S. A. NORSTROM.

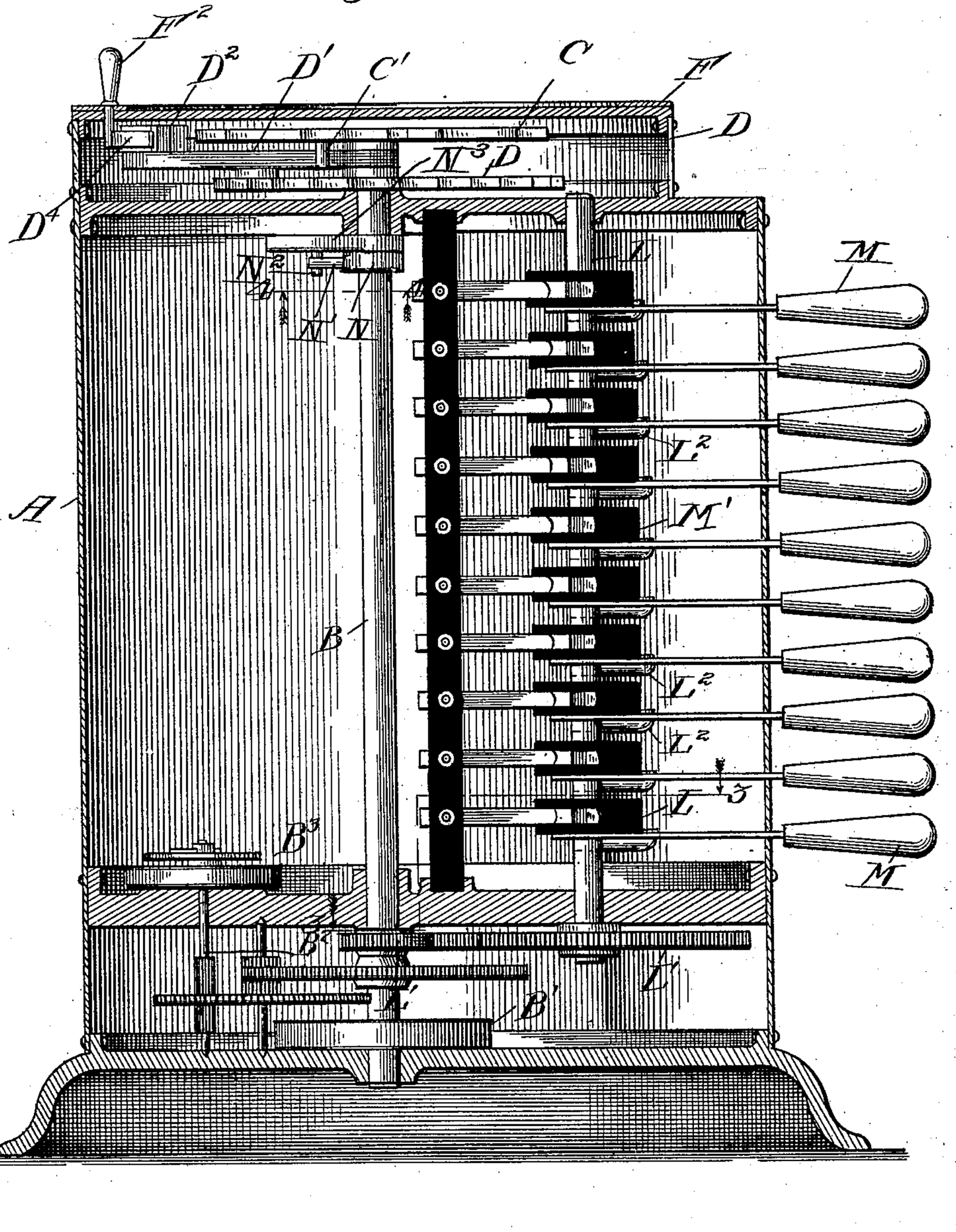
TELEPHONE EXCHANGE.

APPLICATION FILED NOV. 13, 1905. RENEWED FEB. 10, 1909.

980,886. Patented Jan. 3, 1911.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
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H. L. Boston

Inventor:
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4 SHEETS—SHEET 2.

Fig. 2.

