C. A. ANDERSON & W. HAGSTROM.

TELEPHONE EXCHANGE.

APPLICATION FILED AUG. 29, 1904.

938,943.

Patented Nov. 2, 1909.

4 SHEETS—SHEET 1.

Fig. 1

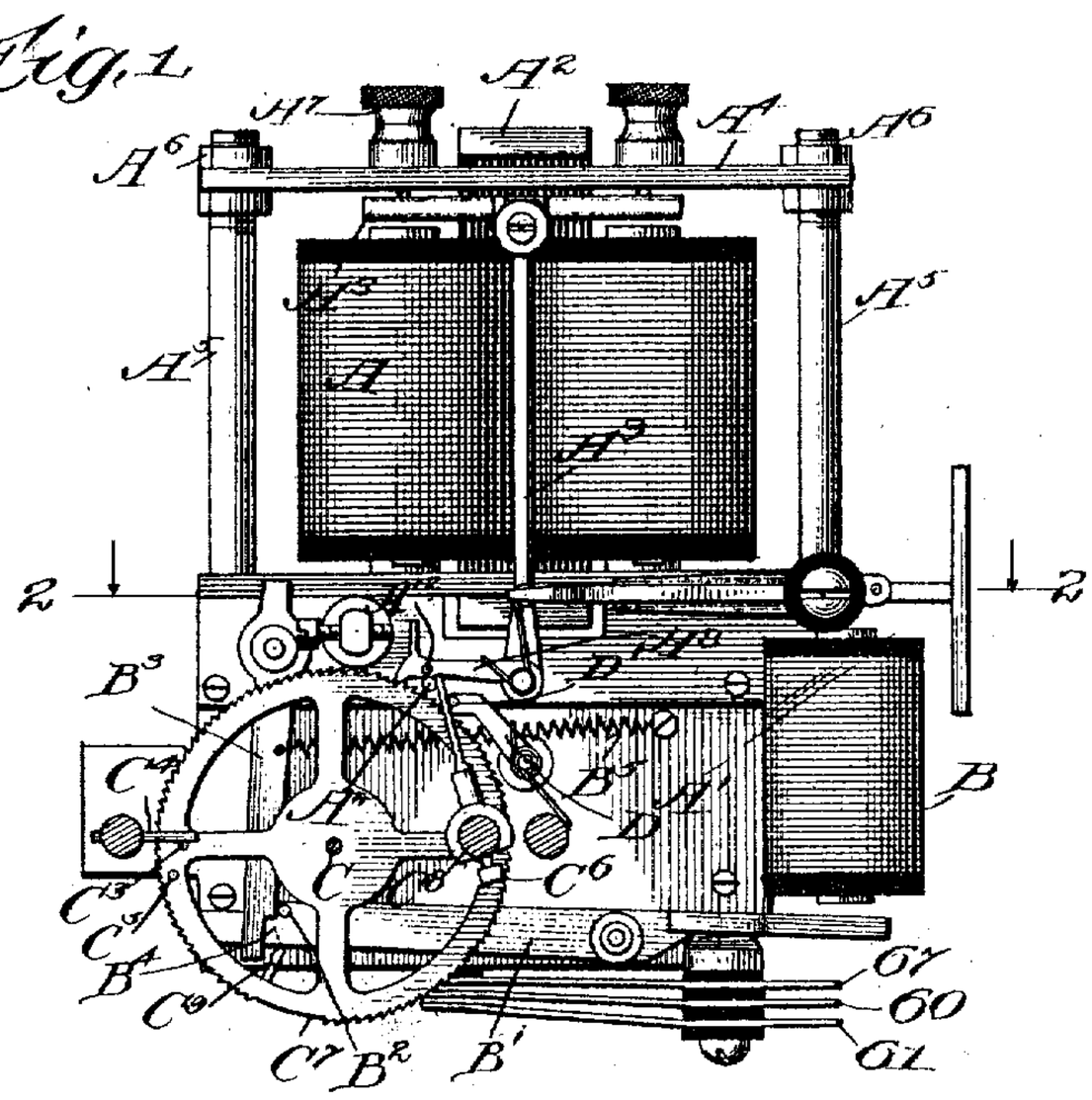
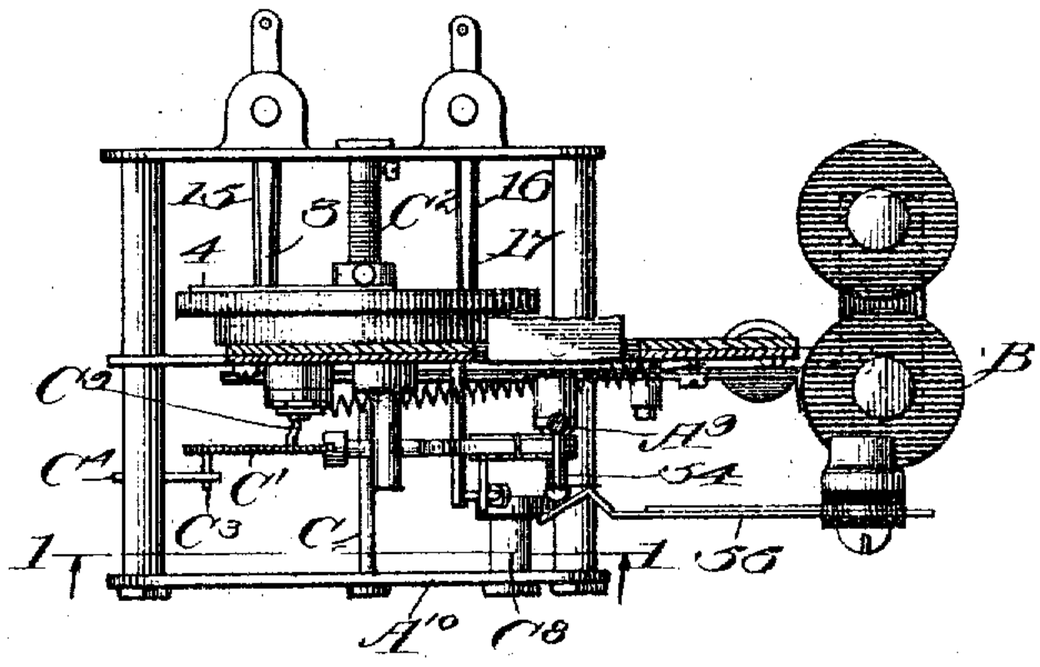


