J. G. BLESSING.

IMPULSE TRANSMITTING DEVICE,

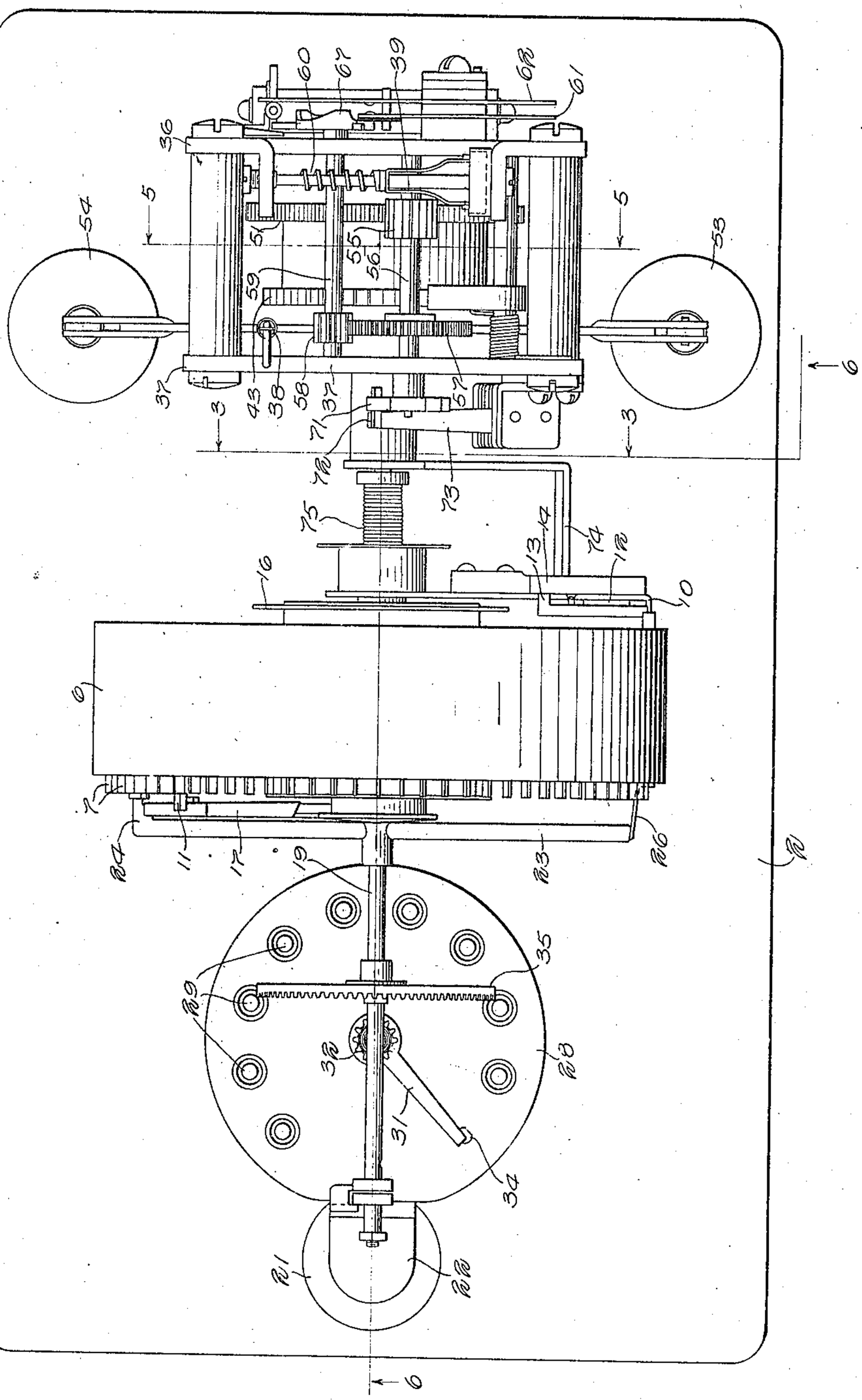
APPLICATION FILED AUG. 2, 1912.

1,145,543.

Patented July 6, 1915.

6 SHEETS—SHEET 1.

FIG. 1.



WITNESSES

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6 SHEETS—SHEET 2.

FIG. 3.

