R. HAMILTON.

TELEPHONE SYSTEM AND THE LIKE.

APPLICATION FILED JUNE 1, 1908.

935,105.

Patented Sept. 28, 1909.

4 SHEETS—SHEET 1.

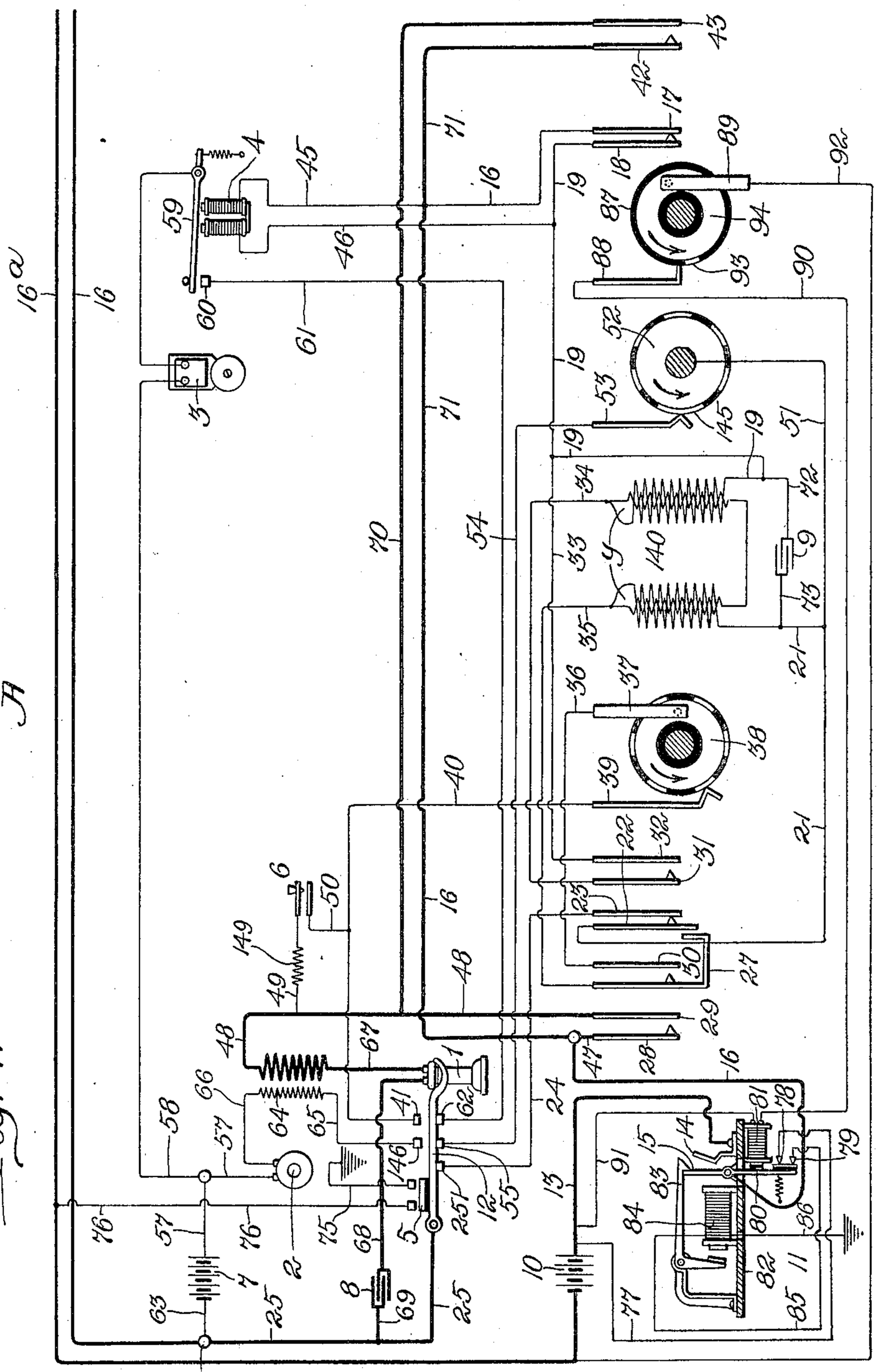

Fig. 1.

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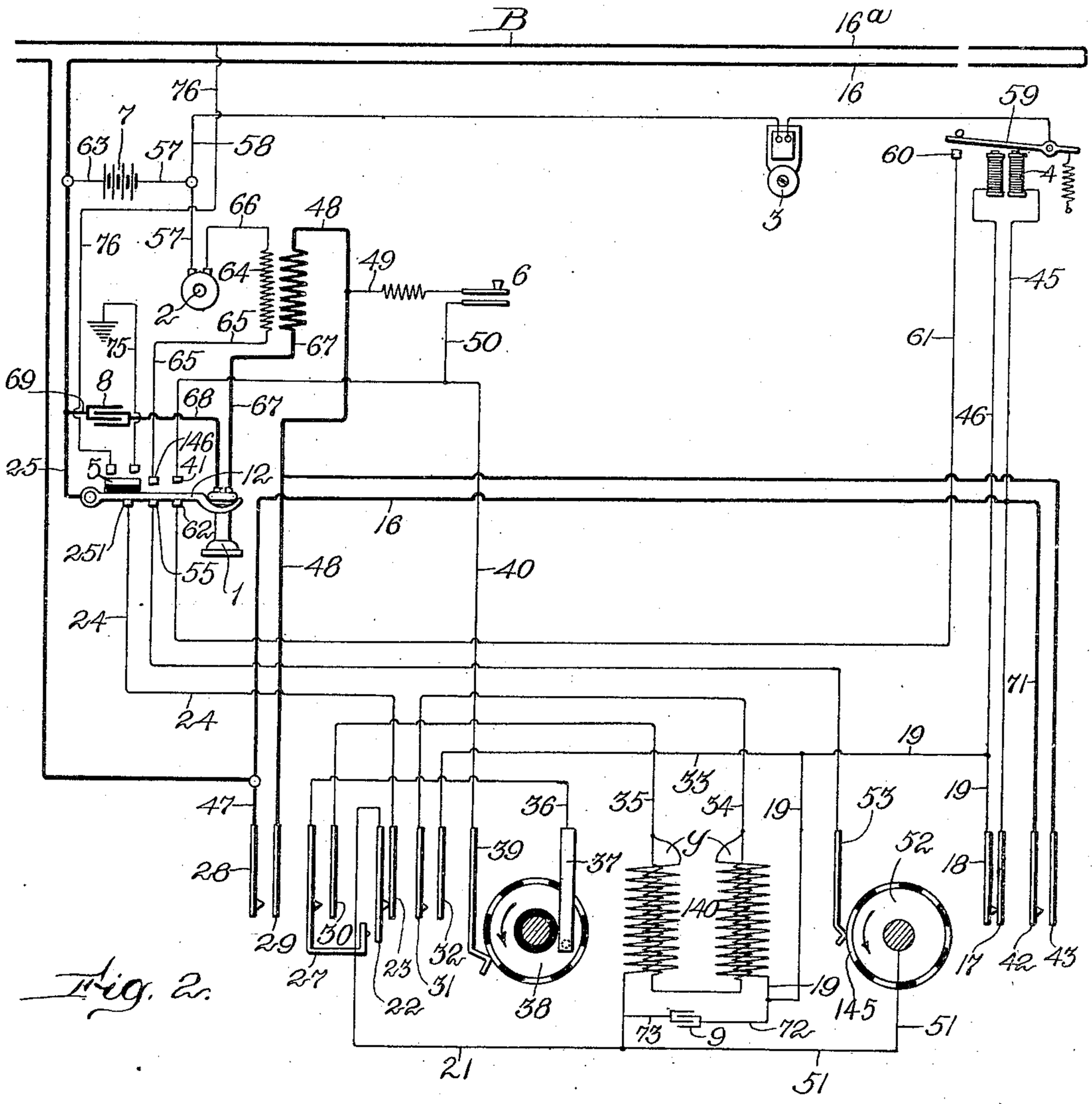
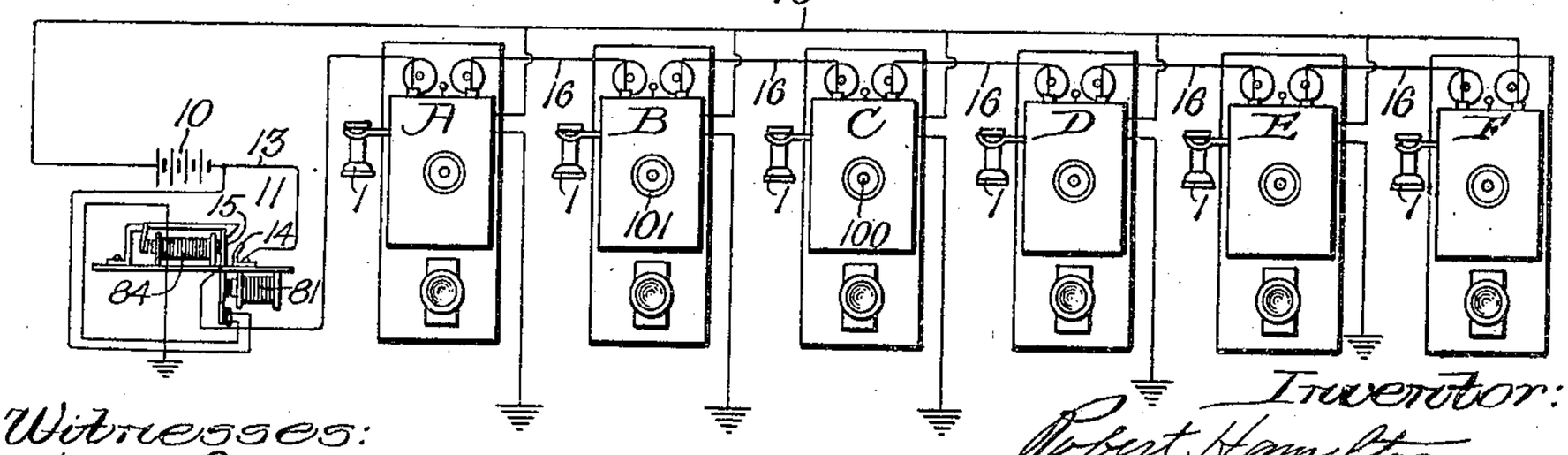