Fig. 2.



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4 SHEETS—SHEET 2.

Fig. 5.

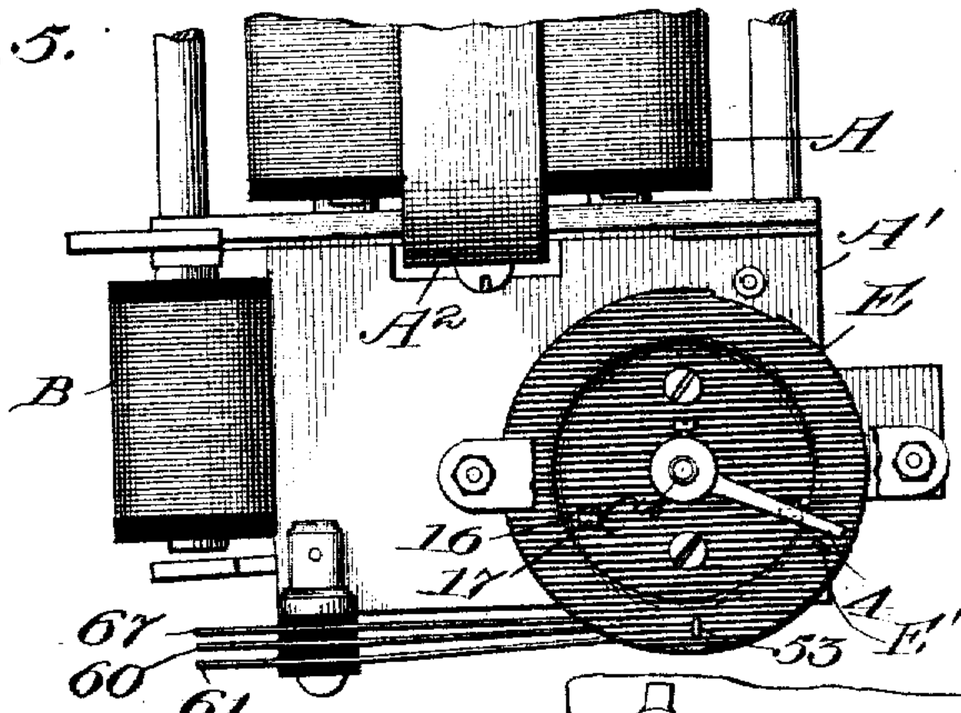


Fig. 4.

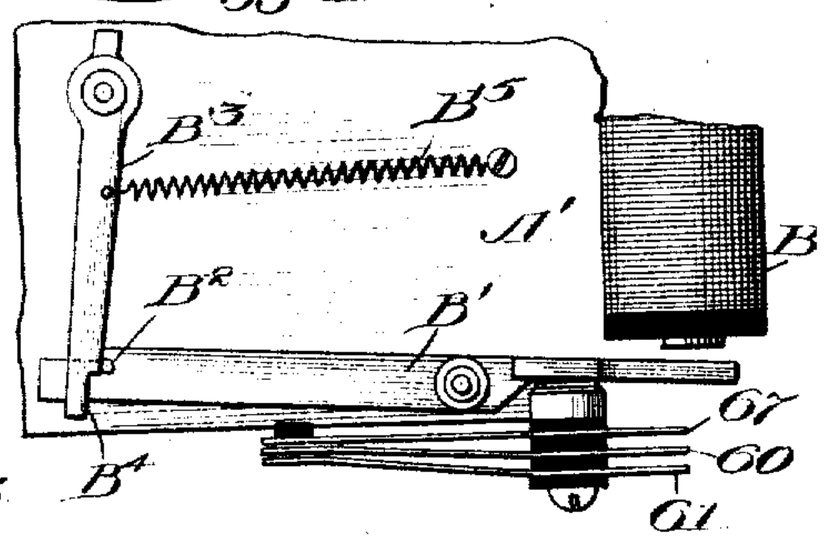


Fig. 3.