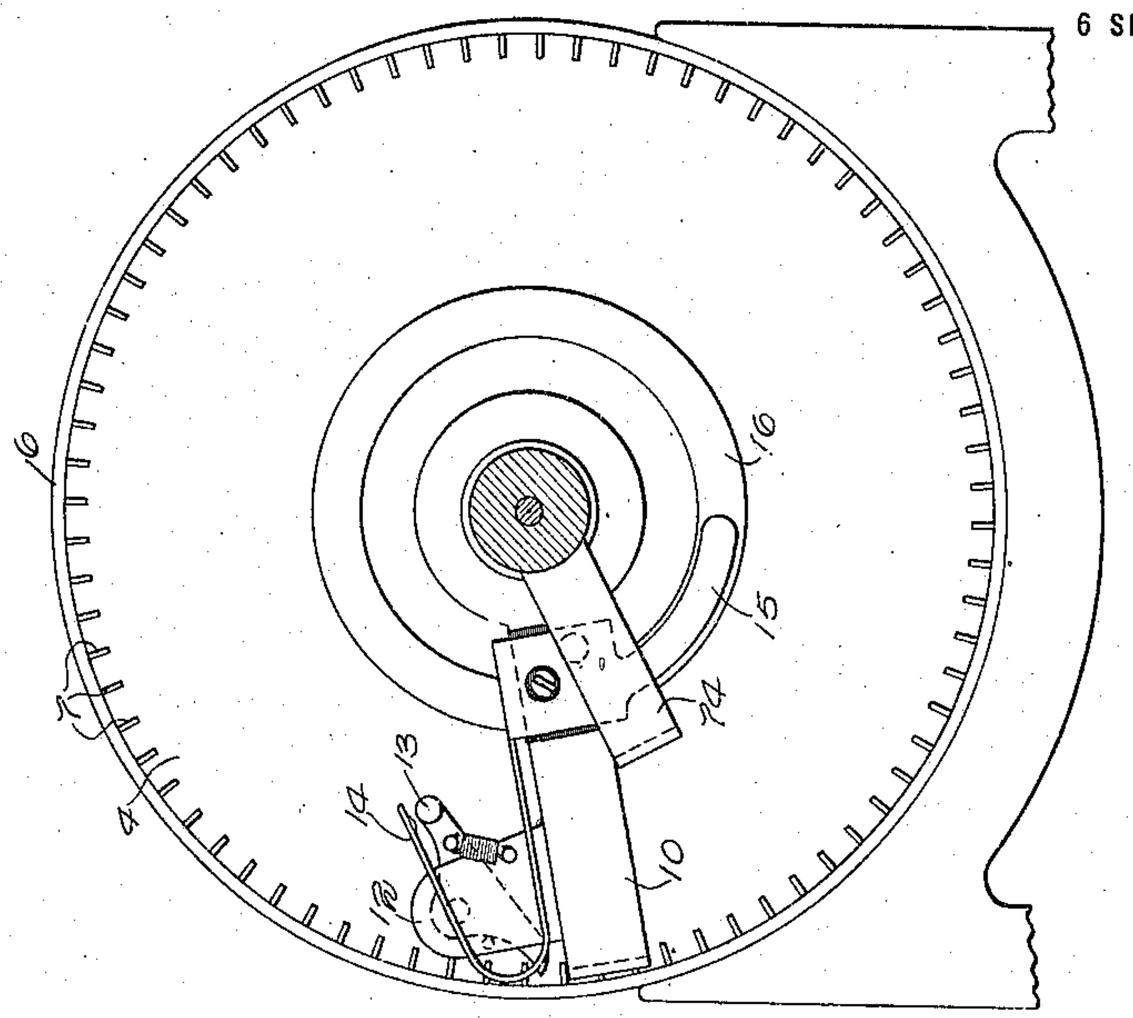

FIG. 2.

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6 SHEETS—SHEET 3.

FIG. 5.

