angles, or approaching thereto, it carries the two arms 30 and 34, 34 being connected thereto by an insulating-connection, as shown, so that it is electrically separated from 29 and 30. Each of these arms carries an escapement and pawl of peculiar

construction. Pivoted to 30 is the pawl 31, inclined upwardly and ending in a plane surface, preferably platinum-faced. A spring, 32, attached to 30 at one end and bearing at its free end upon 31, forces the latter forward normally until its forward movement is stopped by the shoulder 30′ upon the head of 30.

While, if desired, the function 30 and 31—viz., of allowing the measured or controlled rotation of the wheel 19—might be accomplished by a rigid pawl, the construction shown is preferable, as more readily permitting, under conditions to be hereinafter explained, the backward rotation of wheel 19 to its starting-point.

34 at its outer and free end is divided into two arms, 33 and 36, the latter bending upwardly and then forward, while 33 bends downwardly and then forward to some little distance beyond 36, where it bends upwardly, leaving a space between 35 and 36. In 35, if desired, a set-screw, *o*, may be seated, in order to adjust the distance between 35 and 36 and permit a greater or less range of motion to 37, for purposes hereinafter set forth.

Upon a lug on the upper side of 33 is pivoted a pawl, 37, whose limit of motion is determined by 35 and 36, a spring, 38, being arranged to normally hold it back against 36. This magnet 18, its armature-lever, and attached pawl 31 and 37 control the rotation of an escapement-wheel, 19, mounted upon a shaft, 41′, supported in suitable bearings, the end of 41′ being provided with a collar or other suitable device, 46, taking into one of the bearings, 45, (the other not being shown) for preventing any longitudinal movement of the shaft 41′ and the wheel 19. In a recess in the end of 41′ takes the end of a shaft, 41, terminating at its other end in a pinion, 48, which gears with and communicates the motion of any suitable prime motor, here represented as an ordinary clock-work, 49.

The construction shown of the escapement-pawls permits the rotation, when desired, of the wheel 19 for a space greater than one tooth, the number being determined by the distance given between the ends of 35 and 36. As here shown, either one or two teeth at will may be permitted to escape. For instance, if the briefest pulsation, a dot, be sent through 18, its armature being only momentarily attracted, 31 is withdrawn from a tooth and immediately thrown forward again in time to engage the next tooth. If a prolonged pulsation be sent through 18, no matter what its duration be, 31 will be withdrawn and 19 commence to rotate. The face of a tooth shortly (in less than the space of a tooth) takes upon 37. It being pivoted, or a spring, as may be, does not stop the wheel immediately, but is carried forward until 37 takes on 35 and is made rigid, when the wheel is stopped, and in position on breaking of circuit of 18 for 31 to spring into place and relieving 37 of the stoppage work hold 19 where 37 had stopped it. It follows, therefore, that, by properly adjusting the distance 35 36, the wheel may be permitted to rotate the distance of either one tooth or any number of teeth, a capacity useful in many other magnetic escapements—as for instance, those used in magnetic clocks, printing-telegraphs, devices for displaying visual signals, controlling valves, &c.

Attached to 41′ is one member, 44, of any suitable clutch, while the other member, 43, of the clutch is fixed to 41, so that when these two parts of the clutch are in engagement as shown in Fig. 1 the power of the motor 49 is transmitted through 41, clutch 43, 44, and shaft 41′ to the wheel 19, causing it to rotate, except as controlled by the escapement. If, however, the members of the clutch are separated, as in Fig. 2, the wheel 19 is removed from the stress or force of 49. This clutch and the rotation of its members is controlled by the electro-magnet 1 and its armature 42.

The shaft 41 passes to its bearings between the members of the magnet 1, and has attached to it the armature close-cap 42 of the magnet, which is circular in form, and should be seated on the shaft just back of the member 43 of the clutch. Around the shaft 41, in such position as to act thereon and force it toward 41′, is a spring, 40. Then, so long as the magnet 1 is not charged the stress of the spring 40, acting on shaft 41, keeps the members of the clutch together so as to make 41 and 41′ and their associated parts a common system so far as rotation of 19 is concerned; but when 1 is charged it attracts the armature 42, which being circular is attracted, even though attached to 41, and irrespective of the rotation of 41. 42 being attracted, carries with it the member 43 of the clutch, leaving 41′ and 19 free from the action of the motor, while at the same time, by the force of the attraction of the magnet 1 thereon, it holds the motor steady and prevents its now useless movement or expenditure of power.