Fig. 2.

Fig. 3.



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4 SHEETS—SHEET 3.

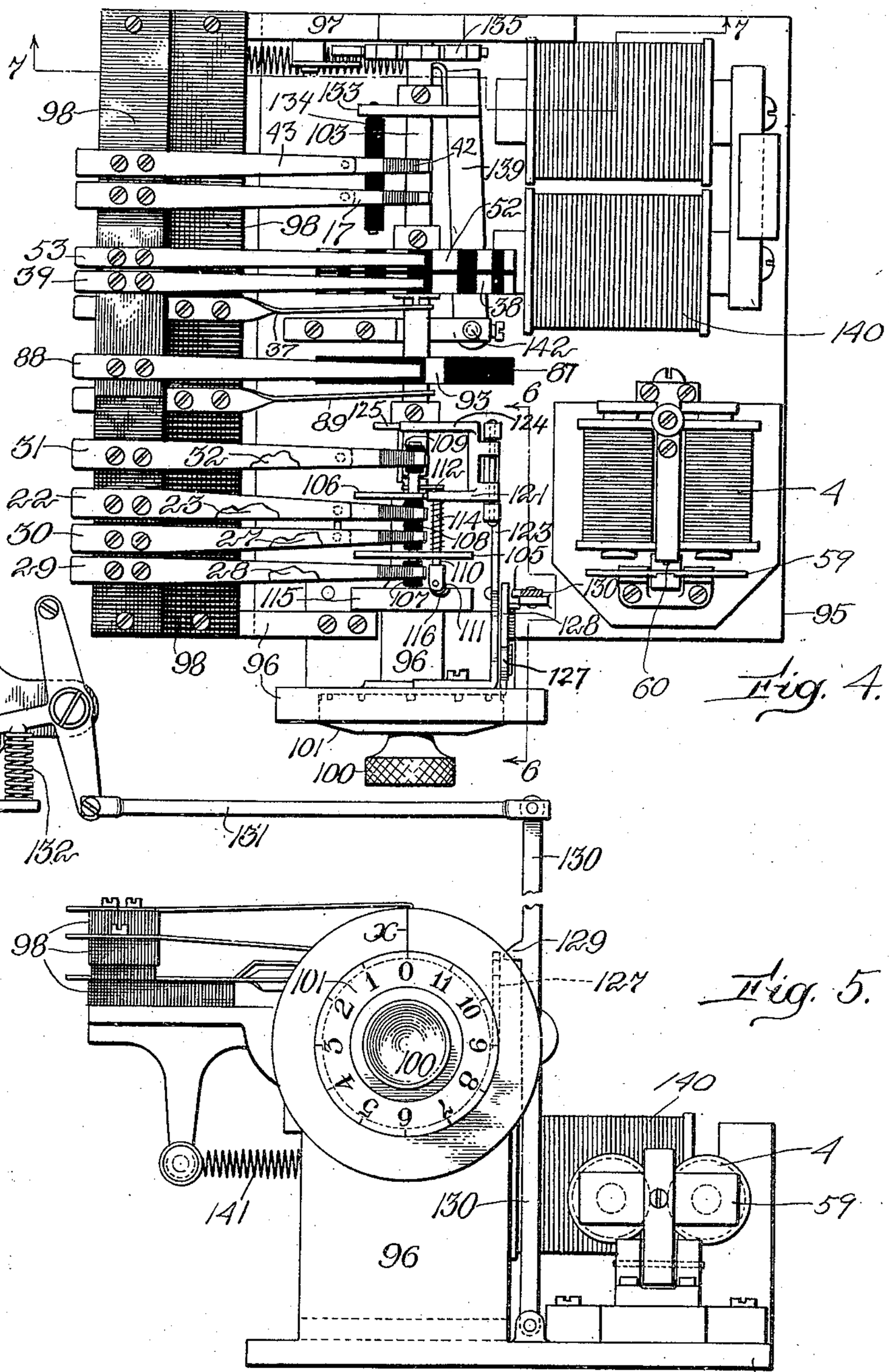

Fig. 4.

Fig. 5.

Fig. 6.

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4 SHEETS—SHEET 4.

Fig. 10.

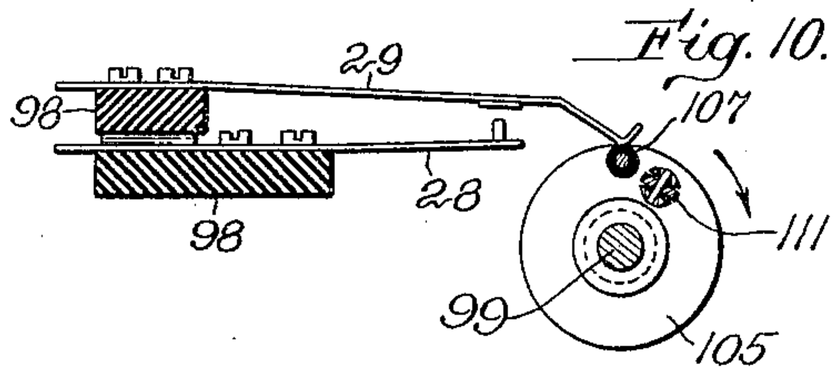


Fig. 16.

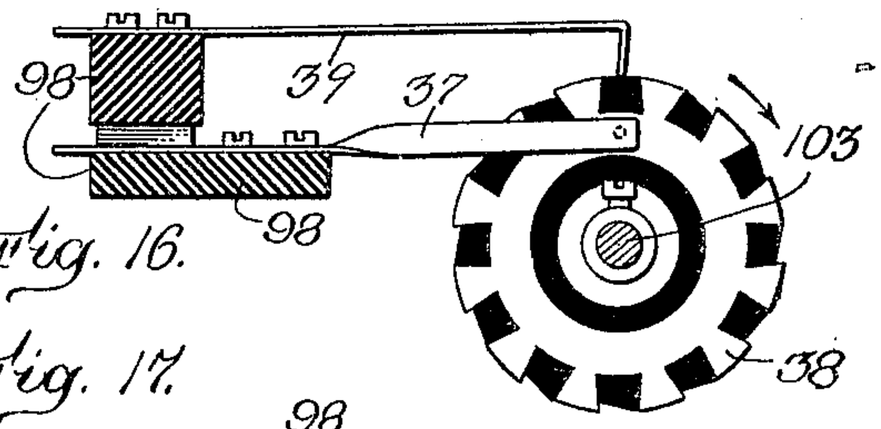


Fig. 17.