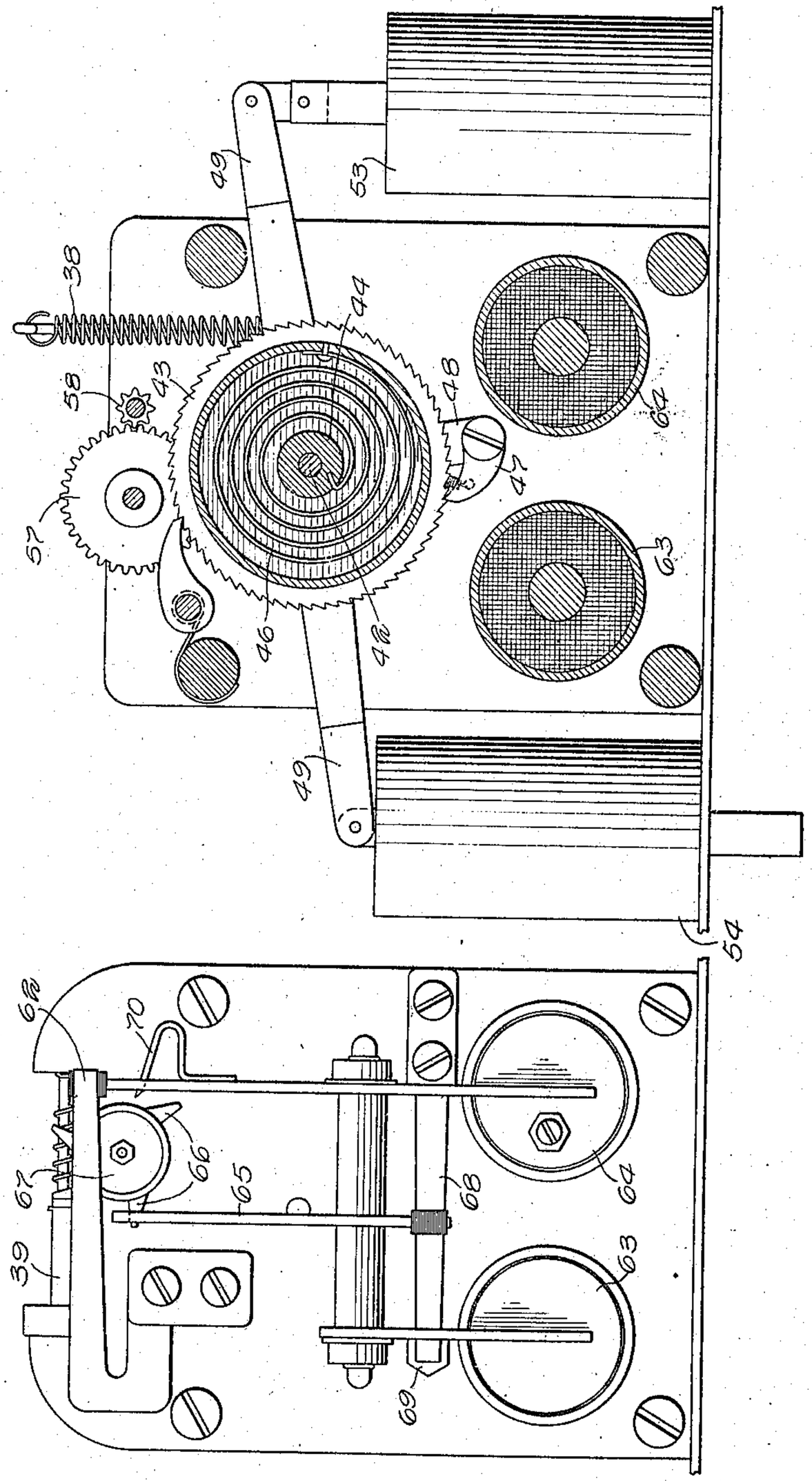

FIG. 4.

WITNESSES

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6 SHEETS—SHEET 4.

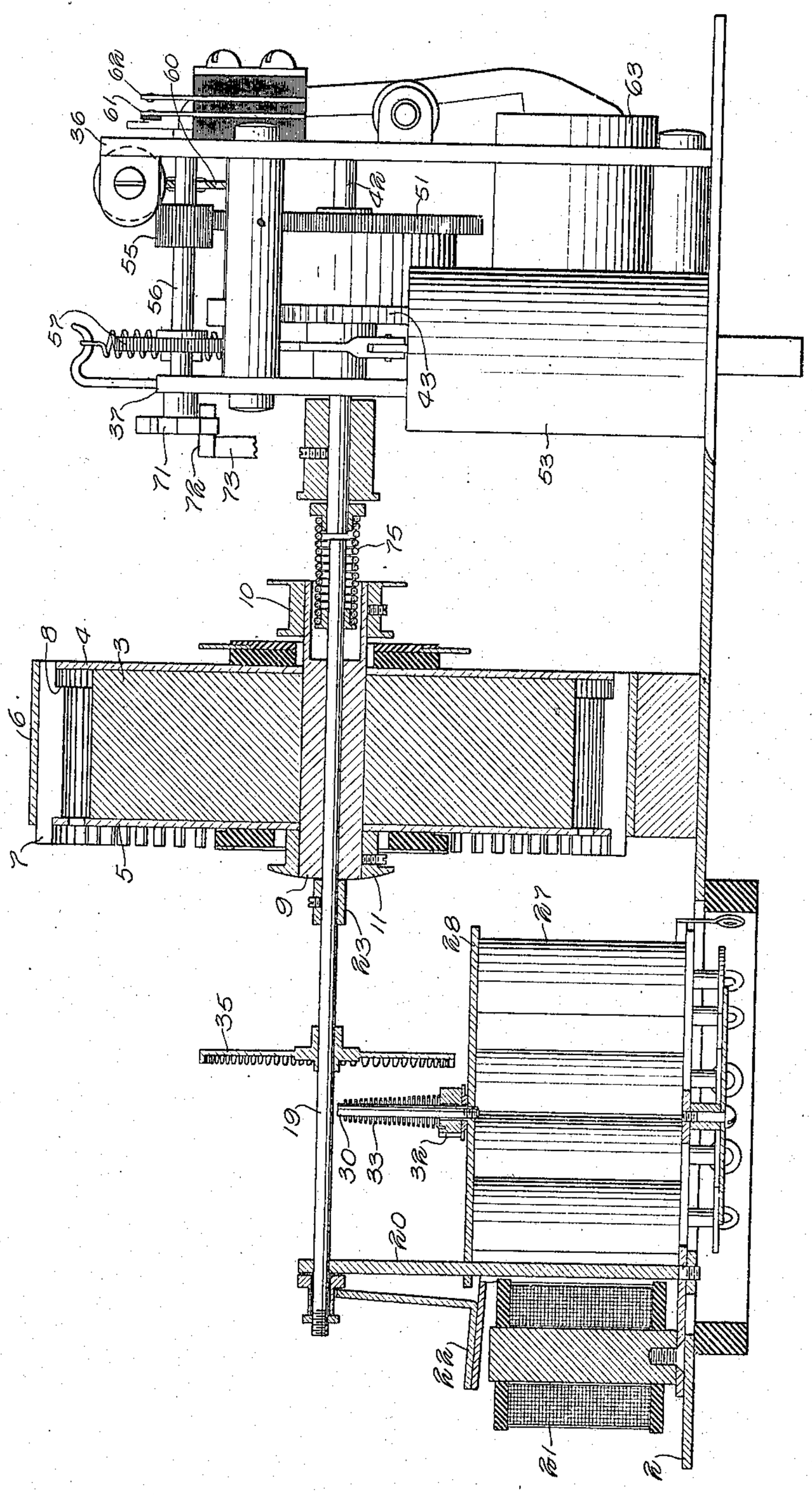

FIG. 6.