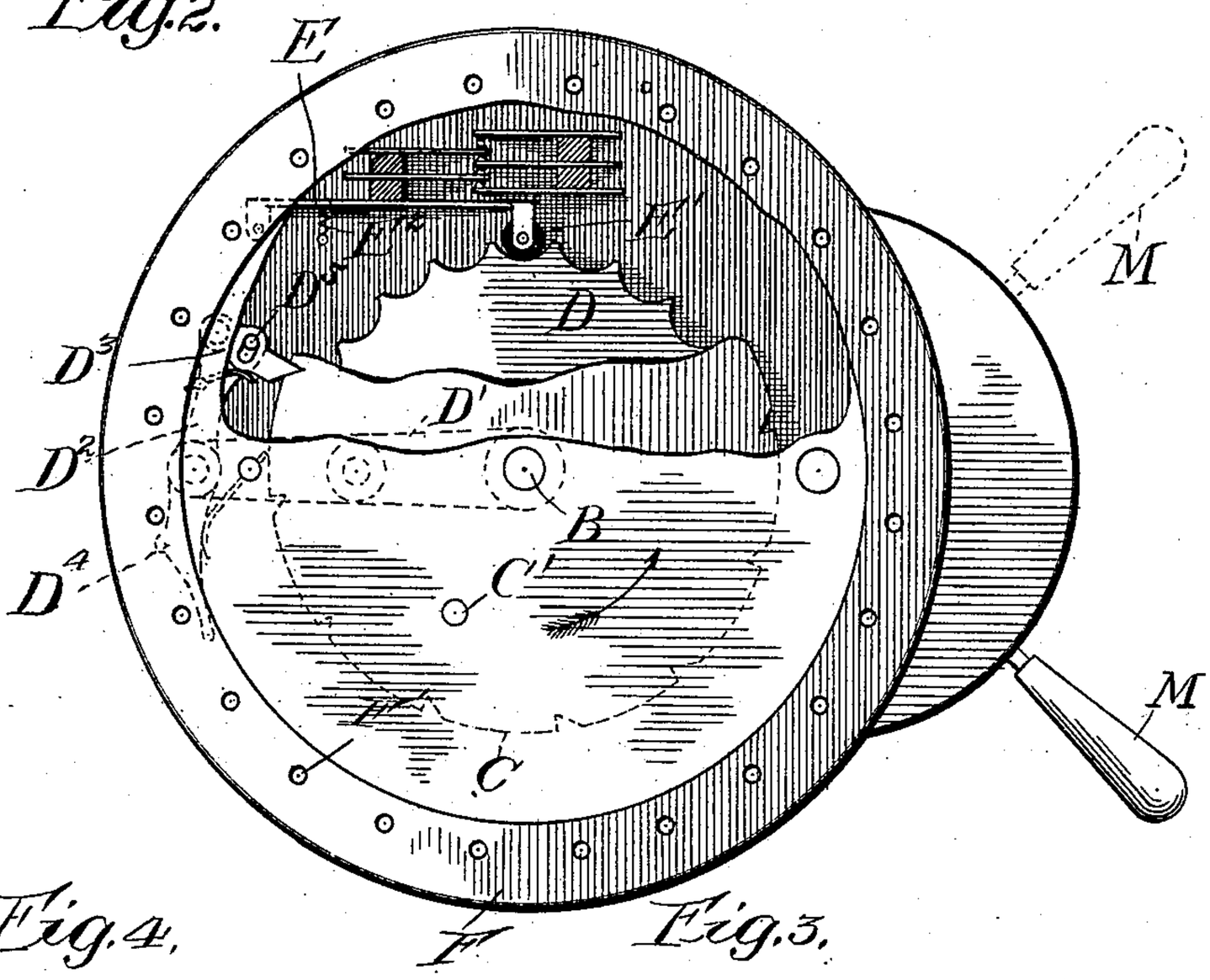


Fig. 4.

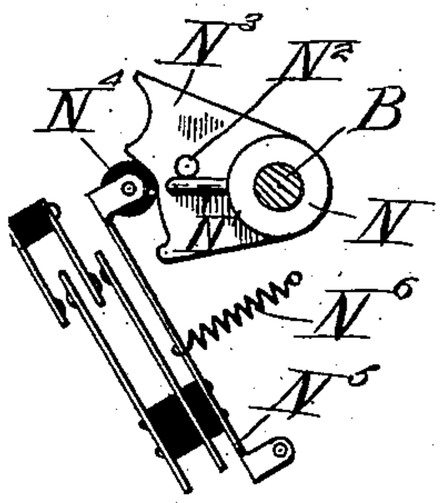
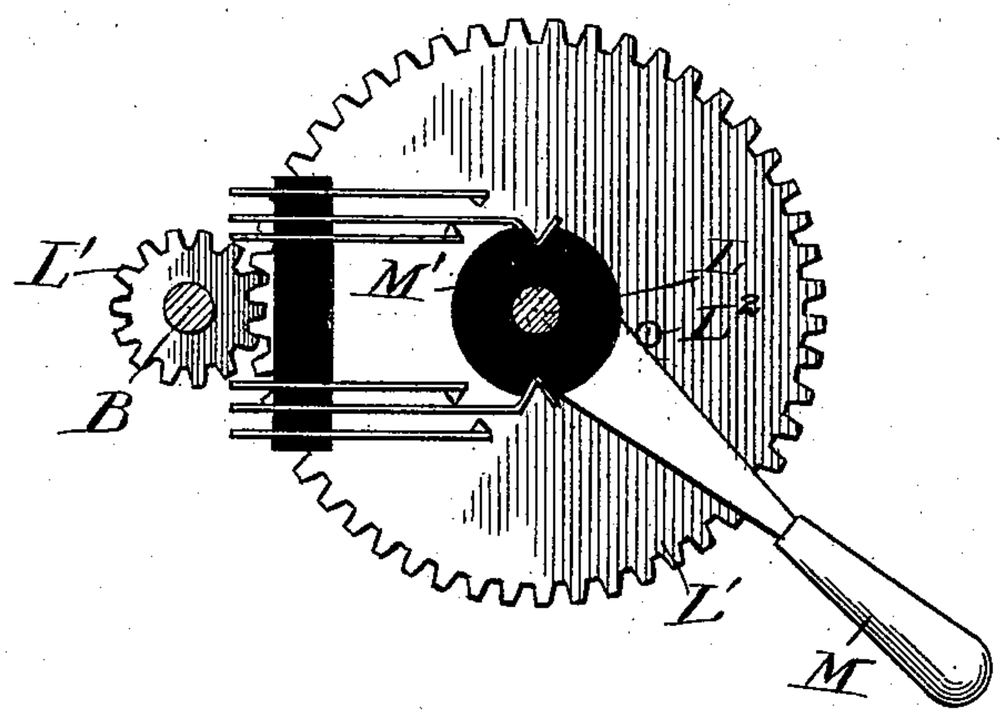


Fig. 3.



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4 SHEETS—SHEET 3.

Fig. 6.