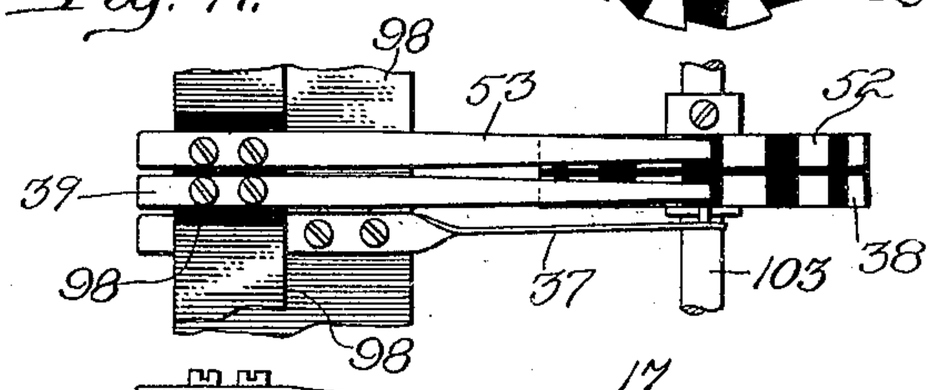


Fig. 11.

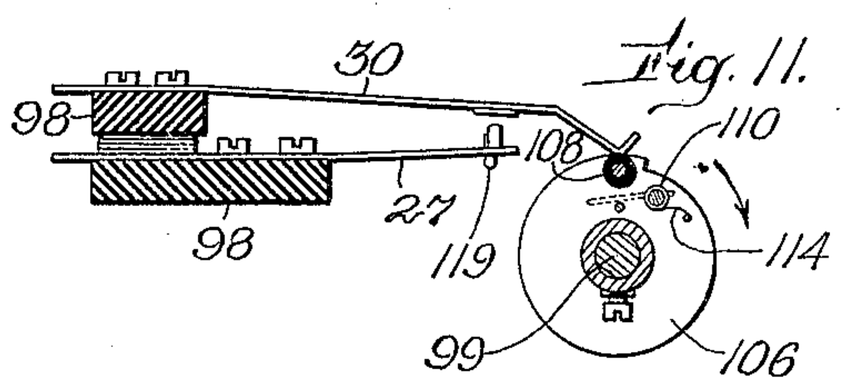


Fig. 18.

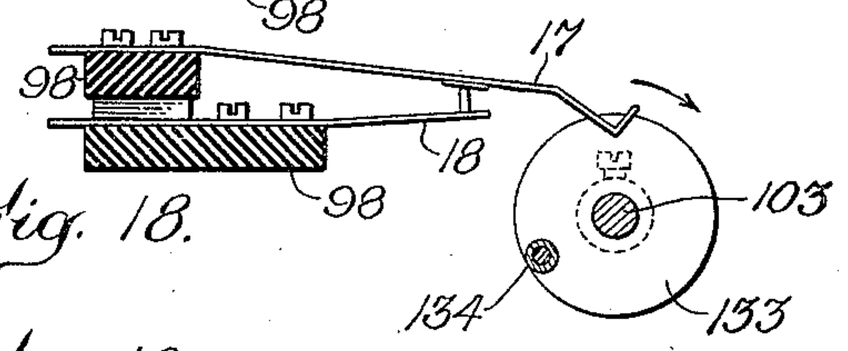


Fig. 12.

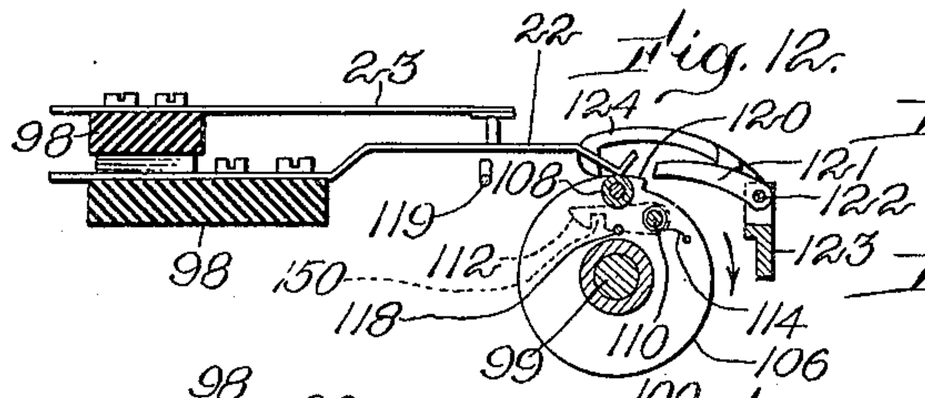


Fig. 19.

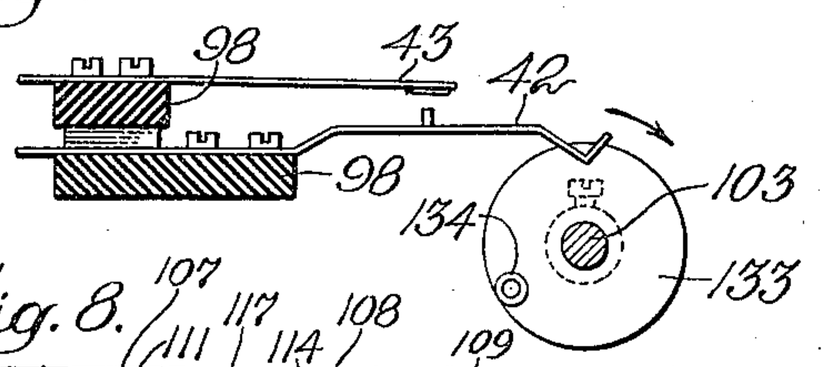


Fig. 14.

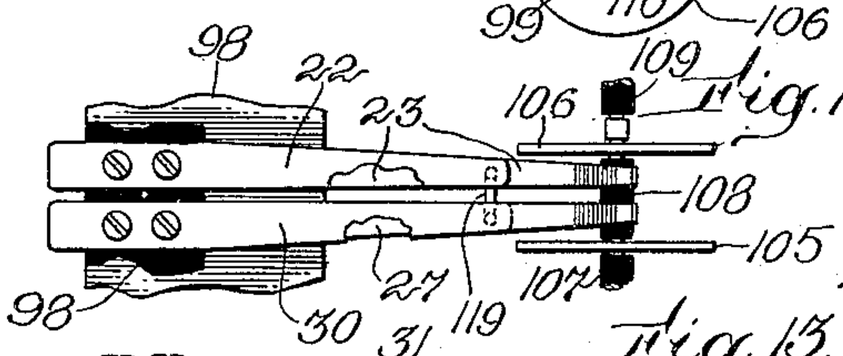


Fig. 8.

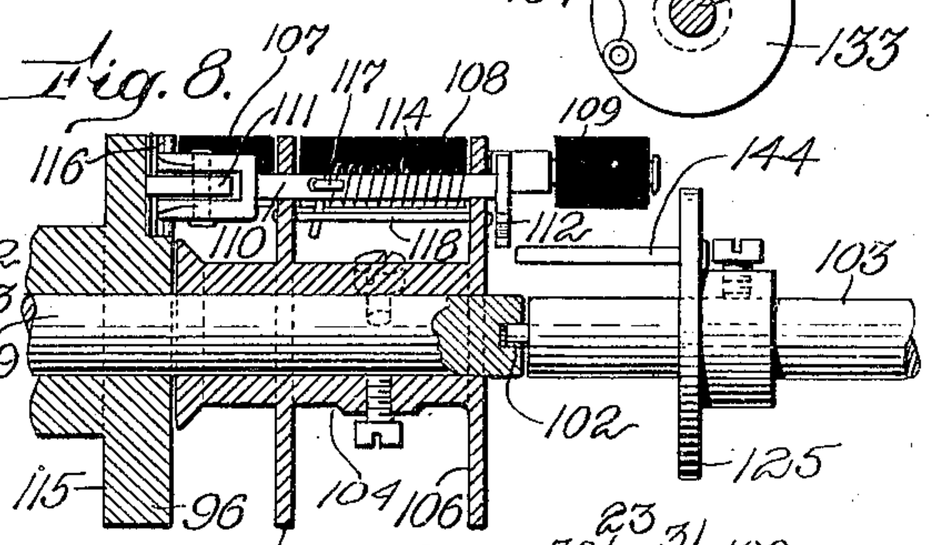


Fig. 13.