WITNESSES

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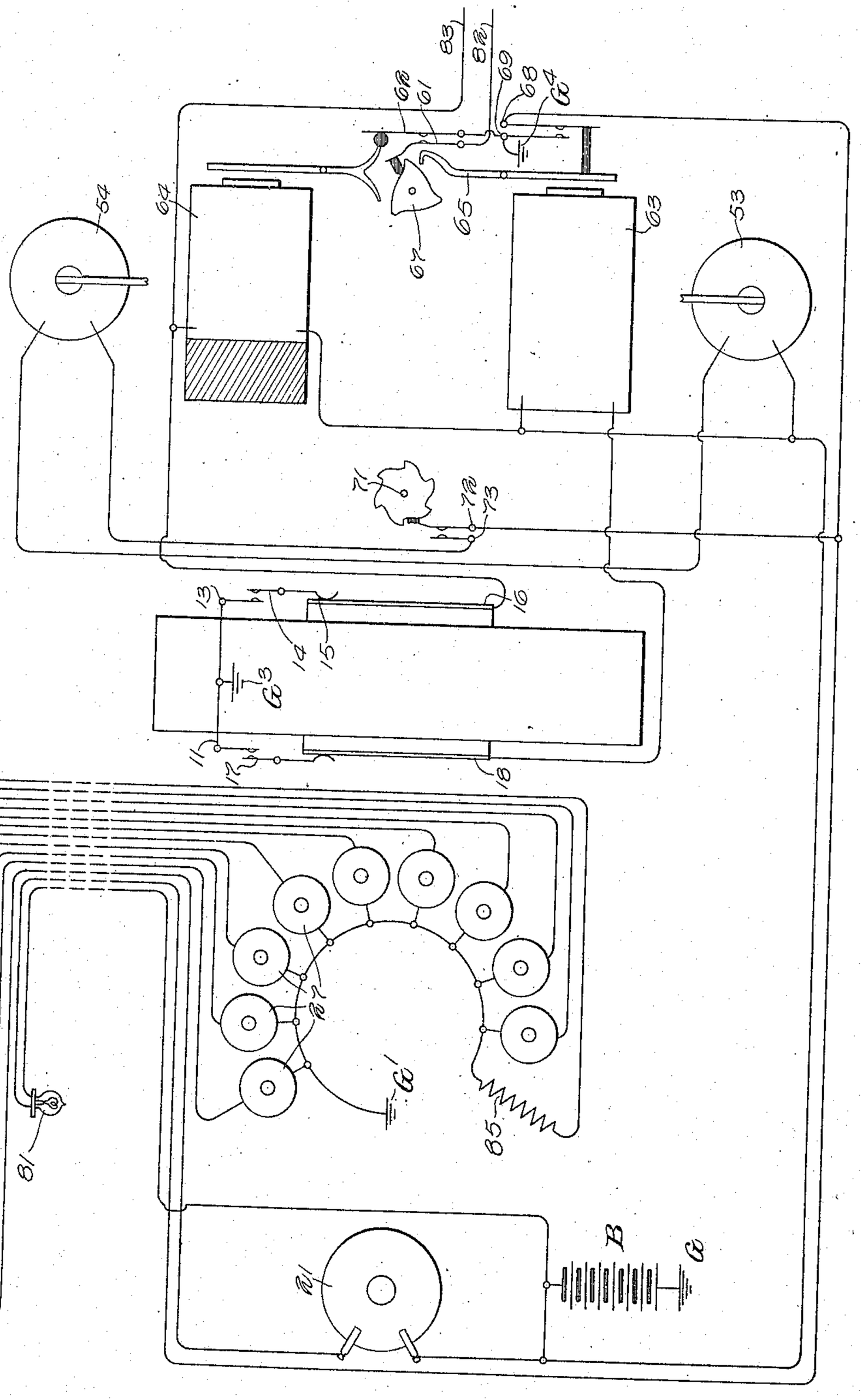
6 SHEETS—SHEET 5.

FIG. 7.