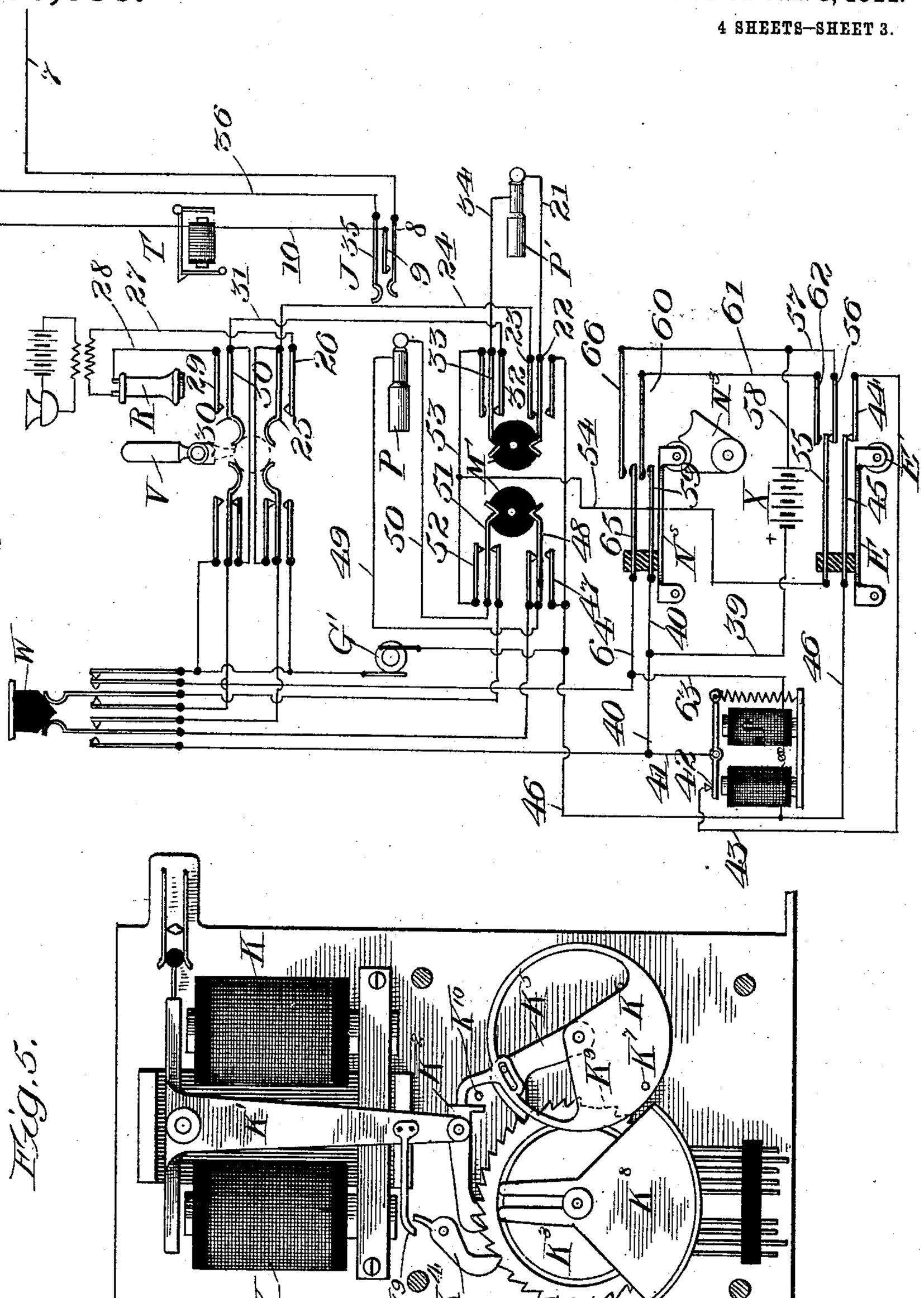

Fig. 5.

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4 SHEETS—SHEET 4.

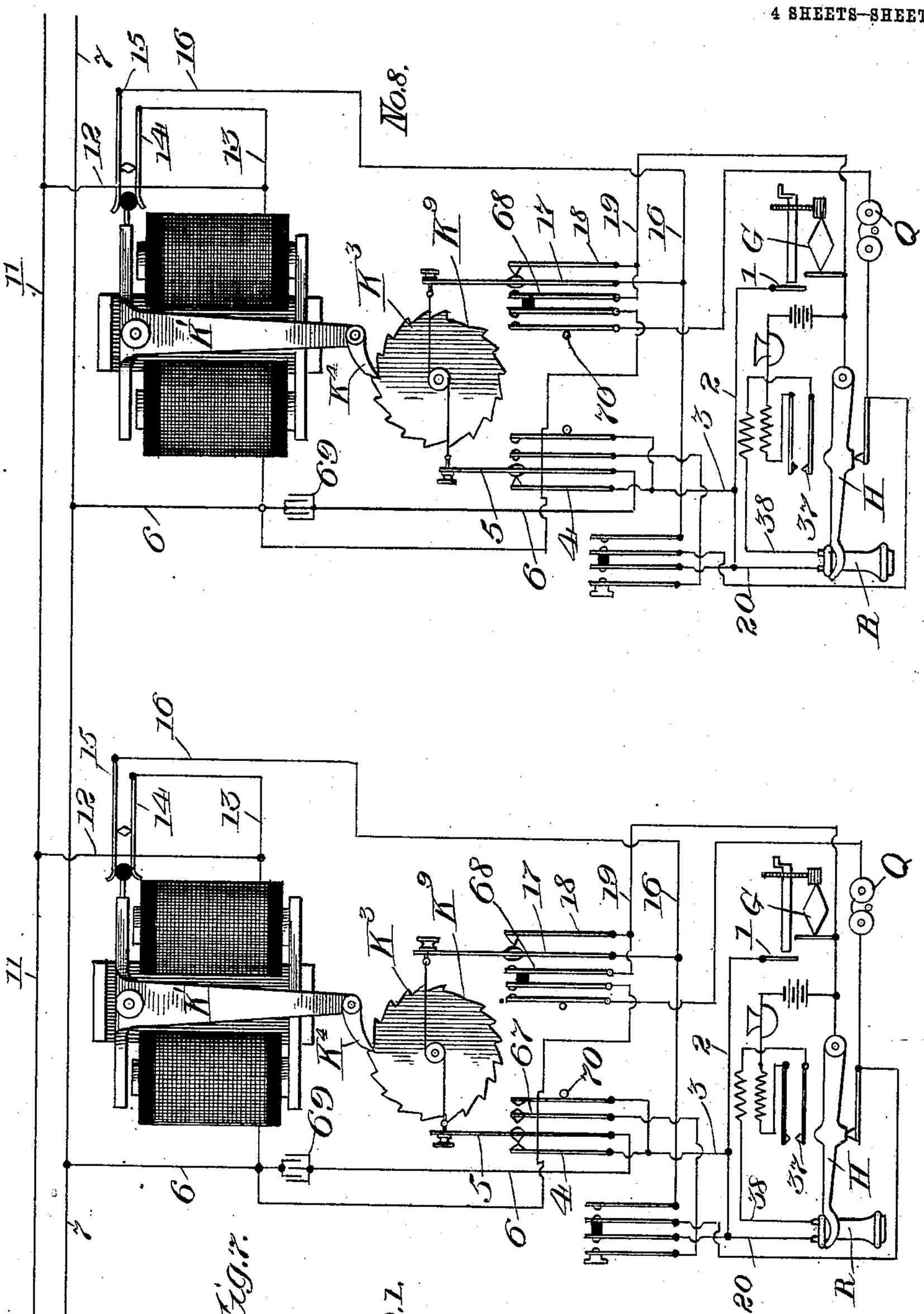

Fig. 1.