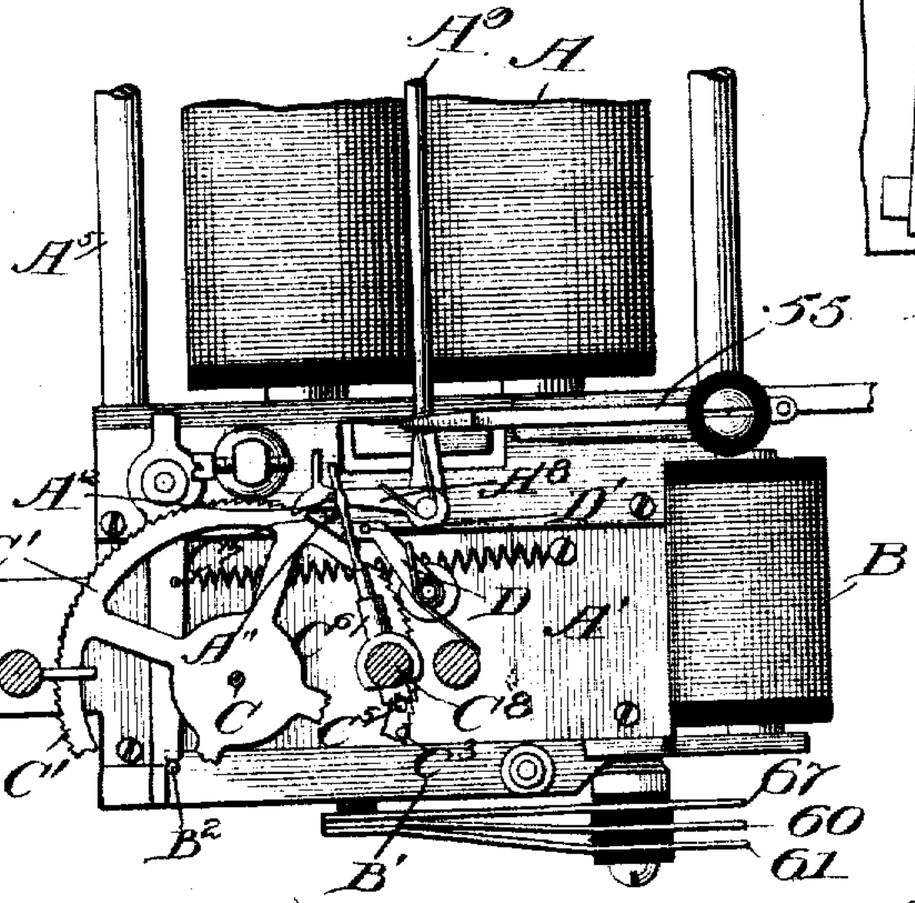


Fig. 6.

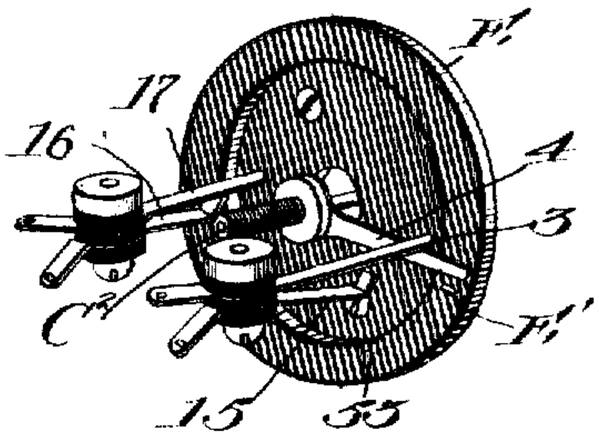
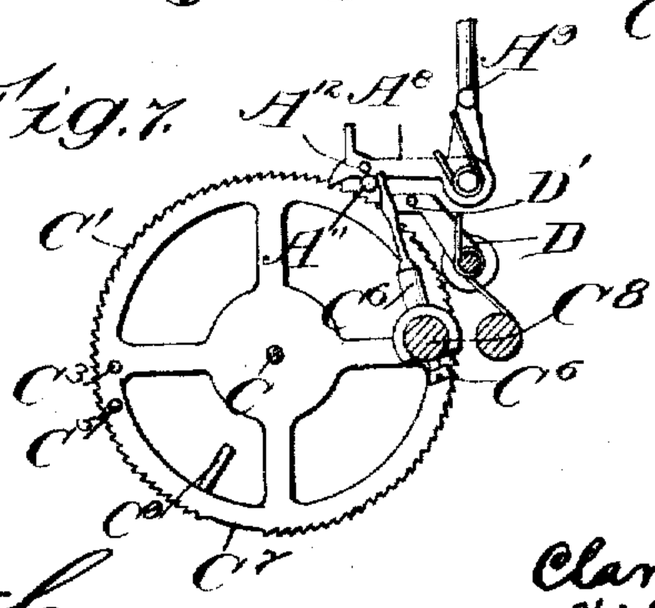


Fig. 7.