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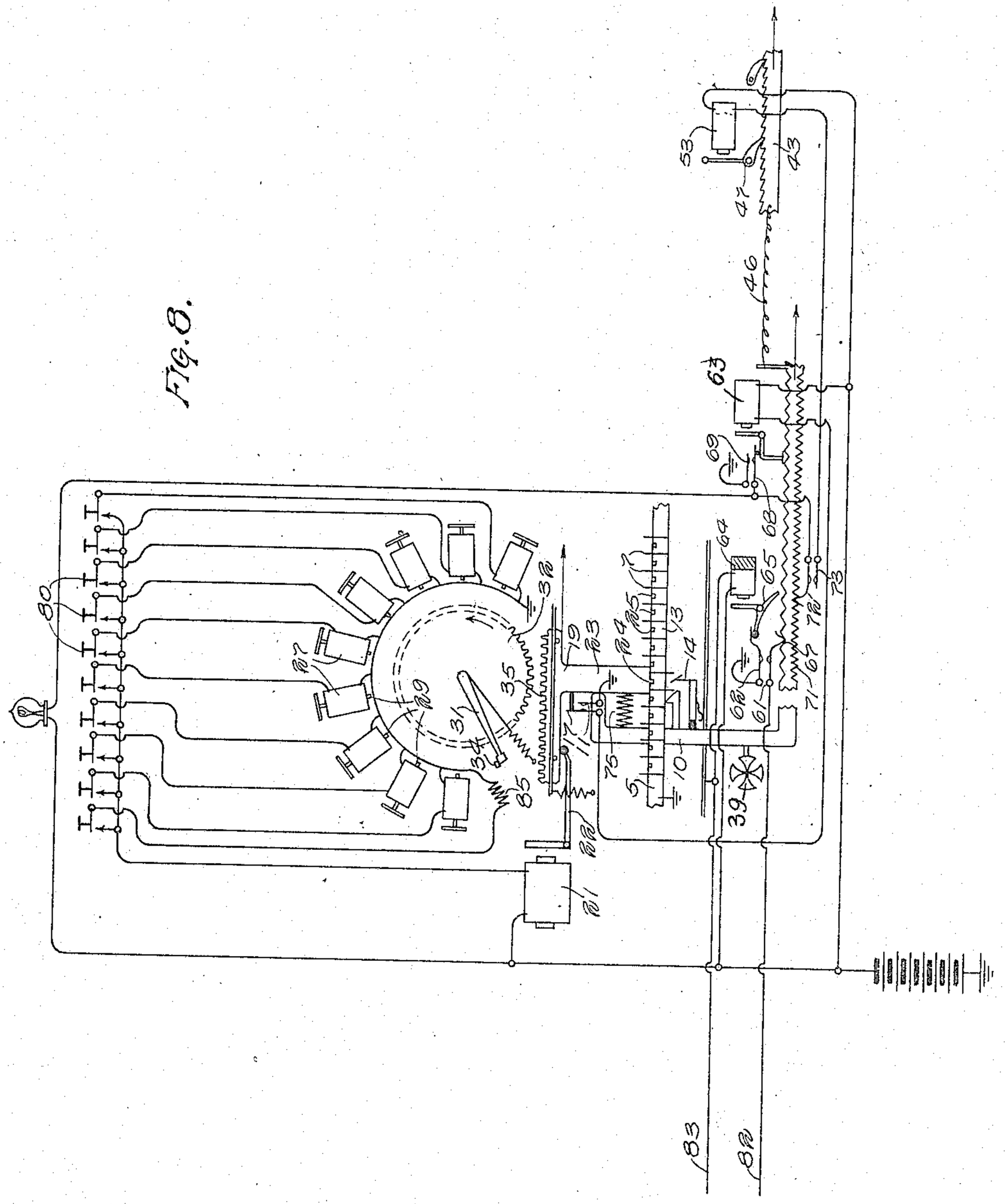
6 SHEETS—SHEET 6.

FIG. 8.



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UNITED STATES PATENT OFFICE.

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IMPULSE-TRANSMITTING DEVICE.

1,145,543. Specification of Letters Patent. Patented July 6, 1915.

Application filed August 2, 1912. Serial No. 712,910.

To all whom it may concern:

Be it known that I, JOHN G. BLESSING, a citizen of the United States of America, and resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Impulse-Transmitting Devices, of which the following is a specification.

My invention relates to improvements in impulse-transmitting devices, and it relates particularly to an impulse-transmitting device for use in connection with automatic telephone systems in which a plurality of groups of impulses are transmitted over a line circuit for the purpose of operating automatic selecting switches.

Among the objects of my invention are to provide an improved construction of such a calling device in which the speed at which such impulses are transmitted is independent of the speed at which the device is operated or set up, whereby the manual operation thereof can be quickly performed as fast as the operator is capable of working, and yet the impulses are transmitted at a rate of speed which will insure the proper operation of the automatic switches.

A special object of my invention is to provide a transmitter which is controlled by a plurality of keys, which keys control circuits including electromagnets, which electromagnets in turn control the operation of the impulse-transmitting device.

A further feature is to provide, in such a transmitter, for the spacing apart of the various groups of impulses which correspond to the digits of any called number, and, furthermore, to provide a device in which a plurality of impulses is transmitted over one side of the circuit and a single impulse is interpolated between two groups of impulses, which interpolated impulses are transmitted over the opposite side of the circuit.

It is also an object of my invention to provide certain details and features of improvement in the various combinations employed in such impulse-transmitting devices which tend to increase the general efficiency of the operation and construction of the same.