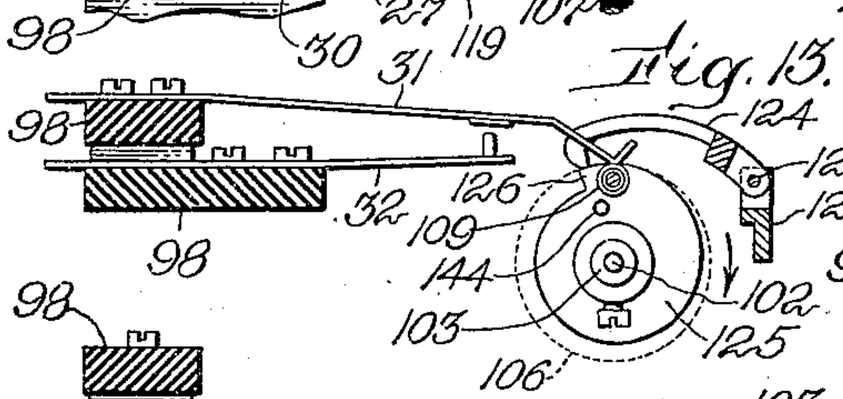


Fig. 9.

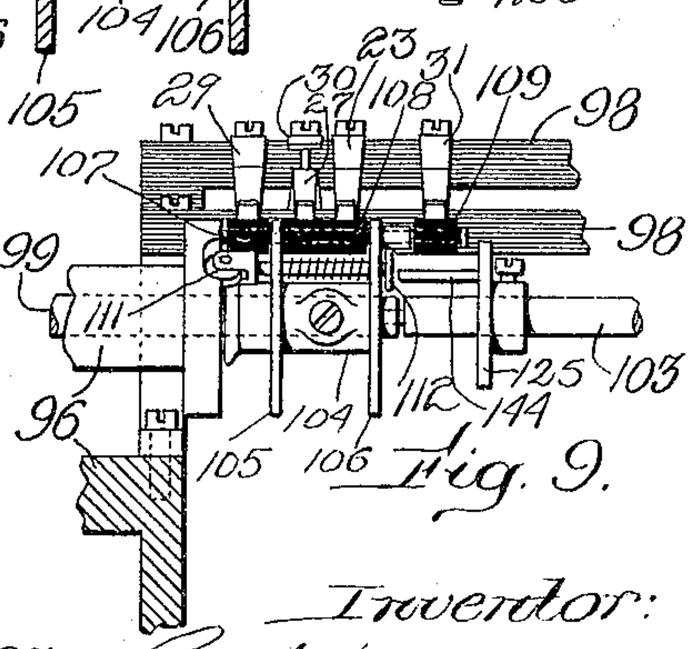
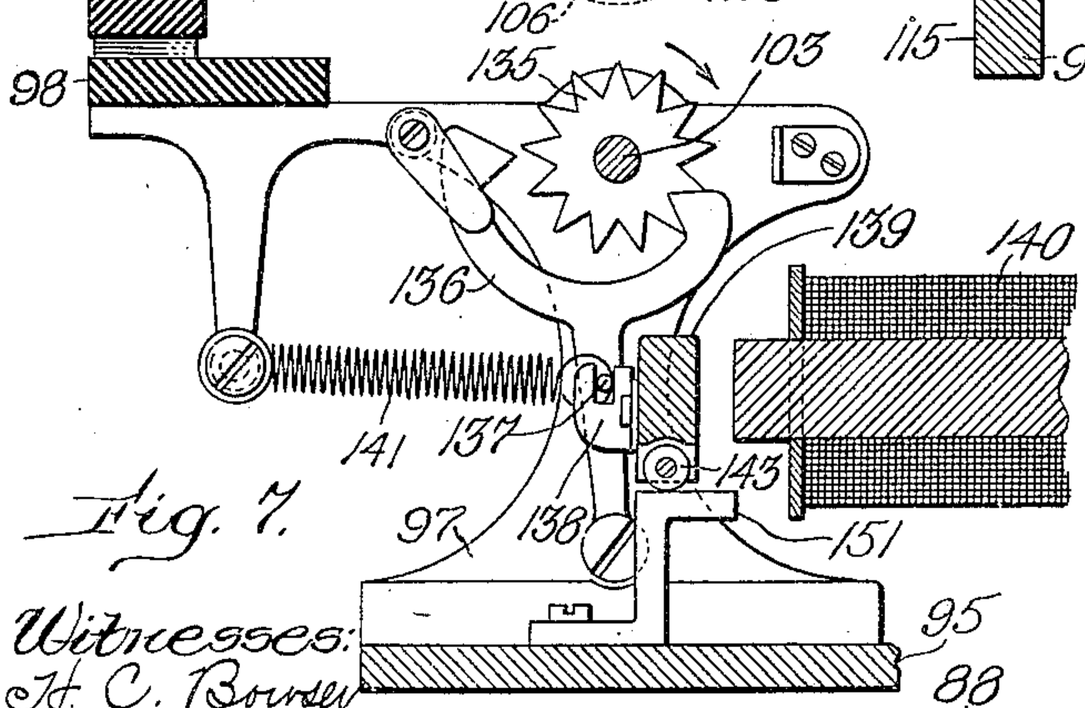


Fig. 7.



Witnesses:
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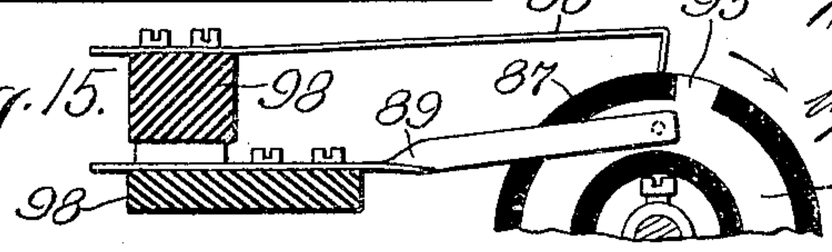
J. A. Holton

Fig. 15.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM AND THE LIKE.

935,105. Specification of Letters Patent. **Patented Sept. 28, 1909.**

Application filed June 1, 1908. Serial No. 435,964.

To all whom it may concern:

Be it known that I, ROBERT HAMILTON, of Boston, in the county of Suffolk and State of Massachusetts, have invented new and useful Improvements in Telephone Systems and the Like, of which the following is a specification.

My invention relates to telephone systems and the like and particularly to so-called automatic party line telephone systems wherein the operator at any one of the several stations of the system can call up and establish communication with any one of the other stations to the exclusion of all the rest without the aid of a central operator or station. A party line system of this type is shown and described in United States Letters Patent No. 754211 and dated March 8, 1904, and the main object of my present invention is to improve the construction and mode of operation of systems of this kind.

An undesirable feature of the system of the patent above noted was that the main line circuit was normally closed and consequently there was a continual drain upon the main battery as well as heating of the magnets forming part of the switch operating motors. To obviate this objection I have herein provided as a feature of my present invention, a normally open main line circuit and means through which the operator at any one of the stations can close said circuit when he desires to operate the system to connect his station with any one of the other stations, means, preferably automatic, being also provided through which said circuit is re-opened when the two connected stations are disconnected.

With the system of the patent noted above the switch operating motors would not always operate in synchrony, the motor at the calling station at times getting ahead of the motors at one or more, and sometimes all, of the other stations thereby disarranging the system so as to practically render it inoperative at times until the motors were re-adjusted. The reason for this was that the motor at the calling station operated the controlling commutator or make and break wheel of that station through which all of the motors were operated, and therefore, the motors being all constructed and operated alike, the motor at the calling station was more responsive to the makes and breaks produced in the motor circuit by the commutator wheel that was operated by it than were the other motors. For this reason the motor at the calling station would at times get ahead of, and out of step with, the other motors. One feature of my present invention removes this difficulty and it consists in providing means at each station for retarding the action of the motor of that station when that station is used as the calling station, so as to keep the several motors in step. That is, by retarding the action of the motor at the calling station and making its action more sluggish than that of the motors at the other stations, synchronous operation of all of the motors is secured and they are prevented from getting out of step. I also preferably provide a support for the free end of the motor armature which materially assists in keeping the several motors in step and this constitutes another feature of my invention.

In the best form of my invention a selecting device is provided as usual at each station by means of which the operator thereof selects the station with which he desires to communicate and, as usual, having by this device made the selection and set in operation the switch operating motor of that station, the said motor automatically operates the motor circuit in which it is itself located until its action is arrested by a stop that is positioned by, and according to, the adjustment of the selecting device. Thus, understanding that the stop is differently positioned for each station of the system as in the patent above noted, it will be seen that the motor at the calling station will operate the motor circuit a number of times corresponding to the selected station so as to establish communication between the selected station and the calling station.

When the operation of the motor at the calling station is caused to be resumed to restore the system to its normal condition either through the means described in the patent above noted, or otherwise, said motor acting through the stop automatically returns the selecting device at the calling station to normal position as the motor controlled switches are returned to normal condition.