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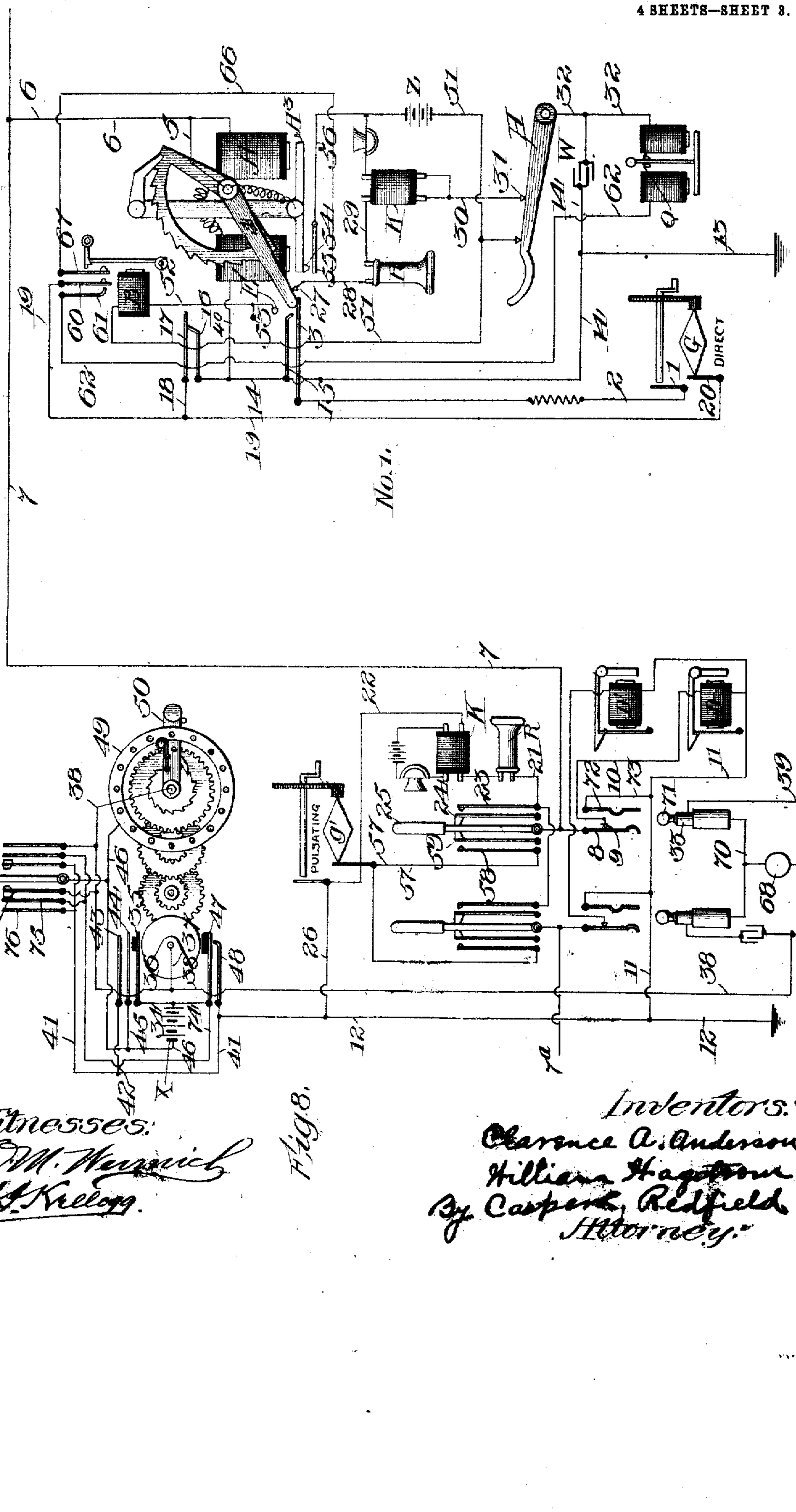

Fig. 8.

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4 SHEETS—SHEET 4.