These and other objects of my invention will be more readily understood by reference to the accompanying drawings, in which—

Figure 1 is a plan view of a calling device embodying the principles of my invention. Fig. 2 is a left end elevation of the same. Fig. 3 is a sectional view on the line 3—3 in Fig. 1. Fig. 4 is a view of the right end. Fig. 5 is a sectional view on the line 5—5 in Fig. 1. Fig. 6 is a side elevation, partly in section, the section being taken along the line 6—6 in Fig. 1. Fig. 7 is a diagram of the circuit connections of the apparatus. Fig. 8 is a diagram showing the principles of the mechanism in simplified form.

As shown herein, the complete apparatus is mounted upon a suitable base plate 2. Near the center of this base plate there is mounted a drum consisting of a central portion 3 (Fig. 6), two end plates 4 and 5 and an outer casing 6. The plates 4 and 5 are provided near their peripheries with a number of slots in which are loosely supported the ends of a number of flat pins 7. Inside the drum these pins are provided near each end with a shoulder 8 which limits their motion in either direction. Extending through the center of this drum there is a hollow snaft 9 to the ends of which there are secured the arms 10 and 11. At its outer end the arm 10 is bent at right-angles toward the plate 4 and is beveled so that any projecting pins which it passes in its revolution will be forced back flush with said plate. The arm 10 also carries upon a projection 12 a movable lever 13. As the shaft 9 revolves and carries the arm 10 around the drum, the outer end of the lever 13 strikes any of the pins 7 which are projecting from the plate 4 and is momentarily tipped down thereby, so that the inner end of the lever engages a contact spring 14 which is carried by, but insulated from, the arm 10. The spring 14 is connected to a brush 15 which rubs upon an insulated metal ring 16. The arm 11 carries at its outer end an insulated spring 17 which is provided with a brush which rubs upon an insulated metal ring 18.

The inside of the hollow shaft 9 serves as a bearing for one end of a shaft 19, the other end of which is journaled in the upright 20. The shaft 19 is capable of lateral movement, which movement is controlled by

the electromagnet 21 through the medium of its armature 22. Firmly secured to the shaft 19 there is an arm 23 (Figs. 1 and 2) which extends diametrically across the face of the central drum. The end 24 of the arm 23 is bent over at right-angles and is adapted to fit snugly in the openings 25 in the plate 5. The other end of the arm 23 is provided with a flat right-angled projection which is broad enough to cover two of the pins 7. At the left of the central drum there are mounted a number of upright solenoids 27 which are arranged around the circumference of a circle, the center of which is directly beneath the shaft 19. Over the top of the solenoids there is a plate 28 provided with openings through which the plungers 29 of the solenoids may project when they are energized. In the center of the plate 28 there is an upright pin 30 upon the lower end of which there is mounted a gear wheel 32 to which there is firmly secured an arm 31. A helical spring 33 serves to normally hold the arm in engagement with the stationary pin 34. Secured to the shaft 19 there is a wheel 35 provided with crown teeth which, when the shaft 19 is moved to the left by the energization of the magnet 21, mesh with the pinion 32.

The power for rotating the shaft 9 and for operating other parts of the mechanism is supplied by a clock spring 46 (Fig. 5) which is mounted inside a cup formed on the face of a gear wheel 51. This gear wheel is firmly secured to the shaft 42, which is journaled in the plates 36 and 37 (Fig. 6). The outer end of the spring is secured to the wheel 51, while the inner end is secured to the hub 44 of a ratchet wheel 43 which is loosely mounted upon the shaft 42. The means for winding up the spring 46 comprises the two solenoids 53 and 54, which operate upon the ratchet wheel 43 through the medium of the arms 49, 48 and the ratchet pawl 47. Both the solenoids 53 and 54 operate to turn the arm 49 in the same direction, the spring 38 serving to return it in the opposite direction. The gear wheel 51 meshes with a pinion 55 on a shaft 56 to which there is also secured a gear 57, which latter meshes with a pinion 58 on a shaft 59. Upon the shaft 59 there is a toothed wheel 60 (Fig. 6) which meshes with the worm of a small governor 39 (Fig. 1), through the medium of which the speed of operation of the device is controlled. Upon the end of the shaft 59 which projects through the plate 36 there is a cam wheel 67 which, as the shaft rotates, makes and breaks the contact between the springs 61 and 62. Mounted in the lower portion of the frame formed by the two plates 36 and 37 there are two electromagnets 63 and 64. The armature of the magnet 63 controls an arm 65, the upper end of which carries a projection which is normally in the path of the locking fingers 66 on the cam wheel 67. When the magnet 63 is energized, the end of the arm 65 is withdrawn from the path of the fingers 66 and the contact spring 68 is pressed into contact with the contact point 69. The magnet 64, when energized, moves the projections 70 into the path of the fingers 66 and moves the spring 62 out of reach of the spring 61. The magnet 64 is slow acting—that is, slow to deënergize when its energizing circuit is broken. This slow action may be conveniently secured by placing a heavy ring of copper around one end of the core of the magnet. On the end of the shaft 56 which projects through the plate 37 there is a notched wheel 71 which, during its rotation, makes and breaks the contact between a pair of springs 72 and 73. Secured to the shaft 42 there is an arm 74 (Figs. 1 and 3), the end of which is bent over at right-angles to extend behind the arm 10, so that the hollow shaft 9 is forced to rotate with the shaft 42. The shaft 42 is also yieldingly connected with the shaft 19 by means of a spring 75 which is normally under tension, tending to rotate the shaft 19