The wheel 19 is constructed from an insulating material, and has upon its face two concentric conducting-rings, 25 and 26. With one exception, its teeth are faced with platinum or other conducting material. The exception is the tooth which normally takes upon 31 when the instrument is at rest and the wheel 19 at its initial or starting point. This facing 28 extends into the body of the wheel to a point beneath the space between the concentric rings 25 and 26.

Upon the face, between the concentric rings and in the radial lines of the teeth-faces, are let-in screws or pins 27, whose inner ends take upon and form good electrical contact with the inner extension of the platinum faces 28. At these points the rings and the pins or screw-heads are cut away, each in the segment of a circle, forming plug-apertures 27′, in which may be inserted plugs 48′, so as to connect any of the faces 28 with either 25 or 26, as desired.

Upon the body of the wheel 19, near to and

concentric with the shaft, is a conducting-ring, 21, connected electrically to the ring 26, while upon the shaft is a conducting-ring, 22, the shaft and hence this ring being connected to the ring 25. These two rings may be arranged in any other convenient way, so long as they are insulated from each other, preserving the electrical separation from each other of the two conducting-rings 25 and 26, and they may for convenience be termed a "commutator." Upon them take ordinary commutator brushes or springs 23 24, which form parts of electrical circuits.

47 is a spring having an end attached to 19 or to its shaft, and its other end to some stationary part of the framing, so that when 19 is turned or rotated by the action of the motor 49 communicated to it the spring 47 is wound up, its recoil acting, when 19 is freed from the stress of the motor, to return 19 to its starting-point. Its stoppage at this starting-point is controlled by a pin, 80, on its face, which takes against a lever, 64, whose limit of motion is determined by adjusting devices 63 and 65, 63 being furnished with a contact-point upon which a contact-point upon 64 takes, so that 63 and 64 are parts of an electric circuit whenever 64 is not forced away from 63 by the action of the pin 80.

In Fig. 1, for facility of showing the circuit-connection, the wheel 19, clutch, magnet 1, and associated parts are shown as segregated from each other. Their construction in practice and relation in use to each other are shown in Fig. 2, which is partly in plan and partly in section.

Upon the base 70 is mounted another electro-magnet, 54, whose armature-lever 53 carries at its outer and free end a pawl, 51, which actuates directly the ratchet-wheel 70, to which the pivoted lever 52 acts as a stop, normally preventing its retrograde motion. This wheel may be loosely mounted on a fixed shaft or be rigidly attached to a revolving shaft. In the first case a spring, 71, has one end attached to the wheel and the other end to the shaft. In the latter case the spring would have one end attached to the wheel or the shaft and the other to a stationary part of the framing, the result being the same in either case. On rotation of the wheel the spring would be wound up, and upon its release from the action of the actuating-pawl 51 and stop 52 the recoil of the spring would rotate it in the opposite direction until it should be stopped at its starting-point. Its stoppage in either direction is determined by the location of pins placed in holes upon its face, there being a pin-hole at the base of the face-line of each tooth. These pins are shown at 72 and 73. If impulses be sent through magnet 54, 70 will be rotated step by step, winding up the spring until pin 73 takes upon lever 16, whereby the wheel is stopped. This lever plays between stops 14 15, both of which are parts of electric circuits, and provided with suitable contact-points, upon which contact-points on 16 take, 16 being also part of an electric circuit. 73 taking upon 16, carries it away from 14, breaking the connection between 16 and 14 and causing it to contact with 15. If now 70 be released, the resilience of its spring 71 causes it to turn backward until 72 takes upon 16, carrying it away from 15 and back to 14, the wheel being stopped thereby at its starting-point.

The releasing of 70 from the control of its pawls is controlled by magnet 1, for which is provided a second or subsidiary armature, 50, controlled by the sides of polar extensions of the poles of 1. To this armature 50 is attached a cord or connection, 74, fast at its other ends to the pawls 51 and 52. Hence, whenever 50 is attracted by 1, it will lift the pawls from engagement with the wheel and leave it free to be acted on by its spring 71.

The magnet 18 whenever in circuit is in a circuit formed from the ordinary local relay-battery B, while magnets 1 and 54, when in circuit, are in circuits formed from the secondary local battery B'.

The various circuits formed and the circuit connections can be described better perhaps than in any other way by enumerating them in a description of the operation of the mechanism.