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UNITED STATES PATENT OFFICE.

SAMUEL A. NORSTROM, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE ANDERSON ELECTRIC AND MANUFACTURING COMPANY, OF WICHITA, KANSAS.

TELEPHONE-EXCHANGE.

980,886. Specification of Letters Patent. **Patented Jan. 3, 1911.**

Application filed November 13, 1905, Serial No. 287,030. Renewed February 10, 1909. Serial No. 477,219.

To all whom it may concern:

Be it known that I, SAMUEL A. NORSTROM, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone-Exchanges, of which the following is a specification.

My invention relates to party line telephone exchanges and has for its object improvements in the operation of such exchanges.

In the accompanying drawings, Figure 1 is a sectional elevation of the calling device used at the central office; Fig. 2 is a plan of the same, partly broken away; Fig. 3 is a detached plan of part of the operating mechanism on line 3—3 of Fig. 1; Fig. 4 is a partial section on line 4—4 of Fig. 1; Fig. 5 is a plan of the switching mechanism used at the local stations; Fig. 6 is a diagram of the electrical connections at the central office; Fig. 7 is a diagram of two local stations connected by the party line to the central office.

In the calling device, A is a casing through the center of which is a shaft B. Secured to the shaft B is a ratchet wheel C having its teeth rather far apart. Mounted loosely upon the shaft B is a serrated disk D having two or three times as many serrations as there are teeth in the ratchet wheel C. Secured to the disk D is an arm D^1 which has on its outer end a pivoted cross bar D^2, which cross bar carries on one end thereof a pivoted pawl D^3 adapted to engage the teeth of ratchet wheel C. As shown in Fig. 2, there are springs adjacent to D^2 and D^3 which normally act to push outward the parts they touch, the result of which is to cause the pawl D^3 to engage the teeth of the ratchet wheel C.

Pivoted at a convenient place on the frame work of the calling device is a lever E which has a roller E^1 adapted to engage the serrations on the disk D, and a spring E^2 for holding the roller against the serrations. Carried on the lever E are two insulated contact springs adapted to vibrate between adjacent contacts whenever the lever E is vibrated. Such vibration is caused by any rotary movement of the disk D.

Whenever the shaft B, and consequently the ratchet wheel C secured thereto, is rotated in the direction of the arrow in Fig. 2, the engagement between the pawl D^3 and the ratchet wheel C causes a like rotation of the disk D. Whenever the ratchet wheel is rotated in the opposite direction, the teeth of the wheel pass under the pawl D^3 and do not cause a rotation of the disk D until a pin C^1 in the wheel C strikes the arm D^1, or some corresponding projection secured to disk D, after which the disk D rotates with the wheel C.

On the top of the calling device is a dial F provided with a series of numbered holes F^1 in which may be inserted pins F^2, as shown in Fig. 1. On the cross bar D^2 is a hump D^4 adapted to engage any pin inserted in one of the holes F^1. The number of holes F^1 in the dial F corresponds to the number of serrations in the disk D.

When the ratchet wheel C is rotated in the direction of the arrow of Fig. 2, each amount of motion which equals the angular distance between one hole F′ and the next causes one vibration of the lever E and the consequent shifting of the adjacent contact springs. When, however, the hump D^4 on the lever D^2 engages a pin F^2 in a hole F′, it lifts the pawl D^3 from the wheel C and permits the disk D to pause while the wheel C continues its movement. To prevent the hump D^4 from being stuck on the pin which it engages, the position of this hump with respect to the pin and the position of the roller E^1 to the serrations in the disk D are such that at the time when the pawl D^3 is released from the wheel C, the roller E^1 has passed the apex of a serration so that the spring E^2 acts to force the disk D, and consequently the arm D^1 and the cross bar D^2, forward in the direction of movement so that the hump D^4 may clear the pin F^2 and permit the pawl D^3 to again engage the ratchet wheel C. To prevent this forward thrust of the arm D^1 from causing the pawl D^3 to reëngage the same notch in the wheel C from which it was released, the said pawl is pivoted on the cross bar D^2 and provided with a slot which engages a pin D^5 on the cross bar. At the instant when the pawl D^3 is released from the ratchet wheel C the adjacent engaging spring pushes the pawl D^3 in a rearward direction a little farther than enough to compensate for the forward movement of the arm D^1 due to the action of the roller E^1 and the spring E^2. The consequence is that the pawl D^3 does not

reëngage the notch from which it is released but the next one to it. As soon as the pawl D^3 engages the next tooth of the wheel C the disk D, which had been stationary during the angular movement of the wheel C equal to the distance between one tooth and the next, again starts on its forward movement causing vibrations of the lever E and consequent contacts by the adjacent springs.

A condensed statement of the results arising from the construction and operation just described is that a uniform rotation of the shaft B causes a uniform series of contacts to be made by the springs carried on the lever E. When a pin is inserted in one of the holes in the dial, a contact by the moving mechanism with that pin causes a pause to occur in the series of contacts by the springs on the lever E for a period of time equal to that normally consumed in making two or three contacts by said springs. If two or three pins are inserted in the dial then there will be two or three such pauses.

On the bottom end of the shaft B is a clock spring B^1 which acts to return the shaft to its normal position after being moved. A train of gears B^2 connects the shaft B with a governor mechanism B^3, the object of which is to regulate the speed of the shaft under the action of the spring B^1.

At one side of the center of the casing A is a second shaft L which is connected by means of the gears L^1 with the main shaft B. These gears are made about four to one so that a partial rotation of the shaft L will cause a complete or nearly complete rotation of the shaft B. In the shaft L are a series of pins L^2 each of which has an upturned end. Loosely mounted on the shaft L adjacent to each pin L^2 are levers M which extend to the outside of the casing A, and in their normal position they rest in the position shown in full lines in Fig. 2. By pushing any one of the levers M by hand to the dotted position shown in Fig. 2, the lever strikes the pin L^2, as shown in Fig. 3, and causes a movement of the shaft L. This movement is communicated through the gears L^1 to the shaft B and causes a rotary movement of that shaft and the parts actuated thereby.

Upon releasing a key M after being so moved, the spring B^1 returns all parts to normal position. Attached to each lever M is a disk of insulating material M^1 provided with notches adapted to be engaged by adjacent springs when the corresponding lever is in its normal position. When a lever M is moved these springs are pushed outward so as to have their normal electrical connections broken and others made. These springs are the terminals of cord and plug connections (Figs. 3 and 6).