Referring to Fig. 7, the electrical connections of the device are as follows: One terminal of each of the solenoids 27 is connected by means of a common conductor with the grounded terminal of a battery B. The other terminal of each solenoid is connected with a contact of one of a plurality of push buttons 80. The other contact of each of the push buttons is connected by means of a common conductor through the magnet 21 to the non-grounded terminal of the battery B. One terminal of each of the electromagnets 63 and 64 is connected to the battery B, while the other terminals of these magnets are connected to the rings 18 and 16, respectively. The contacts 68 and 69 control the circuit of a supervisory lamp 81 associated with the push buttons 80. The springs 72 and 73 control the circuit of the solenoids 53 and 54. The spring 61 is connected to a conductor 82 which is adapted to be connected to one side of the telephone line or trunk over which the impulses are to be transmitted. The other side of the line is to be connected to the conductor 83, which is connected with the insulated ring 16.

As illustrated herein, the calling device is adapted to produce impulses in the following order for each digit called: First a preliminary ground impulse is transmitted over one side of the line, then, after a short pause, a plurality of impulses, corresponding in number to the digit called, is transmitted over the other side of the line, followed by a confirming or switching impulse over the first side. The push buttons 80 are numbered from 1 to 0. In order to call

any number the conductors 82 and 83 are first connected to the line or trunk over which the call is to be transmitted, then the buttons 80 corresponding to the respective digits of the number to be called are pressed one after the other in as rapid succession as desired. Assume, for instance, that it is desired to call the number 135. In this case the #1, #3 and #5 buttons are depressed momentarily in the order named. When the apparatus is at rest, the spring 75 holds the arm 23 up against the plate 5, with its end 24 engaging one of the openings 25, while the other end forces two of the flat pins 7 in flush with the plate 5 and causes said pins to project from the other side of the drum beyond the face of the plate 4. The tip of the lever 13 (Fig. 3) rests between the two pins which thus project from the plate 4. When the #1 button is pressed, a circuit is closed from ground G′ through the first solenoid 27, #1 push button springs and the magnet 21 to battery B. The first solenoid 27, upon energizing, raises the end of its plunger above the surface of the plate 28. The magnet 21, upon energizing, draws the shaft 19 to the left to withdraw the end of the arm 23 from the opening 25 with which it is engaged, and places the gear wheel 35 in mesh with the pinion 32. As soon as the end of the arm 23 is withdrawn from the opening 25, the shaft 19 is free to be rotated by the small spring 75. During this rotation of the shaft 19 the arm 31 is caused to revolve about the pin 30 by the engagement of the gears 35 and 32. When the arm 31 strikes the protruding end of the plunger of the first solenoid, the shaft 19 is brought to rest. The distance between the stationary pin 34 and the plunger of the first solenoid is such as to permit the ends of the arm 26 to rotate through a distance equal to three times the pitch of the pins 7. Since the end 26 of this arm is broad enough to cover two of the pins, this means that it is rotated far enough to entirely pass one pin beyond the two which were originally pressed in by it. When the #1 button is released its solenoid and the magnet 21 are deënergized. The magnet 21, upon deënergizing, permits the shaft 19 to restore to the right, whereupon the end 24 of the arm 23 again engages one of the openings 25, and the end 26 causes the next two pins 7 after the one passed over to project from the plate 4. When the button #3 is depressed, the #3 solenoid and magnet 21 are energized in series, whereby the operations above described are repeated, with the exception that the end 26 of the arm 23 passes over three pins instead of one and then causes the next two to project from the plate 4.

When the #5 button is pressed, the arm 23 is rotated past five pins and then depresses the next two. As soon as the arm 23 makes its initial movement upon the depression of the first button, the spring 17 on the arm 11 (Fig. 2) is permitted to come into electrical contact with the said arm, whereby a circuit is closed from ground G^3 through said contact, ring 18 and the magnet 63 to the battery B. The magnet 63, upon energizing, unlocks the impulse wheel 67, which thereupon begins to rotate under the control of the spring 46. As the wheel 67 rotates, the arm 74 on the main driving shaft also pushes the arms 10 and 11 on the central drum around. This rotation will continue until the arm 11 catches up with the arm 23, to cause the spring 17 to be forced back to break the circuit of the magnet 63. The gearing of the device is so proportioned that the impulse wheel 67 forces the spring 61 out toward the spring 62 each time the lever 13 on the arm 10 passes one of the pins 7. Since the end of the lever normally rests between two pins which are protruding from the plate 4, the first pin which is passed by said lever tips said lever down so as to cause it to make contact with the spring 14, whereby a circuit is closed extending from ground G^3 through the contact 13—14, ring 16 and the magnet 64 to the battery B. The magnet 64, upon energizing, forces the spring 62 out of reach of the spring 61 and places the projection 70 in position to arrest the operation of the device after it has progressed far enough to permit the lever 13 to disengage the spring 14 to break the circuit of the magnet. The making and breaking of the contact between the spring 14 and the lever 13 also transmits a momentary impulse from ground G^3 through the contact 13—14, ring 16 and the conductor 83 to the side of the line or trunk which is connected therewith. The magnet 64, being slow acting, maintains the apparatus in its locked position for a short time before deënergizing and then releases it. The impulse wheel then resumes its revolution, whereupon the spring 61 is forced into contact with the spring 62 once, whereby an impulse of current is transmitted from ground G^4 through the springs 62 and 61 and the conductor 82 to the side of the line which is connected therewith. This occurs while the lever 13 on the arm 10 is passing the single pin 7 which was skipped over by the arm 23 when the #1 button was pressed. The next pin which the lever 13 passes is the first one of the two which were forced out by the arm 23 when the #1 button was released. As the lever 13 passes this pin a second impulse is sent out over the first side of the line by way of the conductor 83, and the circuit of the magnet 64 is energized a second time to bring the apparatus to rest momentarily and to move the spring 62 out of reach of the spring 61 to prevent an im-