As before stated, a switch, S, with three anvils or contacts, 8 9 10, is provided. Of these 8 is intended normally to keep the sounder S' in circuit and cut out the magnet 18, controlling primarily the automatic switching apparatus, whenever desired, while 9 and 10 are used to throw 18 into circuit and to normally cut out the sounder, the latter being thrown into circuit whenever, and only whenever, the proper sequence of operations has been performed by the automatic switching devices. If now the switch S be placed on 8, the circuit of B, controlled as ordinarily and primarily by the relay R in the main line, is B 4 K 5 S' 6 7 8 S 11 R B, in which case all pulsations which pass through R will cause the operation of the sounder or other device there located. If the operator or person using the S' desire that it be operative only when he alone is needed, he turns the switch to 9. The circuit, the parts being at rest and in their normal condition and relation, as shown in Fig. 1, is B 4 K 12 18 13 14 16 17 9 S 11 R B. S' is now cut out, while magnet 18, controlling the switching apparatus, is in circuit.

In order to fully describe the operation of the switching devices, a proper call, consisting of dots or momentary impulses, or of such dots and dashes or prolonged impulses, is assigned to each station, each call differing from all others in the same series or circuit. For each dot a pin, 48', is put in a plug or hole, 27', so as to connect the inner ring, 25, with the facing 28, while for each dash or prolonged impulse, for which two teeth are to be allowed to escape, at the first tooth assigned to the dash a pin is put in to connect the outer ring and the facing, 28, while at the last tooth of such dash the pin is inserted as for a dot.

After pins have thus been inserted in proper order after the blank tooth the plugs are inserted in the remainder of the holes, so as to connect the facings and outer ring, 26. In wheel 70 the pin 73 is set in a hole corresponding in number away from pin 72 to the number of connections made on 19, between the inner ring, 25, and the facing 28. Supposing the designation selected be – — – –, (that is, dot, dash, dot, dot,) then at tooth *a* 25 is connected to the facing 28, while at *b*, which is the first tooth of *b* and *c* assigned to the dash, 26 is connected to the facing 28, at the remaining teeth *c d e*, to compose the call, connection is made between 25 and 28. At all the remaining teeth the connection is between 26 and 28. In the circuit last described, and with S on 9, 18 is in circuit. Suppose, now, the proper call – — – – for this office to be given, the dot causes 31 to allow 19 to escape, one tooth immediately arresting it. 31 is now in contact with 28 at *a*, and a circuit of B′ is formed *via* 61 62 30 31 25 22 23 3 54 69 66, causing 53 to be attracted and moving 70 one tooth. The next impulse is prolonged, and by the action before described 19 escapes two teeth, 31 catching in *c*, forming the same circuit as with *a*, and affecting 54 in the same way, which also follows with the next two dots. The four steps of 70 have now brought 73 against 16, 16 stopping the wheel 70, and 73 moving 16 over to 15, breaking its connection with 14. The circuit now of B will be 4 K 5 S′ 6 15 16 17 9 S 11 R, the sounder being thus automatically thrown into circuit and 18 cut out of circuit.

There are three contingencies which may arise, in all of which the circuit-connections formed and the operations are the same; hence they will first be mentioned, and the circuit then described. It may be that 31 for some reason will fail to jump two teeth, from *a* to *c*, but simply catch on *b*, destroying the sequence of the call. In such case 31 is in contact with a facing connected with the outer ring, 26. Again, suppose a call has gone over the line of a combination of impulses differing from those necessary to the proper signal for this office. In such case 31 may either catch on *b*, forming connection with the ring 26, or, if the call going over have its second element in this instance similar to the second element of this call, the impulses passing over in the succeeding message will cause 18 to allow the wheel to rotate until 31 is in contact with one of the faces beyond the number assigned to its proper signal or call, all of which further faces are connected to the outer ring, 26, as in the preceding instance. If the number of impulses received through 18 be greater than those necessary, the same condition as to 31, 28, and 26 will obtain.