On the shaft B is a collar N having a pin N^1 adapted to engage a second pin N^2 on a loose arm N^3. The arm N^3 has two surfaces of different radii either of which is adapted to be engaged by a roller N^4 on a lever N^5. (See Fig. 4). This lever is pivoted on an adjacent part of the frame, and a spring N^6 holds the roller N^4 in contact with the arm N^3.

There are insulated contact springs mounted upon and moved by the movement of the lever N^5. When the roller N^4 rests on the part of arm N^3 having the greater radius, then the springs on the arm N^5 make electrical connection with adjacent contact points. When the roller N^4 rests on the surface of lesser radius, then this electrical connection is broken, and this is the normal condition. When the shaft B is moved from its normal position the pin N^1 leaves the pin N^2. By the time the shaft B has made a nearly complete rotation the pin N^1 strikes the pin N^2 on the opposite side and moves the arm N^3 so that the roller N^4 rests on the larger radius. When the shaft B returns to its normal position, the pin N^1 strikes the other side of N^2 and moves the arm N^3 so that N^4 will again rest on the lesser radius.

The switching mechanisms used at the local stations consist each of a ratchet wheel and a polarized magnet for operating it. When a current flows in one direction through the magnet the switching mechanism is advanced step by step. When the current flows in the opposite direction the switching mechanism is released and returns to its normal position. Each ratchet wheel has one tooth missing and is provided with primary and secondary holding pawls. If only the primary holding pawl engages the wheel, then the advance movement of the wheel will stop when the space left vacant by removing one tooth reaches that pawl; but if both holding pawls engage the wheel, then it will not stop unless the magnet stops operating. When the magnet is operating uniformly in the ordinary manner, the reciprocations of its armature keep the secondary holding pawl from engagement with the wheel, but if there is a pause in the operation of the magnet then the secondary holding pawl has time to drop by gravity into connection with the wheel. Each ratchet wheel carries a locking device so arranged that if this pause in its operation comes at a predetermined point in its advance movement, then the secondary pawl is locked to engage the wheel and the wheel may be moved beyond its otherwise normal stopping point. If pauses occur at other points and not at the critical point, then the secondary pawl is locked from engagement with the wheel. A switching mechanism of this kind is illustrated in Fig. 5, in which K represents the coils of the polarized magnet, and K^1 the armature lever which car-

ries a driving pawl K^2 for engaging the wheel K^3. K^4 and K^5 are respectively the primary and secondary holding pawls. An unbalanced disk K^6 is provided with a slot adapted to engage a pin on the pawl K^5. A pin K^7 in the disk K^6 lies adjacent to the path of a flange on a sector K^8 carried by the ratchet wheel K^3. The blank part of the wheel is shown at K^9.

At the different stations the sectors K^8 are different distances from the pins K^7 so that when the switching mechanisms are simultaneously operated these flanges arrive at the pins K^7 one at a time. When the switching mechanism is operated by continuous impulses through the magnet K, each retracting movement of the pawl K^2 strikes a projection on the pawl K^5 and drives it from engagement with the wheel K^3. In a continuous series of impulses through the magnet K these blows on the pawl K^5 are frequent enough to prevent that pawl from acting as a holding pawl. Such a series also keeps the pin K^7 driven inward toward the center of the wheel K^3 so that the flange on the sector K^8 may pass outside of said pin K^7 and hold the pawl K^5 permanently from acting as a holding pawl. If, however, there should be a pause in a series of impulses sent through the magnet K and this pause should occur when the flange on the sector K^8 is close to the pin K^7, then this pause will permit the pawl K^5 and wheel K^6 to settle into position shown in Fig. 5. If an impulse is sent through K immediately after such a pause, then the flange on K^8 will pass inside of K^7 and hold K^5 so that it cannot be driven out of acting as a holding pawl.

The switching mechanism is released by sending an impulse in an opposite direction to the operating impulses. Such an impulse causes the lever K^1 to move toward the right so that the back end of pawl K^2 will engage and lift pawl K^5. At the same time a tail-piece on the pawl K^2 strikes a pin K^{10}, and an arm K^9 on the lever K^1 strikes a tail-piece on the pawl K^4. These actions lift the pawls K^2 and K^4 from the ratchet wheel $K.^3$ The return of the switching mechanism is accomplished by cords wrapped around the spindle of the wheel K^3 and extending to contact springs 5 and 17, as shown in Fig. 7. In the normal position of the switching mechanism these two springs are in electrical connection with adjacent springs outside of them, but upon the first forward step of the mechanism these connections are broken by the contraction of the springs 5 and 17 due to the winding of the connected cords upon the spindle of the wheel K^3. When the ratchet wheel has been moved far enough to bring the blank part K^9 to the primary holding pawl, spring 5 just touches spring 67, while spring 17 is close to but does not touch the adjacent spring 68. If the secondary holding pawl is in engagement with the ratchet wheel K^3 so that that wheel may have its blank space moved beyond the primary holding pawl, then one or two steps beyond the normal stopping point closes the connections of all of the inner springs on both sides.

Connected to the armature of the magnet K is a piece of insulation which engages two springs 14 and 15. These springs act to bring the armature to its mid-position when moved for either propelling or releasing the switching mechanism. In normal position these two springs are in electrical connection with each other through an intermediate block which they both touch, but when the armature moves in either direction this connection is broken.

At each local station there are a receiver R, a hook H, a generator G, a ringer Q, and contacts and connections as shown. At the central office there are, in addition to a calling device having the parts described, a battery X, a biased magnet or vibrator S, a generator G^1, a ring back key W, a series of switch-board keys V, plugs P, P^1, etc., for each key M on the calling device, a jack J and a drop T for each party line entering the central office, and electrical connections as shown and as will appear from further description.