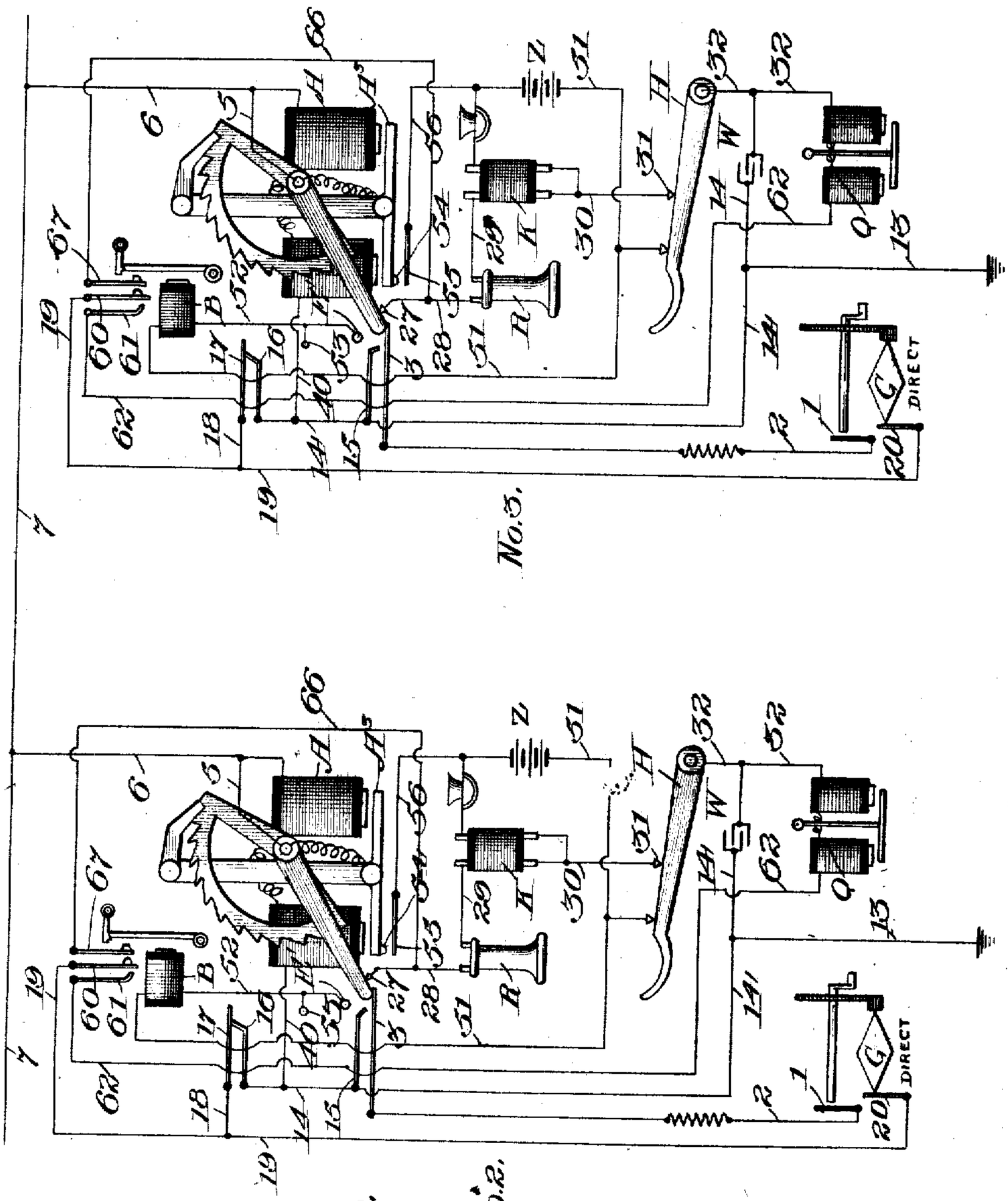

FIG. 9.

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UNITED STATES PATENT OFFICE.

CLARENCE A. ANDERSON, OF SALINA, AND WILLIAM HAGSTROM, OF LINDSBORG, KANSAS, ASSIGNORS, BY DIRECT AND MESNE ASSIGNMENTS, OF TWO-THIRDS TO THE ANDERSON ELECTRIC AND MANUFACTURING COMPANY, OF McPHERSON, KANSAS, A CORPORATION OF KANSAS, AND ONE-THIRD TO HAGSTROM BROTHERS MANUFACTURING COMPANY, OF LINDSBORG, KANSAS, A CORPORATION OF KANSAS.

TELEPHONE-EXCHANGE.

938,943. Specification of Letters Patent. Patented Nov. 2, 1909.

Application filed August 29, 1904. Serial No. 222,534.

To all whom it may concern:

Be it known that we, CLARENCE A. ANDERSON and WILLIAM HAGSTROM, citizens of the United States of America, and residents of Salina, Saline county, Kansas, and of Lindsborg, McPherson county, Kansas, respectively, have invented certain new and useful Improvements in Telephone-Exchanges, of which the following is a specification.

Our invention relates to telephone exchanges and more particularly to party line telephone exchanges.

The object of our invention is improvements in the apparatus used at the sub-stations, and in the manner of operating it from the main station or central office.

The calling device used at the central office in connection with the present improvements is assumed for convenience of a kind in ordinary use for party line exchanges.

In the accompanying drawings:—Figure 1 is a front elevation, partly in section on line 1—1 of Fig. 2, of the switching mechanism; Fig. 2 is a section on line 2—2 of Fig. 1; Fig. 3 is a view similar to Fig. 1, but with the parts moved to another position; Fig. 4 is a detail of some of the parts shown in Figs. 1 and 3; Fig. 5 is a rear elevation of the lower part of Fig. 1; Fig. 6 is a perspective of part of Fig. 5; Fig. 7 is a detail; Fig. 8 is a diagram showing the central office and one local station; and Fig. 9 is a diagram of two other local stations on the same party line with the stations of Fig. 8.

In the said drawings A is a magnet supported in a frame A^1. The magnet A is polarized by means of a permanent magnet A^2. The armature A^3 is supported by a bar A^4, which bar is vertically adjustable on the posts A^5 by means of the nuts A^6. Nuts A^7 provided with interior pins and springs serve to normally hold the armature A^3 in its mid-position.

Supported on a spindle C is a ratchet wheel C^1. A spring C^2 (Fig. 2) normally holds the ratchet wheel C^1 with its pin C^3 against a stop C^4. A pawl A^4 on a lever A^9 extending from the armature A^3 serves to turn the ratchet wheel C^1 until a pin C^5 on the wheel strikes a sliding pin C^6 which is pivotally supported at C^8 on a bridge A^{10} of the frame A^1. (See Fig. 2). At the time the pin C^5 strikes the pin C^6, a blank part C^7 of the wheel C^1 reaches the holding pawl D, so that further operation of the magnet A is without effect.

The pawl A^8 when retracted slides upon a fixed pin A^{11}, and just back of this pin rests the pin C^6 when in its normal position. On the pawl A^8 is a pin A^{12} which passes over the end of pin C^6 when that pin is in its lower position, but which strikes pin C^6 when in its elevated position. In its normal position the pin A^{12} rests slightly to the left of the upper end of the pin C^6, and when the magnet A is operated to advance the ratchet wheel C^1, the movement of the pawl A^8 is such that the pin A^{12} is always to the left of the sliding pin C^6. When a current is sent through the magnet A in a direction opposite to the direction used for operating, then the pawl A^8 is moved to carry the pin A^{12} to the right of the pin C^6 if that pin is in its lower position. If the pin C^6 is in its upper position by reason of having been struck and elevated by the pin C^5, then the pin A^{12} will strike the pin C^6 and move it to the right on its pivot C^8. In a movement of this kind, the pin C^6 strikes the pin D^1 and lifts the holding pawl D from the wheel C^1. As a movement of this kind also moves the driving pawl A^8 away from the ratchet wheel, it results in that wheel being released so that it may be returned to its normal position by the spring C^2. Reviewing this part of the operation, it will be seen that sending a current in one direction through the magnet A causes an advance of the ratchet wheel C^1. Sending a current in the opposite direction through the magnet will result in one of two things depending upon what has been previously done. If the ratchet wheel has been moved only a part of its complete forward movement, then the only thing done will be closing a contact as hereinafter described; but if the ratchet wheel has completed its forward movement, then it will be released

and returned to its normal position. This release results from the interposition of the pin C^6 between the pins A^{12} and D^1, and this in turn is the result of the final part of the forward movement of the ratchet wheel.