A feature of my present invention consists in having the stop of each station normally occupy an inoperative position so that the motor of that station is normally free to be operated independently of said stop, and in providing means through which said stop is rendered operative when the selecting device

of that station is operated to select the station with which it is desired to communicate.

Another feature of my invention consists in providing a movable support or hook for the telephone receiver that is operated to control the stop by the removal and replacing thereon of the receiver, said support serving to lock the stop against being shifted when the receiver is removed and to free said stop when the receiver is replaced.

My improved telephone system as herein shown is a "two-wire" system and the wiring of the motor circuit is used in part for the telephone circuit as in the patent above noted. For this reason I have herein provided, as a feature of my invention, means to entirely remove the resistance of the magnets of the switch operating motors from the telephone circuit, consisting preferably, of a shunt at each station passing around the motor magnet thereof and containing a condenser which serves as a barrier to the battery current used to operate the motors but which leaves said shunt free to be traversed by the induced current produced in the secondary circuit of the telephone. In the patent above noted when any two stations were connected the coils of the magnets of the switch operating motors at all of the other stations were in the talking circuit which of course was objectionable.

With respect to the several features of my invention some of which are mentioned above it is to be understood that I do not mean to limit all of them to use in a party line telephone system solely but as will be obvious some of them are equally as applicable to signal systems and the like wherein are included a number of stations or their equivalents and therefore the expression "telephone system or the like" herein employed is intended to include all such systems.

Other features of my invention are hereinafter pointed out.

In the accompanying drawings:—Figures 1 and 2 illustrate diagrammatically, two stations of an automatic party line telephone system embodying some of the features of my invention. Fig. 3 is a general diagrammatic view of an entire automatic party line telephone system constructed in accordance with my invention. Fig. 4 is a plan view of one of the switch operating motors hereinafter described. Fig. 5 is a front elevation of the motor shown in Fig. 4. Fig. 6 is a section on line 6—6 of Fig. 4. Fig. 7 is a section on line 7—7 of Fig. 4. Figs. 8 and 9 illustrate the motor controlling stop hereinafter described. Figs. 10, 11, 12, and 13 show the four switches that are provided at each station and controlled in part by the selecting device. Fig. 14 is a plan view of the two switches 12 and 13. Figs. 15, 16, 17, 18, and 19 show the other switches and circuit operating devices that are controlled and operated by the motor.

At each station of the system there is provided an instrument such as is shown in Figs. 4 to 19, inclusive; a telephone receiver 1; a telephone transmitter 2; a bell 3; a bell relay 4; a switch 5; a push button switch 6; a battery 7 for the primary of the telephone; two condensers 8 and 9; an induction coil 64; and a receiver supporting hook 12. The system also includes a main battery 10, and an automatic switch 11, Figs. 1 and 3, and a single wheel 87 the latter forming part of one of the stations of the system.

The instrument shown in Figs. 4 to 19, inclusive, comprises a base 95 made with two standards 96 and 97 to which is fastened cross-bar 98 of insulating material. Journaled in the upright 96 is a spindle 99 provided at its outer end with a handle 100 and dial 101, the latter coöperating with an index X on standard 96. At its inner end spindle 99 is made with a socket 102 within which is journaled and supported one end of a shaft 103 which is the shaft of the switch operating motor presently to be described. The other end of shaft 103 is journaled on the standard 97. Fixed to the spindle 99 just inside of bearing 96 is a sleeve 104 made with two flanges 105 and 106 carrying rollers 107, 108 and 109 of insulating material, and an endwise movable rock shaft 110. One end of rock shaft 110 carries a roll 111 and the other end a stop arm 112 which is the stop above referred to. Normally stop 112 is held in the position shown in Fig. 12 by a spring 114 which also serves to hold roll 111 against the face of a disk 115 that is integral with standard 96, said roll being normally in a notch 116 made in the face of said disk, with stop 112 occupying an inoperative position with relation to a pin 144. One end of spring 114 bears against and is fast to disk 106 while the other end bears against a pin 117 around which it is hooked, said pin extending through shaft 99 and resting against a stop bar 118 supported at its ends by disks 105 and 106. The roll 107 coöperates with a spring contact 29 which in turn coöperates with a spring contact 28, the pair of contacts 28 and 29 being fastened to bars 98. Normally the roll 107 holds these two contacts separated. The roll 108 coöperates with a spring contact 30 which in turn cooperates with a spring contact 27 having a lateral projection 119 extending under a spring contact 22 that is normally held out of engagement with projection 119 and in engagement with another contact 23, by the roll 108. Therefore roll 108 controls all of these four contacts. The contacts 27, 30, 22 and 23 are fastened to the cross-bars 98.

The roll 109 on disk 106 coöperates with a contact 31 fast to one of the bars 98 and

coöperating with another contact 32 fast to the other bar 98. The roll 109 normally holds contact 31 out of engagement with contact 32.

The disk 106 is made with a shoulder 120 coöperating with a detent 121 pivoted loosely at 122 to an arm 123 projecting from standard 96. This detent 121 is made with an arm 124 normally supported by a projection 126 on a cam 125 fast to shaft 103 so that detent 121 is held out of the path of shoulder 120. The cam 125 on shaft 103 carries a laterally projecting pin 144 coöperating with the stop 112.

The inner face of dial 101 is made with ratchet teeth or sockets coöperating with a spring pressed latch 127 pivotally mounted on arm 123. Latch 127 is made with an arm 128 coöperating with a projection 129 on a lever 130 pivoted at one end to base 95 and connected at its opposite end by a link 131 with the usual receiver supporting hook 12. Normally the weight of the receiver on hook 12 holds said hook, link and lever in the position shown in Fig. 5 with projection 129 out of the path of arm 128 so that dial 101 and spindle 99 are free to be turned. When, however, the receiver is removed from hook 12 the usual spring 132 lifts the hook and thereby shifts the projection 129 into a position immediately above arm 128 so that latch 127, dial 101 and spindle 99 are locked immovable.

The dial 101, spindle 99 and stop 112 constitute the selecting device referred to above. The latch 127, lever 130, link 131, hook 12 and spring 132 make up the means above referred to for locking the selecting device in its adjusted position.

Fixed to the shaft 103 is a wheel 87 made up of a metal ring 94, Fig. 15, insulated from said shaft and having its periphery covered with a layer of insulating material with the exception of a spot 93. A spring contact 88 fixed to one of the bars 98 engages the periphery of wheel 87 while a spring contact 89 is in continuous contact with the side of ring 94. Normally contact 88 rests upon the insulation of wheel 87 with spot 93 in close proximity. Alongside of the wheel 87 is another wheel 38 fast to shaft 103 comprising a metal ring insulated from said shaft and having its periphery made with notches filled with insulation. A spring contact 39 fixed to one of the bars 98 engages the periphery of wheel 38 while another spring contact 37 fixed to the other bar 98 is in continuous contact with the metal ring of said wheel. Alongside of wheel 38 but insulated from the metal ring of the latter is a metal wheel 52 likewise made with notches in its periphery that are filled with insulating material. This wheel 52 which is fast to but not insulated from shaft 103, coöperates with a spring contact 53 fixed to one of the bars 98 and bearing upon the periphery of said wheel.

Next to the wheel 52 and fixed to shaft 103 is a disk 133 carrying a roll 134 that coöperates with two contacts 17 and 42, the contact 17 being normally in engagement with a contact 18 and the contact 42 being normally separated from a contact 43. All of the contacts 17, 18, 42, and 43 are fixed to the bars 98. The roll 134 is normally separated from the contacts 17 and 42 a definite angular distance and this distance is different at each station of the system from what it is at each of the other stations, the same as in the patent above noted, so that when shafts 103 are rotated in unison as described later only one of the rolls 134 of the entire system can be brought into engagement with its contacts 17 and 42 at one and the same time.

Next to disk 133 there is fixed to shaft 103 a pallet wheel 135 engaged by a pallet 136 carrying a stud 137 engaged by a yoke 138 fast to the horizontal armature 139 of a magnet 140 fixed to base 95. The pallet 136 is swung in one direction by the armature 139 when magnet 140 is energized and in the opposite direction by a spring 141 when magnet 140 is deënergized, and as will be obvious the back and forth movements thus imparted to the pallet act to rotate shaft 103 step by step in the direction of the arrow. The armature 139 is pivoted at 142 to base 95 and its free end is supported by a roller 143 traveling on a track 151. Thus the weight of the free end of the armature is borne by the roller 143 and prevented from cramping the armature on its pivots and thereby reducing its freedom of movement. This feature of supporting the free end of the horizontal armature is of considerable value, since in practice I have found it difficult with such an armature to operate the several armatures of the system in unison without this support.