In Fig. 7 the two stations illustrated are marked "No. 1." and "No. 8." and for the purpose of describing the operation it will be assumed that the subscriber at No. 1 wishes to talk to the subscriber at No. 8. The subscriber at No. 1 turns the crank of his generator when a current flows:—G—1—2—3—4—5—6—7—8—9—10—T—11—12— of No. 1—13—14—15—16—17—18—19—G. This calls central when the operator inserts plug P^1 in jack J and moves the switch board key V to spread springs 25 and 30 to connection with their adjacent springs. Beginning at the receiver of No. 1 the talking circuit is:—R—20—3—4—5—6—7—8—21 of P^1—22—23—24—25—26—27—R—28—29—30—31—32—33—34—35—36—11—12—13—14—15—16—17—18—19—H—37—38—R. When the operator at the central office is informed that No. 1 wishes to talk to No. 8, she inserts pins F^2 in the holes F^1 which are numbered "1" and "8" for convenience of determination. She then removes plug P^1, which is connected to the answering cord, and inserts plug P, which is connected to the calling cord. She next pushes the key M on her calling device which is associated with the calling plug used, to the limit of its movement and releases it. The first movement of the lever M causes the insulation M^1 attached thereto to shift the engaging springs 48 and 51 from those between them to those on the outside. The

movement of the lever also causes the ratchet wheel C to move in the direction contrary to the arrow in Fig. 2. At first the ratchet wheel C passes idly under the pawl D^3 until the pin C^1 strikes the lever D^1, after which the two travel together causing a rotation of the serrated disk D and a vibration of the lever E. During this part of the movement the outward vibrations of E are without effect because the arm N^3 and lever N^5 are in normal position, but at each inward vibration a current flows:—X—39—40—41—42—43—44—45—46—47—48—49—35—36—11—12 of each local station—K—6—7—8—50—51—52—53—54—55—56—57—58—X. These are impulses in the release direction through the switching mechanisms of the local stations, and continue up to the end of the pushing movement applied by the operator to the key M. The only effect they have is to insure that the switching mechanisms are fully released and are at their normal positions.

At the end of the pushing movement applied to the lever M the arm N^3 is moved so as to move the lever N^5 outward and close the connections of the springs carried thereby. When the calling device begins its return movement upon the release of lever or key M, each outward vibration of the lever E causes a current to flow:—X—39—40—59—60—61—62—55—54—53—52—51—50—8—7—6 of each station—K—12—11—36—35—49—48—47—46—45—56—57—58—X. This is an impulse in the operating direction through the switching mechanisms of all stations and causes them to advance. Each outward movement of the lever E to cause an operating movement of the switching mechanisms is followed by an inward movement which closes the circuit for a release impulse as before described. But with the lever N^5 in its outer position there is a branch of this release circuit closed from 46 through the vibrator S—63—64—65—66—57—58—X. This branch through the vibrator S actuates its armature to break the release circuit at 42. The armature of S is light and operates very quickly to make and break this release circuit at 42. The total result is that this release impulse which follows an operating impulse, is broken up into a series of very short release impulses which are incapable of releasing the switch, but which serve to destroy any residual magnetism in the magnet K and to assist in returning its armature lever to its normal position. These release impulses are not only short as to length of time but are reduced in voltage by reason of the fact that the armature of S vibrates so quickly as to make a poor contact at 42, which poor contact causes resistance at this point and reduces the voltage of the current flowing over the line and through the branch for S. The magnet S and the magnets K of the stations are in bridges of the circuit from the battery X. The current flowing from the battery over this circuit is divided so that part flows through each bridge. If there are three stations on the line there will be four bridges and, considering the resistance of each bridge to be the same, the magnet S and the three magnets K would each receive one-fourth of the current flowing from X. If the line should have fifteen stations on it, then each magnet would receive one-sixteenth of the current. It will thus be seen that the amount of current flowing through S is inversely proportional to the number of bridges on the line. Consequently, when the line is long and has many stations on it, the amount of current flowing through S is less than when the line is shorter. This reduced current through S results in its armature moving more slowly than when the current is greater. This slower movement of this armature gives a better and longer contact at 42 and thus permits a greater current to flow in the short impulses over a heavily loaded line than over one with a less load. The polarized relay or magnet S thus serves as an automatic means for controlling or regulating the current in these short impulses to correspond to the load on line over which they travel. By reason of the fact that these short release impulses assist the return of the armature levers K^1 at the local stations, the retractile springs for these armature levers may be lighter than would be necessary if no such impulses were used. With light springs at these places the operating impulses do not need to be so heavy as when stronger springs are used. This is particularly advantageous on long lines having many stations.

Each operating impulse together with its series of very short impulses in the opposite direction serves to advance the switching mechanisms one step forward. As station No. 1 is one of the stations to be connected to the line, a pin F^2 is in hole number one and immediately after one operating impulse and its reverse impulses are sent the hump D^4 on the cross bar D^2 strikes the inserted pin and releases the pawl D^3 from the wheel C. This causes the serrated disk D to stop in its rotary movement until the next tooth in the wheel C comes up to and engages the pawl D^3, after which the disk D starts again. This stopping and restarting of the disk D causes a pause to occur in the series of operating impulses being sent by the vibration of the arm E. At the time when this occurs for a pin placed in hole No. 1 of the calling device, the flange on the sector K^8 of station No. 1 is closely adjacent to the pin K^7 on the wheel K^6. The pause in the return blows delivered by the driving pawl K^2 on the secondary pawl K^5

permits that pawl to settle down into engagement with the ratchet wheel K^3, and also permits the pin K^7 to swing outside of the path of the flange on sector K^8. When the operating impulses recommence after this pause the first impulse advances this flange past the pin K^7 with the result that the secondary pawl K^5 of this station is retained as a holding pawl and the blank part K^9 of the wheel K^3 can be moved beyond the primary pawl K^4. The same operation occurs at station No. 8 as a result of a similar contact with the pin placed in hole No. 8 of the calling device. At the intermediate stations, and the stations beyond No. 8, there are no pauses when the flanges of sectors K^8 are close to pins K^7 with the result that the flanges pass outside of these pins and hold the corresponding pawls K^5 from acting as holding pawls. At all of the stations where this occurs the ratchet wheels K^3 are stopped when the blank parts K^9 reach the primary holding pawls K^4.