Secured to the spindle C is a contact maker or wiper 4 which sweeps over a dial plate E when the ratchet wheel C^1 is moved. In this dial plate are three contact points. One of these (27 of the diagrams) is covered by the wiper when at its normal position.

The next contact point E^1 is covered by the wiper when it has been moved one step forward. The third contact point 53 is at a distance from E^1 that depends upon the particular local station in which the switching mechanism is to be placed. For the first station on the line it is one step of the ratchet wheel C^1, for the second station it is two steps and so on. When at its normal position, the wiper 4 engages a spring 3 and moves it away from a contact spring or point 15. When at the extreme of its forward movement, it engages a spring 17 and moves it away from a contact spring or point 16.

At one side of the frame A^1 is a magnet B whose armature lever B^1 extends behind the ratchet wheel C^1 and which carries a pin B^2. Supported at a convenient place is a pivoted lever B^3 having a notch B^4 adjacent to the pin B^2, against which pin the lever B^3 is drawn by the spring B^5. When the magnet B is energized, the pin B^2 descends and is caught and held by the notch B^4. When the lever B^3 is pushed back, the pin B^2 is released and rises to its normal position. This last is due to the fact that the armature end of lever B^1 is of sufficient weight to overbalance the end that carries the pin B^2.

On the back of the ratchet wheel C^1 is a pin C^9 adapted to strike the lever B^8 and release it from the pin B^2 when said wheel returns to its normal position. When the wheel moves forward the pin C^9 leaves the lever B^3 so that that lever may catch and hold the pin B^2 whenever the magnet B is actuated.

Directly beneath the armature lever B^1 are three contact springs 60, 61 and 67 which are normally separated from each other, but which are closed to electrical contact with each other when the armature lever B^1 is attracted by the magnet B.

On the armature lever A^9 is a pin or projection 54 which is free from an adjacent spring 55 when said lever is in its normal position and also when it is operating to move the ratchet wheel C^1, but which electrically engages said spring when a current flows in a reverse direction through magnet A.

An exchange of the kind herein involved consists of a central office and a series of local stations connected together by a party line. The party line herein used consists of a single wire and a ground connection. Such party line exchanges have heretofore been made with varying degrees of success, but all have had their faults.

The construction of the switch just described and the devices and connections for operating constitute the improvements by which we make such exchanges more successful.

At the central office are a calling device, a generator, an ordinary telephone set, a drop, spring jack and plug for each party line running from the central office, a battery, and certain keys, connections and contact springs as will be readily understood from the drawing and the description of the circuits.

At each local station there are a switch like that described, a telephone set, a receiver hook, a generator, a bell ringer, a condenser, a battery, and contacts and connections.

One of the peculiarities of the present invention consists in the relationship existing between the construction and operation of the switching mechanisms and the nature of the impulses sent from the battery and generator at the central office. As there is only one complete circuit involving the central office and the various local stations, it will be evident the electrical impulses for calling the central office, those for talking between the calling station and the central office, those for operating the switching mechanisms, first for selecting the required station and second for connecting the selected station telephonically to the party line, those for signaling the selected station, those for talking between local stations, those for ringing off, and those for returning the switching mechanisms to their normal positions must all travel over this one circuit.

While it is possible that an exchange might be operated with some of these impulses omitted, the applicants provide means by which they all may be used. As before stated, part of these means consist in the construction and operation of the switching mechanism, and part in the kind and direction of the electrical impulses sent.

It will be remembered that impulses sent in one direction through the magnet A cause an advance of the switching mechanisms step by step, while impulses sent in the opposite direction close electrical connections and release the switching mechanisms so that they may return to normal position. The electrical connections made by reverse currents are also used to connect selected stations telephonically to the party line, while release disconnects the connected stations. Hence it is necessary that release

should not always occur as a result of a reverse current, but only under special circumstances. This is accomplished by making release impossible until the switch has moved to its extreme position.

As electrically operated switches sometimes miss a step, unison is secured by sending more operating impulses than necessary and stopping the switching mechanisms at definite positions by causing them to strike an abutment.

In making the connections within the local stations it happens that if a subscriber who was not wanted had his receiver removed from its hook part of the operating current would pass over a branch circuit and connect that station to the line. To overcome this, a condenser W is placed in this branch which is part of the ringing circuit. The problem is to operate the ringer. A battery or an ordinary direct current generator cannot be used because a condenser stops currents from such sources. An alternating current cannot be used because a branch of this circuit goes through the operating magnet A, and an alternating current would release the switching mechanism and disconnect the station. Under these circumstances we have recourse to a pulsating generator and a polarized bell ringer. A pulsating generator is a direct current generator which has its current short circuited during a part of its revolution, with the result that the current flows over the line in pulsations. We have discovered that a direct current, when sent in pulsations of sufficiently high frequency, will pass through a condenser and will operate a polarized magnet, but will not operate a non-polarized one. As there is a branch of this circuit through the magnet A, the direction of the pulsations is that for operating. As the switch, at the time these pulsations are sent, has been stopped by striking an abutment, they are without effect. If the ringing had been when the switches were in normal position, then the pulsations would have been in the opposite direction.

The calling device consists of a dial provided with a series of holes, each one representing a different station on the party line. Pins are inserted in the holes of the stations wanted and the lever of the calling device is turned to make connection with these pins. Each time a pin is touched by a spring on the lever, electrical connection is completed from the metallic ring in which the pins are inserted and the spindle on which the lever turns.