The magnet 140, armature 139, pallet 136, spring 141, pallet wheel 135 and shaft 103 constitute the switch operating motor referred to above.

In operating the system from any one of its stations the operator first rotates dial 101 by hand to the right until the dial indicates the station that it is desired to communicate with. Then the operator removes the receiver 12 and the motor at that station as it operates, rotates shaft 103 until pin 144 strikes stop 112 whereupon the motor is stopped with contacts 39 and 53 on the metal of wheels 38 and 52. The partial rotation of dial 101 and spindle 99 by the operator at the calling station moves the rolls 107, 108 and 109 at the calling station away from the contacts with which they coöperate so that contacts 28 and 29 are closed, contacts 27 and 30 are closed, contacts 22 and 23 are opened, contacts 31 and 32 are closed and the pro-

jection 119 connects contacts 22 and 27. As this movement of the dial is started by the operator the stop 112 is carried away from the pin 144, on shaft 103 and at the same time the roll 111 travels out of notch 116 thereby shifting said stop into the path of pin 144. The removal of the receiver from the hook locks the dial in its adjusted position and at the same time, as will appear later, closes the main line through battery 10 at the switch 11 and starts the motors of the system in operation. The motors continue in operation until the pin 144 following in the path of stop 112 reaches the latter and is stopped. When the motors of the system are started all of the shoulders 126 immediately move away from their arms 124 allowing the detents 121 to drop into the paths of the shoulder 126 thus locking all of the dials 101 throughout the system in their normal positions so that the normal condition of the contacts controlled by the selecting devices cannot be disturbed after the operation of the system has started. During this first movement of the several shafts 103 the motor circuit is automatically operated by the commutator wheel 38 at the calling station each impulse given to the pallet 136 by armature 139 shifting contact 39 from the metal of wheel 38 to the insulation thereof, and each impulse given to pallet 136 by spring 141 shifting contact 39 from the insulation of wheel 38 to the metal thereof. The movement of the shaft 103 at the calling station is arrested by stop 112 with contact 39 of that station on metal at the moment when the roll 134 at the selected station is brought into engagement with the contacts 17 and 42. At all of the other stations the rolls 134 have either not reached their contacts 17 and 42 when shaft 103 at the calling station is stopped, or have passed said contacts. It will therefore be clear that at the completion of this first movement of shaft 103 the normal condition of the contacts controlled by the selecting devices has been changed only at the calling station by the operator thereof in the respect described above, while the normal condition of the contacts controlled by the shaft 103 has been changed only at the selected station where the contacts 17 and 18 are opened and the contacts 42 and 43 closed.

As soon as the operator at the calling station hears the stopping of the motor of that station he closes the push button 6 and thereby operates the bell 3 of the selected station to call the operator thereof to the telephone.

When the operators at both the calling and called stations replace their receivers 1 on their hooks 12 the latches 127 at both stations are unlocked and the operation of the motors thereby permitted to be resumed, the pin 144 at the calling station carrying the stop 112 with it as the shaft 103 at that station is rotated. As the dial 101 and its spindle 99 at the calling station reach normal position the roll 111 reënters the notch 116 disengaging stop 112 from pin 144 and at the same time the motors are stopped. In order to provide for thus continuing the operation of the motors to restore the system to normal condition and in order to stop them when the parts reach normal position, the wheel 52 is provided and used as a commutator for operating the restoring motor circuit during this return movement, the motor circuit being shifted from wheel 38 to the wheel 52 by the movement of the hook 12 at the calling station occasioned by the replacing of the receiver on said hook. The wheel 52 operates the restoring motor circuit the same as the wheel 38 operated the preliminary motor circuit except that as the parts return to normal position the spring 141 acting through pallet 136, pallet wheel 135 and shaft 103, shifts the spot 145 of wheel 52 into engagement with contact 53. This spot 145 is made larger than the other exposed spots of the metal ring of wheel 52 so that when armature 139 is now attracted and shaft 103 given another step movement the spot 145 does not leave contact 53 and therefore the operation of the motors by wheel 52 is stopped. During this step movement of shaft 103 by the armature 139 the spot 93 of wheel 87 is carried past contact 88 which as will be described later acts to open the motor circuit at 11 thus deënergizing the magnets 140 and allowing the springs 141 to impart the final step movement to the shafts 103 which leaves the system in normal condition.

Each magnet 140 is of peculiar construction, each coil thereof comprising two parts, an inner winding and an outer winding connected by a loop y extending to the exterior of the coil to be connected, one loop with a wire 34 and the other loop with a wire 35, Fig. 1. In making each of the coils of magnet 140 the inner part of the winding is wound first, then the loop y is carried to the exterior, and then the outer part of the winding is applied.

The magnets 140 of the several stations, A. B. C. etc. are normally in series in a main line circuit which is open at the switch 11, and when this switch is closed the complete main line circuit is traced as follows:— From battery 10 through wire 13 to two contacts 14 and 15 of switch 11, from contact 15 through a wire 16 to the contacts 17 and 18 of station A, from contact 18 of station A through wire 19 to one end of the winding of the magnet 140 of station A, through said winding and thence through a wire 21 to contacts 22 and 23. From contact 23 through a wire 24 to contact 251 coöperating with hook 12, the latter being connected by a wire 25 with a binding post 26 to which is also connected the wire 16

leading to the next station B. At this next station B the circuit continues as at A and at the last station F the binding post 26 thereof is connected by a return conductor or wire 16ª with battery 10.

When the operator at any one of the stations desires to operate the system to call up and connect with any other station, he first adjusts the dial 101 of that station and then removes the receiver 1. This closes switch 11 and completes a preliminary motor circuit which is the same at all of the stations as the main line circuit just described except at the calling station. The switch 11 is automatically closed through the engagement of the movable bridge piece of the switch 5 with the stationarily supported contacts of said switch as hereinafter described. At this station the preliminary motor circuit is from wire 16 to wire 19 and thence by a wire 33 to contacts 32 and 31 which are closed at the calling station by the shifting of the dial 101. From contact 31 through a wire 34 to one of the projecting loops y of the winding of magnet 140, through the inner part of the winding of magnet 140, and thence by a wire 35 to contact 27 which at the calling station is, through the adjustment of dial 101, in engagement with contact 30. Through contact 30 and a wire 36 to the contact 37, wheel 38 and contact 39, and from the latter through a wire 40 to a contact 41 coöperating with the receiver hook 12. The hook 12 being up at the calling station and in engagement with contact 41 the circuit continues through the hook and wires 25 and 16 to the next station of the system. It will therefore be seen that as soon as the receiver is removed from its hook at the calling station this preliminary motor circuit is closed and the motors set in operation.

When the operation of the motors is arrested by the stop 112 at the calling station as above described the operator at that station closes the push button 6 and thereby operates a circuit through the bell relay 4 which is traced as follows:—From battery 10 through wire 13, contacts 14 and 15, and wire 16 to station A. If station A is not the calling station then the circuit continues therethrough the same as in the case of the preliminary motor operating circuit but, assuming Sta. A to be the calling station, then this bell relay circuit continues through a wire 47 to contacts 28 and 29, and thence by a wire 48 to a wire 49 connected with push button 6 through a resistance 149 which prevents the operation of magnets 140 at this time. From push button 6 through a wire 50 to wire 40 and contact 41, from contact 41 through hook 12 and wire 25 to binding post 26. If there are any stations between the called and calling stations then the circuit takes the same course through those stations as the preliminary motor operating circuit traced above. At the called station this bell relay circuit continues from the wire 16 through a wire 45 to the magnet of relay 4 and thence by a wire 46 to wire 19, from wire 19 through magnet 140, wire 21, contacts 22 and 23, wire 24, contact 251, hook 12 and wire 25 to binding post 26, and from the binding post 26 of station F back to battery 10 through wire 16ª. At this time the contacts 17 and 18 are open at the called station and closed at all of the other stations of the system so that the circuit is shunted through the bell relay 4 only at the called station while the resistances 149 prevent the bell operating current from operatively energizing the magnets 140. The closing of this relay circuit by means of the push button 6 at the calling station therefore energized only the magnet of the relay 4 of the selected station and only said magnet attracts its armature 59 and closes a local bell circuit at the selected station including the bell 3 which is traced as follows:—From the battery 7 through wires 57 and 58, bell 3, armature 59 of relay 4, contact 60, wire 61, contact 62, hook 12, and back to battery 7 through wires 25 and 63.