In practice, the combinations of the elements of the various calls in a series are so arranged that in instruments at all stations not desired to be called up the movement of the wheel shall cause 31 to contact with the outer ring within the movement of a tooth or two by not making the proper combinations for such stations. In these cases the circuit of B′ will be *via* 61 62 30 31 28 26 21 24 2 1 2 63 64 66, it being remembered that the first movement of the wheel has allowed 63 and 64 to contact, closing that break in this circuit. Magnet 1, being now charged, attracts the armatures 42 and 50. 42 in its movement to the poles of the magnet carries with it the member 43 of the clutch, destroying momentarily the connection between the motor and 19. To fully restore the parts to their normal condition, it is necessary that this connection be more than momentarily destroyed. This is done by the movement of 42, which carries a lever, 86, against an anvil or contact, 85, whereupon a circuit, independent of the devices hitherto acting, is established through 1, as follows: B′ 61 60 86 85 2 1 2 63 64 66, keeping the circuit through 1 closed sufficiently long for it to attract and hold 42, while 19, under the recoil of spring 47, returns to its starting or initial point, the pin 80 then taking against 64, and breaking the connection between it and 63, and destroying this circuit through 1. At the same time armature 50 lifts pawls 51 52 from engagement with wheel 70, which then, under the stress of its spring 71, returns to its initial or starting point, and if 15 and 16 have contacted the pin 72 carries 16 from contact with 15 and into contact with 14. By this sequence of operations, the entire apparatus is returned to its initial or starting point, ready for recall, the sounder S′ being thrown out of circuit and the magnet 18 into circuit. During this disconnection of the motor from the wheel and the controlling escapement, the force exerted by the magnets 1 upon the armature 42, attached to the shaft 41, gearing with the prime motor 49, is sufficient to hold 42 and prevent the motor 49 from movement and useless expenditure of its power. If the call were properly given, the wheel 19 remains in position until the message has been received. The recipient now desires to return the apparatus to its initial point to be ready for a new call, thereupon he momentarily throws S upon 10, then restoring it to 9. The connection of S with 10 establishes this circuit from B: B 4 K 12 18 13 51 10 S 11 R B, causing 31 to allow 19 to escape another tooth, putting 31 in contact with a facing, 28, connected to the outer ring, 26, whereupon the circuits last before set forth are established with the result of returning the apparatus to its initial or starting point, ready for a fresh call.

It will be readily understood that the mere construction or mechanical embodiment of my invention may be varied without departing from the spirit thereof. For instance, the wheel 19 is shown as one having plug-holes and pin, as in a switch-board, so that the pins may be arranged in any one wheel to form the desired combination for any one station, and the combination on such wheel may be changed,

if desired. Such wheels, however, could be made as complete articles, the pins being fixed therein so as not to be changeable, a special wheel being arranged for each station. While this is given as an instance of formal change, it is evident that many other formal changes might be made in the construction and arrangement of the details and individual members of the apparatus necessary to put into practice the invention.

By these means an automatic switching apparatus is provided at each station, substantially under the control of any transmitter upon the line, upon the transmission therefrom of the proper sequence of signals, every contingency which could possibly arise being provided for. It is automatic and reliable in its action, obviates the necessity of constant attention at every station on the part of operator or subscriber for fear of missing a call, in that the sounder or signal apparatus at any station is quiescent and inactive until such station itself and no other shall have been called, while at the same time the operation of the switching devices is comparatively noiseless. Its capacity for desirable use is not confined, as stated, to a telegraphic line as ordinarily constructed, but it is applicable also to all forms of electrical communication and signaling wherever it is desired to use a definite sequence or combination of pulsations to give information or to call into action registering or indicating apparatus. Among these may be mentioned regular Morse lines, Wheatstone or Needle lines, printing-lines, automatic lines, telephone-lines, district lines, visual-signal lines, electro-magnetic locks, &c.

Having thus described my invention, what I desire to claim, and secure by Letters Patent, is—

1. In an automatic switching apparatus, the combination of an escapement-wheel, a magnet controlling its rotation and located in the relay-circuit, and a second escapement-wheel, a magnet controlling it and located in a circuit controlled by the first escape-wheel, and controlling in turn the cutting in or out of the relay-circuit of such magnet and the signaling apparatus, substantially as set forth.

2. The combination of a ratchet-wheel, 19, a motor, 49, a clutch connecting the motor to the wheel, a magnet, 1, controlling the clutch, a magnet, 18, controlling and regulating the movement of the wheel 19, and circuit-connections therefor, substantially as set forth.

3. The combination of the wheel 19 and its magnetic escapement, a wheel, 70, and its magnetic propeller, and a magnet, 1, controlling the engagement or disengagement with or from the wheel 70 of its escapement and stop mechanism, substantially as set forth.

4. The combination of the magnetic escapement consisting of the wheel 19, magnet 18, and armature-lever with its releasing and stopping pawls, the wheel 70, and its magnetic escapement controlled by wheel 19, the magnet 1, and its armatures 42 and 50, and the circuit-connections shown, whereby a sounder or signaling instrument is thrown into circuit only upon passage through 18 of the proper sequence of impulses and the wheels are restored to their initial or starting point whenever a wrong signal or call is given, substantially as set forth.

5. The combination, with a ratchet-wheel, of a magnetic escapement having one of its anchor or pallet pawls pivotally or resiliently mounted and provided with stops therefor and determining the amount of movement of such pawl to permit the wheel to rotate step by step a determinate number of teeth at will at one impulse, substantially as described.