At the beginning of a forward movement of the switching mechanisms the springs 17 are in contact with the springs 18. If the receiver R of any station should be off of its hook H when the first impulse is sent from the central office, then there is a closed branch of the operating circuit which runs through the hook H and receiver R, which branch contains the condenser 69. Under these circumstances the condenser 69 receives a charge, which, upon breaking the circuit, is discharged and sometimes causes the switching mechanism to "kick back" so as to cause a release at the wrong time. In the present case this branch circuit is broken at 14 or 15 by the first movement of the armature of the magnet K as the result of an impulse sent through that magnet. This break prevents the condenser from becoming fully charged as the result ot an impulse, and the break being open for an appreciable period of time during the forward movement, whatever charge may have got into the condenser 69 is dissipated and does not affect the magnet K. Immediately after the first movement the connection is broken between 17 and 18, but immediately after a switching mechanism has been advanced with its blank part K^9 beyond the primary holding pawl electrical connection is made with the inner springs adjacent to the springs 5 and 17. These springs close a similar branch through the condenser 69. Heretofore I have purposely insured the closing of such a branch so as to cause the condenser to be charged as the result of an impulse flowing through the operating magnet, and I have used the discharge of the condenser to destroy residual magnetism in the operating magnet to prevent sticking. This is a successful means for accomplishing the desired result, but as aforesaid, it sometimes happens that this discharge is powerful enough to cause a release of the switching mechanism and a disorganization of the system. I have heretofore provided means for preventing the condenser being charged as the result of an impulse being sent through the magnet associated with the switching mechanism and have substituted therefor the series of minute reverse or release impulses before described. This feature of the invention is in effect a transference from the local stations to the central office of means for preventing the armatures of the magnets from sticking, and the provision of additional means for preventing the original means, though retained, from operating as it heretofore operated. As now made the means for preventing the armatures of magnets at the local stations from sticking is controlled by mechanisms which form part of the calling device.

The number of operating impulses sent by the return movement of the calling device is enough to cause the switching mechanisms which have their secondary pawls acting as holding pawls to move two or three steps beyond their normal stopping positions. Preferably the impulses are numerous enough to cause five or six or more extra steps and the switching mechanisms are stopped at two or three extra steps by striking some convenient abutment. Such an abutment may consist of pins 70 located behind the springs whose electrical connections are to be closed, and the stopping may be the result of such closure. Such surplus of impulses is without effect to disorganize the operation while it at the same time provides means for overcoming any misstep of one of the switching mechanisms. The closing of connection to the inner springs adjacent to the spring 17 immediately after the switching mechanism has been advanced with its blank part K^9 beyond the primary holding pawl closes a branch from 11 to 7 through the ringer Q as follows:—11—12—13—14—15—16—17—68—19—H—Q—inside spring adjacent to 68 and then to 6—7. The five or six or more impulses just mentioned passing over this branch cause an automatic signaling of the selected stations.

After the calling device has sent the necessary number of operating impulses, and as it reaches its normal position, the pin N^1 strikes the other side of the pin N^2 and returns the arm N^3 to normal position, which is the position shown in Fig 4. In thus returning to normal position the insulating block or piece M^1 permits the springs 48 and 51 to again assume the position shown in Fig. 6. This change cuts out the battery X and cuts in the alternating generator G^1. By pressing ringing key W the current flows:—G^1—46—45—44—43—42—41—left hand contact closed by W and thence to in-

side spring in contact with 48—49—35—36—11—12 of the selected stations—13—14—15—16—17—68—19—H—Q—inside springs adjacent to 68 and then to 6—7—8—50—51 and inside spring in contact therewith, and thence through right hand springs closed by W to G^1. This impulse from the alternating generator G^1 for operating the ringer Q at the local station passes over the line 11—7 so that they pass through the branches for the magnets K at the local stations in the release direction. The branch from 46 through the relay S is in the direction to operate its armature and break up this impulse so that it will not be effective to release the switches of the subscribers. It is sufficient, however, to ring the bells as these bells may have clappers without springs. The impulse just described is, of course, immediately followed by another in the opposite direction from the generator G^1. This impulse does not operate the relay S as that relay is biased or polarized and the only action is to press the armature more firmly against the contact 42. The circuit for this impulse has a branch in the operating direction through the magnets K, but as the switching mechanism operated by these magnets have already reached the limit of their movements, such impulses through them are without effect upon the switches. They do, however, cause a greater or less amount of operation by the magnets K, which operation serves to shorten the impulse through the ringer Q by breaking the connection between 14 and 15. This ringing is in addition to and independent of the automatic ringing before described. After the subscribers have finished their conversation they indicate that fact to the central office in the ordinary manner. The operator then pushes the key M as before, except that she pushes it for only a part of its movement and not enough to change the position of the arm N^3. As before described, this sends a series of release impulses which release the switching mechanisms and permit them to return to normal position.

What I claim is:—

1. The combination with the stations of a party line exchange, of a device for sending a series of impulses over the party line to said stations, means by which one or more cessations of impulses are caused to occur at predetermined points and of specified duration in a series of impulses so sent and means by which a station is telephonically connected to the line as the result of such cessation of impulses, the particular station so selected being determined by the location of the cessation of impulses in the whole series of impulses.

2. The combination with the stations of a telephone exchange, of a device adapted to be set into operation for the sending of a series of impulses through said stations, automatically operating means for causing a cessation of impulses to occur at any desired point within the series of impulses so sent and means by which a station is telephonically connected to the line as the result of such cessation of impulses, the particular station so selected being determined by the location of the cessation of impulses in the whole series of impulses.

3. The combination with the stations of a party line exchange, of a calling device arranged to be set into automatic operation, means by which a series of impulses are sent over the line by such operation, means by which a cessation of impulses is caused to automatically occur at any desired point in said series of impulses and means by which a station is telephonically connected to the line as the result of such cessation of impulses, the particular station so selected being determined by the location of the cessation of impulses in the whole series of impulses.

4. In a selecting device, a wheel and means for moving it, a contact maker for sending impulses, connections between the wheel and the latter for operating the latter, and automatically operating means for disconnecting the contact maker from and then re-connecting it to the wheel so as to cause a pause in the operation of the contact maker.

5. The combination with the moving parts of a selecting device, of a contact making device connected to and operated by said moving parts, automatically operating means by which the contact making device is temporarily disconnected from its driving mechanism so as to cause a temporary pause in its operation, and an adjustable device by which such pause is caused to occur at any desired point in the operation of moving parts of the selecting device.

6. The combination with the stations of a telephone exchange, of a selecting device arranged to send impulses alternately in opposite directions through said stations, and means by which the impulses in one of said directions is broken up into a series of very short impulses.

7. The combination with the stations of a telephone exchange, of mechanism for sending a series of operating impulses through said stations, and means by which each impulse in said series is followed by two or more impulses of short duration in a direction opposite to said operating impulses.