Now when the receivers 1 at both the calling and called stations are removed from their hooks telephone connection is established since the closing of contacts 28 and 29 at the calling station occasioned by the operation of the dial 101 of that station and the closing of contacts 42 and 43 at the called station effected through the operation of the shaft 103 of that station, completes the secondary of this telephone connection, while the engagement of the forks 12 at those two stations, each with a contact 146 completes the two primary circuits of this telephone connection.

The primary telephone circuit at each station is traced as follows:—From contact 146 through wire 65, the primary of induction coil 64, a wire 66, transmitter 2, wire 57, battery 7, wires 63 and 25, to hook 12 which at the calling and called stations is now in engagement with its coöperating contact 64. The secondary circuit of the telephone connection incidentally includes the battery 10 and is traced as follows:—From battery 10 through wire 13 to contacts 14 and 15, wires 16 and 47, contacts 28 and 29 of station A which is assumed to be the calling station, wire 48, the secondary of induction coil 64, a wire 67, receiver 1, a wire 68, condenser 8, wires 69, 25 and 16 to station B which we will assume to be the called station. Here the secondary telephone circuit continues from wire 16 through wire 71 to the contacts 42 and 43, and thence through wires 70 and 48 to the secondary of induction coil 64 thence

through wire 67, receiver 1, wire 68, condenser 8, wires 69, 25 and 16 to station C. At station C and all of the remaining stations of the system, except the calling and called stations of course, the secondary telephone circuit continues from wire 16 through contacts 17 and 18, wires 19 and 72, condenser 9, wires 73 and 21, contacts 22 and 23, wire 24, contact 251, hook 12 and wire 25 to binding post 26. From the binding post 26 of the last station F the return wire 16ª leads back to battery 10 thus completing the secondary telephone circuit. It will now be clear that while the magnets of the motors of the calling and called stations are excluded from the secondary telephone circuit through the closing of the contacts 28 and 29 of the calling station and the contacts 42 and 43 of the called station as in the system of the patent above noted the provision of the shunt 72, 73 including the condenser 9, excludes the motor magnets from the telephone secondary at the other stations of the system thus eliminating the resistance of said magnets at those stations which was an objectionable feature of the construction shown and described in the patent referred to.

When the operators at the two stations that have been connected replace their receivers 1 on their hooks 12, the latch 127 at the calling station is freed as above described and the restoring motor-circuit is closed thereby setting the motors in operation to restore the parts to normal condition. This restoring motor circuit is traced as follows, assuming station A to be the calling station and station B the called station:—From battery 10 through wire 13 contacts 14 and 15, wire 16 to station A. Through station A, the calling station, by contacts 17 and 18, wires 19 and 33, contacts 31 and 32, wire 34, the interior winding of magnet 140, wire 35, contacts 27 and 22 wires 21 and 51, the latter connected with the base 95 of the instrument shown in Fig. 4; through the frame of this instrument to the shaft 103, wheel 52 and contact 53, wire 54, contact 55, hook 12, and wire 25 to binding post 26. The course of this circuit through the calling station is maintained as just described throughout the restoring operation of the motors but at the called station the first impulse over the line is carried through the relay 4 because at that time the contacts 17 and 18 are open, but the first step movement of the shaft 103 of the called station shifts roll 134 away from contacts 17 and 42 so as to close contacts 17 and 18 and open contacts 42 and 43. It will therefore be clear that after the first impulse the restoring circuit at the called station will be from wire 16, through contacts 17 and 18, wire 19, magnet 140, wire 21, contacts 22 and 23, wire 24, contact 251, fork 12, and wire 25 to binding post 26. At all of the other stations other than the calling station this circuit is the same as that just described for the called station after the first impulse.

It will be observed that when considering the entire journey of each shaft 103 from its normal position there is a movement at each station when the motor circuit is shunted through relay 4 due to the engagement of roll 134 with its coöperating contacts 17 and 42.

At the end of the operation of the restoring circuit when the spot 145 is brought into engagement with contact 53 by spring 141 the magnet 140 is energized and armature 139 of station A imparts another step movement to shaft 103 carrying the spot 93 past contact 88 thus opening the main line at 11 and stopping the motors with contact 53 on spot 145 and contact 39 on the metal of wheel 38.

The means through which the operator at any one of the several stations closes the normally open main line circuit is as follows:—One of the stationarily supported contacts of each switch 5 is grounded through a wire 75 while the other stationarily supported contact of said switch is connected by a wire 76 with the return conductor or wire 16ª which connects with one side of battery 10. The movable bridge piece of switch 5 is mounted on but insulated from hook 12. The wire 13 at the other side of battery 10 has connected to it one end of a wire 77 that is connected at its opposite end to a contact 78 normally connected with another contact 79 by a bridge piece carried by but insulated from one arm of the armature 80 of a magnet 81. The armature 80 is pivotally mounted upon the base of switch 11 and at its upper end carries the contact 15 which normally is held away from the contact 14 by a pivoted latch 83 carrying the armature of a magnet 84. One end of the winding of magnet 84 is connected by a wire 85 with contact 79 while the other end thereof is connected by a wire 86 with the ground. When the operator at the calling station removes his receiver from its hook, switch 5 is closed thus energizing the magnet 84 and causing the latter to disengage latch 83 and contact 15, the spring shown in Fig. 1 as connected with armature 80 swinging contact 15 against contact 14 and at the same time carrying the bridge piece on armature 80 away from contacts 78 and 79 thereby immediately opening the circuit through magnet 84 so that the wire 13 is no longer grounded through contacts 78 and 79. The circuit that is closed when the switch 5 is closed is as follows:—From the ground through wire 75 to switch 5 and thence through wire 76 and 16ª, battery 10, wires 13 and 77, contacts 78 and 79 and the bridge piece coöperating therewith, wire 85, magnet 84 and wire 86 to ground again.

Without opening this circuit at contacts 78 and 79, or without providing some other equivalent means, it would be possible for the operator at any one of the several stations by removing his receiver to short circuit the battery 10 through the ground thereby rendering the motors of the system inoperative.

The wheel 87 and its coöperating contacts 88 and 89 constitute part of the means for automatically restoring the relay 11 to normal condition and only at one of the stations of the system is it necessary to provide this means. Therefore it is to be understood that only at station A of the system herein shown is there provided a wheel 87 and its coöperating contacts 88 and 89. The contact 88 is connected by a wire 90 with one end of the winding of magnet 81 whereof the other end is connected by a wire 91 with wire 13 leading to one side of battery 10. The contact 89 is connected by a wire 92 with the wire 16ª at the other side of battery 10. The wheel 87 moves in unison with the wheel 52 and 38 of station A and as it nears the end of its revolution the contact 88 passes across the exposed spot 93 of ring 94 and a circuit through magnet 81 is momentarily closed which is traced as follows:—From battery 10 through wires 13 and 91; magnet 81; wire 90; contact 88; ring 94; contact 89; and wires 92 and 16ª back to battery 10. The magnet 81 when thus energized attracts armature 80 thereby returning contact 15 into engagement with latch 83 and reconnecting contacts 78 and 79.

From the above description it will be seen that when the motors are in operation the action of the motor at the calling station is retarded because of the fact that only the inner part of its winding is at any time in the motor operating circuit so that the strength of the magnet 140 at that station is correspondingly reduced. It is also a fact that with the construction shown the outer part of the winding of the magnet 140 of the calling station operates as the secondary of an induction coil in a local circuit thereby increasing the retarding effect upon the motor of the calling station. As has been described above the motors at all of the other stations outside of the calling station operate under full power, while the motor at the calling station is retarded, and in this way the several motors are kept in step and caused to operate synchronously.

The stop 112 as shown in Fig. 12 consists of an arm fast to the end of the rock shaft 110 having a beveled free end just back of which is a notch 150. When during the operation of the preliminary motor circuit the pin 144 at the calling station reaches the position to which the stop 112 has been shifted by the adjustment of dial 101, said pin strikes the beveled end of stop 112 rocking shaft 110 in opposition to spring 114 and entering the notch 150. Spring 114 then turns shaft 110 back thus locking pin 144 in notch 150 so that while the restoring motor circuit is being operated and pin 144 is pushing on stop 112 to restore the selecting device at the calling station to normal position the pin and stop are locked together, and remain thus locked until roll 111 enters notch 116 whereupon shaft 110 is shifted endwise by spring 114 carrying notch 150 out of engagement with pin 144. This disengagement of pin 144 and stop 112 occurs at the moment that rolls 107, 108 and 109 reengage the contacts with which they coöperate.

What I claim is:—

1. In a system of the character described, in combination, a plurality of stations; a single normally open main line circuit connecting said stations; a normally open switch in and controlling said main line circuit; means at each station for closing said main line controlling switch and maintaining the latter continuously closed while the system is in use, and means at each station for selectively controlling communication between each station and the other stations of the system through said main line circuit.