6. The combination, with a ratchet-wheel, of a magnetic escapement having one of its engaging pawls arranged to be moved within certain limits by a ratchet-tooth, and means for determining the limit of motion thereof, whereby the escapement can be used to permit one tooth or two or more teeth to escape at one impulse through the controlling-magnet, substantially as described.

7. In a magnetic escapement, the combination, with the ratchet or escapement wheel, of a magnet, 18, an armature-lever, 29, having arm 30 and pawl 31 seated thereon, and arm 34, insulated from the body of the lever, substantially as set forth.

8. In a magnetic escapement, the pawl-arm 34, constructed with two arms, 35 and 36, and having a pawl, 37, pivotally or resiliently mounted between the two arms, whereby the pawl is permitted to have a determined degree of movement, substantially as set forth.

9. In a magnetic escapement, the combination of an escapement or ratcheted wheel, an electro-magnet, an armature-lever therefor, and two escapement-pawls mounted thereon, one of which is insulated from the other and from the body of the lever, and circuit-connections, as described, from the insulated pawl, substantially as described.

10. An escapement-wheel of insulating material having the active faces of its teeth faced with a conducting material, substantially as set forth.

11. An escapement-wheel of insulating material having the active faces of its teeth faced with a conducting material which extends into the body of the wheel, substantially as set forth.

12. An escapement-wheel made of insulating material and having the active faces of its teeth faced with conducting material extending into the body of the wheel, and having two concentric conducting-rings upon one of its plane surfaces and plug-connections to the teeth-facings, whereby any tooth-facing may be connected to either ring, substantially as set forth.

13. An escapement-wheel formed of insulating material, and having conducting material placed upon the active faces of its teeth, and extending into its body and provided with rings 25 26, and pins 27 connecting with the

metal-tooth facings, plug-holes 27′ being formed one for each tooth adapted to receive switch-plugs, so as to connect any one tooth-facing with either ring, substantially as described.

14. An escapement-wheel formed of insulating material and having the active surface of its teeth faced with conducting material extending into its body, and having a switch-board formed upon one of its sides, whereby any desired combination or permutation of connections of the metal tooth-facings may be made, substantially as set forth.

15. The combination, with an escapement-wheel and its motor 49, of the clutch 43 44, an electro-magnet, 1, and a circular armature therefor fastened to the shaft, conveying motion from the motor to the wheel and controlling the clutch, substantially as set forth.

16. The combination, with the relay and a signaling-instrument adapted to be controlled by the relay and its local circuit, of a mechanism, substantially as described, for automatically cutting into circuit the signaling-instrument and cutting out the controlling-magnet of such mechanism, a three way or point switch and circuit-connections, as shown and described, whereby by operation of the switch either the signaling or the switching mechanism may be placed normally in circuit or the switching mechanism restored to a normal condition after use, substantially as described.

17. The combination of the wheel 19, having pin 80, lever 64, contact 63, lever 86, contact 83, magnet 1, battery B′, and circuit-connections, as shown, whereby an independent circuit is established through 1 to permit the complete restoration of the switching apparatus to its normal position, which circuit is then immediately broken, substantially as described.

18. The combination, with wheel 70, of pins 72 73, lever 16, contacts 14 15, battery B, and circuit-connections, as shown and described, whereby the cutting in or out of circuit of the magnet 18 and the signaling-instrument is controlled, substantially as set forth.

19. The combination, with a controlling escapement-pawl, of an escapement wheel of insulating material, with the faces of its teeth faced with conducting material, and a switch-board upon one of its sides, as described, whereby determinate combinations of circuits may be formed by the contacts of the pawl and wheel, substantially as set forth.

20. The combination, in a magnetic escapement, of an escapement-wheel constructed as described, the commutator or contact-rings 21 22, and the commutator springs or brushes 23 24, whereby the circuits formed by the use of the switch-board 25 26 may be connected with the exterior circuits, substantially as set forth.

21. The combination of the ratchet or escapement wheel 19, its magnetic escapement, the wheel 70, and its magnetic escapement, the prime motor 49, clutch 42 43, magnet 1 with armatures 42 50, substantially as set forth.

22. The combination of the escapement-wheel 19, its magnetic escapement, the wheel 70, and its magnetic escapement, the magnet 1 and its armatures, a relay, R, signaling apparatus S′, switch S, batteries B B′, and circuit-connections, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

E. R. GILL, JR.

Witnesses:
A. H. NORRIS,
JOS. L. COOMBS.