8. The combination with the electro-magnetic switching mechanism of a telephone exchange, of a station selecting device arranged to send impulses for causing the operation of such mechanism, and devices by which each impulse so sent is followed by two or more impulses of very short duration in the opposite direction whereby resid-

ual magnetism is neutralized in said electromagnetic switching mechanism.

9. The combination with the switching mechanism of a telephone exchange, and a magnet for operating it, of mechanism for sending a series of impulses through said magnet to operate it, of means by which each impulse so sent is followed by two or more impulses in the opposite direction through said magnet, each of said two or more impulses being of a duration too short to cause a reverse operation of said magnet.

10. The combination with the stations of a party line exchange, and electrically operated switching mechanisms therefor, of a station selecting device arranged to send impulses alternately in opposite directions through said switching mechanisms, and a vibrating magnet associated with said selecting device and arranged to break up the impulses in one of said directions into sections of short duration.

11. The combination with the stations of a party line exchange, electrically operated switching mechanisms therefor, and an electric circuit including the switching mechanisms of said stations and extending to a central office, of a battery at the central office, two open branches from said battery to said circuit, devices for closing the connections of said branches alternately so as to send impulses in opposite directions over said circuit and through said switching mechanisms, and a make and break device in one of said branches arranged to be operated by a current flowing therethrough.

12. The combination with the central office, the local stations, and the conductors of a party line exchange, of an impulse sending device at the central office arranged to send impulses over said conductors, a magnet at each station permanently connected in bridge of said conductors, a condenser at each station located in a normally closed branch bridge of said conductors, and means by which upon impulses being sent over said conductors to operate said magnets, the operation of said magnets will break the said branch bridges.

13. The combination with the central office, the local stations, and the conductors of a party line, of a switching mechanism at each station permanently connected in bridge of said conductors, a condenser at each station located in a normally closed bridge of said conductors, an impulse sending device located at the central office, means by which an impulse sent by said device over said conductors will cause an operation of the switching mechanisms at the local stations, and means by which the operation of a switching mechanism serves to break the connection of the bridge including the said condenser.

14. The combination with the central office, the local stations, and the conductors of a party line exchange, of a magnet at each station permanently connected in bridge of said conductors, a condenser at each station connected in a normally closed bridge of said conductors, means located at the central office for sending impulses over said conductors to cause operations of said magnets, and means by which the operation of a magnet at any station will break the connection of the bridge of the condenser which is located at that station.

15. The combination with party line conductors extending from a central office to a series of local stations, and a device at the central office for sending impulses over the line, of a magnet at each station located in a bridge of said conductors, a condenser at each station located in a separate bridge of said conductors, means by which impulses sent over said line by said device causes operations of said magnets, and means by which the operations of said magnets break the bridges of said condensers.

16. The combination with party line conductors, a series of local stations, and an impulse sending device, a magnet and a condenser at each station located in separate bridges of said conductors, means by which an impulse sent by said device will cause the operation of all of said magnets, and means by which the operation of a magnet will break the bridge of the associated condenser and hold said break open during the time in which an impulse is flowing through the magnet.

17. The combination with party line conductors, and a device for sending impulses over said line, of a condenser connected in a bridge of said conductors, and automatically operating means for breaking said bridge at the time when an impulse is sent over the line by said device.

18. The combination with party line conductors, and a device for sending impulses over said line, of a series of condensers each located in a separate bridge of said conductors, and automatically operating means for breaking said bridges at the times when impulses are sent over said line by said device.

19. The combination with a central office, a series of local stations, and a party line connecting the stations to the office, of a switching mechanism at each station arranged to be advanced by operating impulses and to be permitted to be returned to normal position by release impulses sent over the line, an impulse sending device at the central office arranged to be moved from its normal position by hand and to automatically return to normal position when released, means by which a series of release impulses are sent over the line by the hand movement of said device, and means by which

operating impulses are sent over the line by the automatic return of said device to its normal position.

20. The combination with a central office, a series of local stations, and a party line connecting the stations to the office, of a switching mechanism at each station having its operations controlled by the impulses sent in given directions over the line, an impulse sending device at the central station office and connected to the line, means by which said device is moved from and to its normal position, means by which a movement of said device in one direction causes impulses to flow over the line in a given direction, and means by which a movement of said device in the other direction causes impulses to be sent over the line alternately in opposite directions.

21. The combination with a central office, a series of local stations, and a party line connecting the stations to the office, of a switching mechanism at each station having its operations controlled by the impulses sent in given directions over the line, an impulse sending device at the central office connected to the line, means by which a movement of said device in one direction causes impulses to flow over the line in a given direction, means by which a movement of said device in the other direction causes impulses to flow over the line in the opposite direction, and means by which there are sent over the line alternately with the last named impulses a short series of very short impulses in the same direction as those of the first named impulses.

22. The combination with a central office, a series of local stations, and a party line connecting the stations to the office, of a switching mechanism and a condenser at each station connected in separate bridges of said line, a device at the central office for sending impulses over the line to cause forward movements of the switching mechanisms, means by which each such forward movement of a switching mechanism serves to break the bridge of the condenser and thereby prevent said condenser from affecting the operation of said switching mechanism, and means by which each operating impulse sent over the line will be followed by a short series of short impulses in a direction opposite to said operating impulses.

23. The combination with a series of switching devices, of a selecting device arranged to send impulses alternately in opposite directions through said switching devices, and means by which the impulses in one of said directions are broken up into a series of very short impulses.

24. The combination with a central office, a series of local stations, a party line connecting the stations to the office, and means for sending operating and signaling impulses from the office over the line, of a switching mechanism at each local station permanently connected in bridge of the line, a signaling apparatus associated with each switching mechanism and also in bridge of the line when the switching mechanism has been advanced, and means by which a movement of a switching mechanism operates to temporarily break the bridge connection of its associated signaling apparatus.

25. The combination with a series of switching devices on a party line, and means for sending impulses alternately in opposite directions through said switching devices, of automatically operating means for breaking up the impulses in one of said directions into shorter impulses the current of which is proportional to the load on the line over which the impulses flow.

Signed at Chicago, Ill., this 9th day of Nov. 1905.

SAMUEL A. NORSTROM.

Witnesses:
A. L. BUCHANAN,
C. L. REDFIELD.