2. In a system of the character described, in combination, a plurality of stations; a normally open main line circuit connecting said stations; a normally open switch in and controlling said main line circuit; means at each station for closing said main line controlling switch and maintaining the latter continuously closed while the system is in use, and means at each station for selectively controlling communication between each station and the other stations of the system, and automatic means for opening said main line switch when two connected stations are disconnected.

3. In a system of the character described, in combination, a plurality of stations; a normally open main line circuit connecting said stations; a normally open switch in and controlling said circuit; means at each station for closing said main line controlling switch and maintaining the latter continuously closed while the system is in use; means at each station for selectively controlling communication between each station and the other stations of the system, and automatic means for opening said main line switch when two connected stations are disconnected.

4. In a system of the character described, in combination, a plurality of stations; a normally open main line circuit connecting said stations; a normally open switch in and controlling said main line circuit; means at each station for closing said main line controlling switch and maintaining the latter continuously closed while the system is in use; means at each station for selectively controlling communication between each station and the other stations of the system, and

automatic means controlled by the last mentioned means for opening said main line switch when two connected stations are disconnected.

5. In a system of the character described, in combination, a plurality of stations; a normally open main line circuit connecting said stations; a normally open electrically operated switch in and controlling said main line circuit; means at each station for closing said main line controlling switch and maintaining the latter continuously closed while the system is in use; a switch opening circuit connected with said switch; means at each station for selectively controlling communication between each station and the other stations of the system, and automatic means for operating the switch opening circuit to open said main line switch when two connected stations are disconnected.

6. In a system of the character described, in combination, a plurality of stations; a normally open main line circuit connecting said stations; means at each station for selectively controlling communication between each station and the other stations of the system through said main line; a normally open switch controlling said main line circuit; electrically operated means for actuating said switch, said means being connected through the main line with the several stations of the system; means at each station connected with the main line for causing the switch actuating means to close said switch when the system is operated to connect two stations, and means to cause the switch actuating means to open said switch when two connected stations are disconnected.

7. In a telephone system or the like, in combination, a plurality of stations; a normally open two wire main line circuit connecting said stations in series; a battery in said main line circuit; means at each station for selectively controlling communication between that station and the other stations of the system; a normally open branch circuit leading from the main line circuit at each station; a normally open switch for each of said branch circuits; a normally open switch for controlling said main line circuit; electrically operated means for closing said main line switch; a normally closed branch circuit leading from the main line and connected with the normally open branch circuits, said switch closing means being arranged in said normally closed branch circuit; means to open the normally closed branch circuit when the main line switch is closed by said switch closing means, and means to open the main line switch and close the last mentioned branch circuit when two connected stations are disconnected.

8. In a telephone system or the like, in combination, a plurality of stations; a main line battery; a main line circuit comprising a main conductor connected at one end with one side of the battery and in which the several stations of the system are arranged, and a return conductor connecting the other end of the main conductor with the other side of the battery; a normally open switch for controlling the main line circuit; means at each station to close said switch and operate the main line circuit to connect that station with one of the other stations of the system through said main line circuit, and automatic means to open said switch when two connected stations are disconnected.

9. In a telephone system of the character described, in combination, a plurality of stations; a main line circuit in which said stations are arranged; a current generator in said main line circuit; a normally open switch for controlling said main line circuit; means at each station for closing said switch and holding it continuously closed while the system is in use; means at each station for operating said circuit while said switch is closed to connect said station with any one of the other stations of the system through said main line circuit, and automatic means to open said main line controlling switch when two connected stations are disconnected.

10. In a telephone system or the like, in combination, a plurality of stations; a normally open main line circuit in which said stations are arranged; means to close the main line circuit when operating the system to connect two stations; a switch operating motor at each station; means for operating the motors when the main line circuit is closed to connect two of the stations of the system; means to operate the motors to disconnect the two connected stations; and means through which one of the motors opens the main line circuit when the motors are operated to disconnect two stations.

11. In a telephone system or the like, in combination, a plurality of stations; a normally open main line circuit in which said stations are arranged; means to close the main line circuit when operating the system to connect two stations; a switch operating motor at each station; means for operating the motors to connect two of the stations of the system when the main line circuit is closed; means to operate the motors to disconnect the two connected stations; and means operated by one of the motors for opening the main line circuit when the motors are operated to disconnect two stations.

12. In a telephone system or the like, in combination, a plurality of stations; a main line battery; a main line circuit comprising a main conductor connected at one end with one side of the battery and in which said stations are arranged; a return conductor connecting the other end of the main conductor with the other side of the battery; a

normally open switch in the main line circuit; a magnet for closing said switch; a plurality of circuits in which said magnet is arranged, each circuit connecting the magnet with one of the stations; means at each station through which the magnet circuit of that station can be operated to close the switch, and means to open said switch when two connected stations are disconnected.

13. In a telephone system or the like, in combination, a plurality of stations; a main line battery; a main line circuit comprising a main conductor connected at one end with one side of the battery and in which said stations are arranged; a return conductor connecting the other end of the main conductor with the other side of the battery; a normally open switch in the main line circuit; a magnet for closing said switch; a plurality of normally open circuits in which said magnet is arranged, each circuit connecting said magnet with one of the stations; means at each station for closing its magnet circuit to close said switch; means operated by the closing of the switch to open the magnet circuit that is operated, and means to open the switch when two connected stations are disconnected.

14. In a telephone system or the like, in combination, a plurality of stations; a main line battery; a main line circuit comprising a main conductor connected at one end with one side of the battery and in which said stations are arranged; a return conductor connecting the other end of the main conductor with the other side of the battery; a normally open switch in the main line circuit; a magnet for closing said switch; a normally open connection at each station between the return conductor and the ground; a normally closed connection from the main conductor to the ground including said magnet; means at each station to close the ground connection thereof to energize said magnet and close the switch; means to open the ground connection from the main conductor when the switch is closed, and means to open the switch when two connected stations are disconnected.

15. In a telephone system or the like, in combination, a plurality of stations; a switch operating motor at each station; a motor circuit in which the several motors of the system are arranged; means at one or more of the stations operated by the motor thereof for automatically operating the motor circuit to connect two of the stations of the system and means to render the motor at the station from which the circuit is operated less responsive to the operations of the motor circuit than the other motors of the system.

16. In a telephone system or the like, in combination, a plurality of stations; a switch operating motor at each station; a motor circuit in which the several motors of the system are arranged; means at one or more of the stations operated by the motor thereof for operating the motor circuit to connect two of the stations of the system, and means to render the motor at the station from which the circuit is operated less responsive to the operations of the motor circuit than the other motors of the system.

17. In a telephone system of the character described, in combination, a plurality of stations; a switch operating motor at each station; a motor circuit in which the several motors of the system are arranged; means at each station operated by the motor thereof for operating the motor circuit to connect two of the stations of the system; and means to render the motor at the station from which the circuit is operated less responsive to the operations of the motor circuit than the other motors of the system.

18. In a telephone system of the character described, in combination, a plurality of stations; a switch operating motor at each station; a motor circuit in which the several motors of the system are arranged; means at each station operated by the motor thereof for operating the motor circuit to connect that station with and disconnect it from another station of the system, and means to render the motor of the station from which the system is operated less responsive to the operations of the motor circuit than the other motors of the system.

19. In a telephone system or the like, in combination, a plurality of stations; a switch operating motor at each station comprising a magnet and armature; a motor circuit in which the magnets of the several stations are arranged; means at one or more of the stations operated by the motor of that station from which the system is operated for operating the motor circuit to connect that station with any one of the other stations; and means to render inoperative part of the winding of the magnet of that station from which the motor circuit is operated so as to retard the motor at that station.

20. In a telephone system or the like, in combination, a plurality of stations; a switch operating motor at each station comprising a magnet and an armature; a motor circuit in which the magnets of the several stations are arranged; means at one or more of the stations operated by the motor of that station from which the system is operated for operating the motor circuit to connect that station with any one of the other stations, and means to exclude part of the winding of the magnet of the station from which the system is operated.

21. In a telephone system or the like, in combination, a plurality of stations; a switch operating motor at each station comprising a magnet and armature; a motor circuit in which the magnets of the several stations are

arranged; means at one or more of the stations operated by the motor of that station from which the station is operated for operating the motor circuit to connect that station with any one of the other stations, and means to impede the current passing through the winding of the magnet of that station from which the circuit is operated to a greater degree than at the other magnets.

ROBERT HAMILTON.

Witnesses:
ARTHUR F. RANDALL,
ABRAM TILLES.