There is a contact making device 36 which is connected by a train of gears to the spindle for the lever 50. The lever normally rests in the position shown, and a ratchet wheel is interposed between the lever and the train of gears so that the contact making device is rotated only while the lever is being returned to normal position. The train of gears is so arranged that the contact making device 36 will be rotated once during the time when the lever is moving the space between one hole and the next adjacent one.

We will explain the operation by assuming that the subscriber at station No. 1 wishes to talk to the subscriber at station No. 3. Either before or after removing his receiver, the subscriber operates his generator G which is of the ordinary direct current type. A current then flows:—G—20—19—18—17—16—14—13—ground—12—11—D—10—9—8—7—6—5—4—3—2—1—G. This operates the line drop D and calls the operator. The other line drop D^1 is for another party line shown extending to the left at 7^a. The operator then presses key 25 to the right when the talking circuit is:—R at central—21—23—24—25—7—6—5—4—27—28—R—29—K—30—31—H—32—W—14—13—ground—12—26—22—K—R.

The key 25 is one of a well known kind which is normally held in its mid-position by the adjacent springs, but will stay at the place it is put when pushed to one side. After having received information as to the station calling and the station wanted, she pushes the key 25 to the left and inserts a plug in the connected spring jack.

For reasons hereinafter explained, the first hole in the dial of the calling device is for a special purpose and the second hole is used for the first station. The operator therefore inserts pins in the second and fourth holes. She then moves the lever 50 by hand past as many contacts as there are stations on the line and returns it to its normal position causing a rotation of contact maker 36. When 36 connects to 35 a current flows:—battery X—34—35—36—37—38—39—33—8—7—6—A—40—14—13—ground—12—41—42—43—44—45—46—X. This current flows through each station and moves the switch mechanisms forward. It is repeated so as to bring all switches to a stop with pins C^5 against pins C^6. The extra contacts more than enough to normally bring the switches to the end of their stroke, may be any desired number.

When a pin in the dial 49 is struck, which will be the case for stations 1 and 3, a current flows:—X—34—47—48—12—ground—13—14—40—A—6—7—8—33—39—38—49—46—X. This is a current in a reverse direction through the magnets A. As this occurs before the switches have reached the end of their movements, the only result is to close 54 to 55 at each station. When this occurs, one of the stations has its wiper 4 on the contact 53 and at that station a local current flows:—battery Z—51—B—52—53—4—A^3—54—55—56—Z. This operates the

magnet B and places the springs 60, 61 and 67 in electrical connection with each other. As the pins were placed in dial 49 so as to select stations 1 and 3 it is at these stations that this action occurs. As soon as the lever is returned to its normal position, the consequence of which is that all switching mechanisms are at their extreme positions, the operator turns her generator crank when a pulsating current flows:—g^1—57—58—59—25—7—6—of the called stations—5—4—17—18—19—60—61—62—Q—32—W—14—13—ground—12—26—G^1. The branch from 6 through A and 40 to 14 being in the same direction as the operating impulses does not release the switch, and the switch being already stopped by striking its abutment, this branch is without effect. The impulses through the bell ringers Q call the subscribers, after which the talking circuit between stations is:—R at station No. 1—29—K—30—31—H—32—W—14—13—ground to station No. 3—13—14—W—32—H—31—30—K—29—R—28—66—67—60—19—18—17—4—5—6—7 back to station No. 1—6—5—4—17—18—19—60—67—66—28—R.

When through talking, the subscriber rings off as follows:—G—20—19—18—17—4—5—6—7—8—33—39—68—70—71—72—73—11—12—ground—13—14—15—3—2—1—G. This operates the clearing out drop 68 and notifies central that conversation is finished. There is a branch of this circuit from 6 to 14 through A but as the current flows in the operating direction it does not release the switch. By referring back to the original ringing circuit, it will be seen that there is the same branch but in that case the flow was in the opposite direction and did not operate the switch. At the time of first calling central, the switch was in its normal position, hence to prevent moving it when calling the current is made to flow in the release direction. At the time of operating the clearing out drop, the switch was at its extreme position, hence to prevent releasing it prematurely, the current is made to flow in the operating direction. In other words, the movement of the switch from one extreme to the other reverses the direction of the current from the local generator for the purpose of preventing that current from affecting the position of the switch. At intermediate positions the generator current is shunted as follows:—G—20—19—18—17—16—14—15—3—2—1—G. To release the switches the operator presses key 79 to the left when a current flows: X—34—74—75—76—41—12—ground to all stations—13—14—40—A—6—7—8—33—39—78—79—46—X.

The contact point E^1 being connected to 53 and B, and being at the same distance from normal on all switches, a pin inserted in the first hole of the dial 49 will connect all stations simultaneously to the party line.

What we claim is:

1. The combination with the conductors, the stations, and the switching mechanisms of a party line exchange, of connecting and releasing devices for each switching mechanism but normally disconnected therefrom, a magnet for advancing the switching mechanisms simultaneously step by step, means by which upon the switching mechanisms being advanced they will make temporary connections in succession to their connecting devices, and means by which upon further advance they will make simultaneous operative relationships between their releasing devices and said magnets so that said magnets may directly operate said releasing devices.

2. The combination with a switching mechanism, and a magnet for advancing and for releasing it, of a holding pawl normally not operated by said magnet and its armature, and means by which the advance movement of said switching mechanism serves to cause said holding pawl to be operated by the armature of said magnet.

3. The combination with a switching mechanism arranged to be advanced by impulses sent therethrough in one direction and to be released by impulses in the opposite direction, and a source of electricity from which impulses in either direction may be sent through said switching mechanism, of a signaling device, means by which an impulse in the operating direction may be used to operate said signaling device, and means by which such an impulse used to operate the signaling device is inoperative upon the switching mechanism.

4. The combination with a switching mechanism, a magnet having an armature arranged to be moved in either of two directions according to the direction of the impulses flowing through said magnet, and means whereby a movement of the armature in one direction serves to advance said switching mechanism, of a holding pawl arranged to be released by a movement of the armature in the opposite direction but normally not in operative relationship to said armature, and means by which the advance movement of said switching mechanism serves to bring about such operative relationship between said holding pawl and the armature.

5. The combination with a switching mechanism, a magnet having an armature arranged to be moved in either of two directions, and means by which a movement in one direction serves to advance said switching mechanism, of a holding pawl arranged to be released by a movement of the armature in the opposite direction but normally not operated by the armature, a device arranged to cause said holding pawl

to be operated by the armature, and means for operating said device by the forward movement of the switching mechanism.

6. The combination with a switching mechanism, a magnet for advancing it, and means by which said switching mechanism may be released by a reverse operation of said magnet, of a holding pawl normally not in operative relationship with said magnet so that such reverse operation will not release it, and a device arranged to be operated by the advance of said mechanism so as to bring about an operative relationship between said pawl and said magnet.

7. In a telephone exchange, the combination with a switching mechanism, a signaling device, electrical connections having branches through both the switching mechanism and the signaling device, and means by which said switching mechanism is advanced by impulses sent in one direction over said connections and is released by an impulse in the opposite direction; of means by which impulses sent over said connections to operate said signaling device are prevented from either operating or releasing said switching mechanism.

8. The combination with a switching mechanism, a signaling device, and electrical connections including both, of means by which impulses sent over said connections are caused to operate said switching mechanism without operating said signaling device, and means by which similar impulses sent over said connections are caused to operate said signaling device without operating said switching mechanism.

9. The combination with a switching mechanism, a signaling device, and electrical connections including both, of means by which electrical impulses sent over said connections and capable of moving both are caused to operate either without operating the other.

10. The combination with an electric circuit, a battery from which impulses may be sent, and a condenser in said circuit for stopping impulses sent from said battery, of a polarized magnet located in series with said condenser in said circuit and normally not operable by direct impulses delivered to said circuit, and means for delivering to said circuit at a high frequency impulses similar to those stopped by said condenser whereby such impulses are caused to operate said magnet.

11. The combination with an electric circuit, a polarized magnet in said circuit, and a condenser arranged to normally prevent impulses of a constant polarity from operating said magnet, of means for delivering such impulses at a high frequency to said circuit whereby said condenser becomes inoperative to prevent the operation of said magnet.

12. The combination with an electric circuit having two branches, a switching mechanism in one branch, and a signaling device in the other branch, of means by which impulses delivered to both branches and adapted to operate the signaling device are caused to operate the switching mechanism only, and means by which other impulses similarly delivered and adapted to operate the switching mechanism are caused to operate the signaling device only.

13. The combination with a circuit having two branches, a switching device in one branch, and a signaling device in the other branch, of a condenser in the branch containing the signaling device for causing impulses of constant polarity to be inoperative on the signaling device, and means for sending such impulses at a high frequency so that they will operate the signaling device located in the branch containing the condenser.

14. The combination with the electrical connections of a telephone station, and a switching mechanism adapted to be advanced when impulses sent over said connections pass through said mechanism in one direction and to be released when they pass through in the opposite direction, of a generator adapted to send impulses over said connections and through said mechanism, and means by which the impulses from said generator will pass through said switching mechanism in one direction when it is in its normal position and in the opposite direction when at its extreme forward movement.

15. The combination with the electrical connections of a telephone station, and a switching mechanism adapted to be moved in opposite directions when impulses sent over said connections pass through the mechanism in opposite directions, of a generator adapted to send impulses over said connections, and means by which such impulses will have their direction through said mechanism automatically reversed by the arrival of the mechanism at either extreme of its movement.

16. The combination with electrical connections, and a switching mechanism arranged to have the direction of its movements determined by the direction of impulses therethrough, of a generator, means by which impulses from said generator pass through said mechanism in opposite directions when it is at the opposite extremes of its movement, and means by which such impulses are shunted when the mechanism is at intermediate positions.

17. The combination with a switching mechanism, means for advancing it from its normal position, and devices by which it is released so that it may return to its normal position, of a telephone set, a signaling

device, and means by which the final advance movement of the switching mechanism serves to complete connection to the telephone set and to the signaling device and also brings the releasing device from inoperative to operative position.

18. The combination with a switching mechanism, a signaling device, and electrical connections including both, of a condenser by means of which impulses sent over said connections and capable of operating both are prevented from operating the signaling device while the switching mechanism is being operated, and a stopping device for the switching mechanism by means of which impulses sent over said connections and also capable of operating both are prevented from operating the switching mechanism while the signaling device is being operated.

19. The combination with a switching mechanism, and a magnet therefor provided with a movable armature, of a holding pawl for said mechanism, and a movable body interposed by the movement of said mechanism between the armature and the holding pawl so that a movement of the armature will serve to release the holding pawl.

20. The combination with a driving pawl, a switching mechanism moved thereby, and a holding pawl, of a pin interposed by the movement of said mechanism between the driving pawl and the holding pawl so that a movement of the former may be conveyed to the latter.

Signed at Chicago, Ill., this 17th day of August 1904.

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