pulse from being sent out by way of the conductor 82. This completes the impulses for the first digit 1, which impulses included one impulse over the line 83, followed by a pause, then one impulse over the line 82 and then a final impulse over the line 83. After a short pause, the magnet 64 deënergizes and the mechanism resumes its operation. The next pin passed by the lever 13 is the second one which was forced out by the arm 26 when the #1 button was released. This causes the contact 13—14 to be closed momentarily, whereby the preliminary impulse for the second digit is transmitted over the line 83 and the magnet 64 is energized to arrest the motion of the apparatus for an instant. After the magnet 64 deënergizes, the mechanism resumes its operation and continues to operate without interruption until the lever 13 on the arm 10 strikes the first pin which was forced out by the arm 23 when the #3 push button was released. During this operation the lever 13 will pass three pins which are not forced out into its path, and therefore three impulses are transmitted to the line 82 by way of the springs 61 and 62, followed by a single impulse over the conductor 83. For the last digit 5 the operations are just the same as for the preceding digit, with the exception that five impulses instead of three are transmitted over the conductor 82. Immediately after the final impulse is transmitted over the conductor 83 by the engagement of the lever 13 with the first pin which was forced out by the arm 26 when the #5 button was released, the spring 17 on the arm 11 catches up with the end 24 of the arm 23 and breaks the circuit of the magnet 63, whereupon the entire mechanism is brought to rest permanently.

It will be seen that during the entire time the magnet 63 is energized, and therefore during the entire time the mechanism is operating, the circuit of the lamp 81 is closed at the springs 68 and 69, whereby the operator is enabled to know when the call has been completed. Also during the operation of the device the springs 73 and 72 are alternately closed and opened to cause the solenoids 53 and 54 to be energized and deenergized to maintain the tension in the main spring 46. During its rotation the arm 10 restores each of the pins which are forced through the drum by the arm 23 to normal position after it has been engaged by the lever 13.

As shown herein, there are only nine solenoids 27 and ten push buttons 80. When the tenth push button is pressed, the arm 31 makes a complete revolution and is brought to rest by the stationary pin 34. It is, of course, evident that the last push button could be provided with a solenoid the same as the others, but the arrangement shown herein effects the practical saving of one solenoid. However, in order to provide a similarity of circuits, the last push button is preferably connected to ground G′ through a resistance 85 which is equal to the resistance of the solenoids.

In order to more clearly and graphically understand the operation of my device, reference will now be made to diagrammatic Fig. 8 in which various circular parts of the mechanism, such as the gear wheel 35, the central drum with its row of movable pins 7 and the ratchet wheel 43 in the driving mechanism, are shown developed into a straight line and the movable parts are assumed to have a rectilinear motion. The impulse wheel 67 and the interrupter wheel 71 are also represented as rectilinear elements, with a large number of impulse teeth. Referring to this diagrammatic figure, the operation of the device is in short as follows: Upon depressing any of the buttons 80 the corresponding solenoid 27 and the magnet 21 are energized in series. The magnet 21, upon energizing, lifts the gear 35 and the arm 23 until the gear 35 engages the pinion 32 and the lower end of the arm 23 disengages the opening 25 in the plate 5 with which it was last engaged. When this occurs, the spring 75 forces the arm 23 and the gear 35 to the right. This apparatus will be brought to rest when the arm 31, which is rotated by reason of the engagement of the gears 35 and 32, strikes the plunger of the energized solenoid 27. When this occurs, the arm 23 will have passed over a number of the pins 7 corresponding to the button pressed. When the button is released, the arm 23 returns to its lower position, forcing two pins through the plate 5 and disengaging the gears 32 and 35, whereby the arm 31 is permitted to return to its normal position. Upon the initial forward movement of the arm 23 the springs 11 and 17 are permitted to close contact, whereby the circuit of the magnet 63 is closed. The magnet 63, upon energizing, withdraws the stop from the impulse wheel 67, whereupon said wheel and the arm 10 begin to be moved to the right by the spring 46 at a speed which is controlled by the governor 63. Upon the initial movement of the arm 10, the finger 14 contacts with the projecting end of one of the pins 7, whereby an impulse of current is transmitted over the line 83 and the circuit of the magnet 64 is closed momentarily. The magnet 64, upon energizing, moves a stop into the teeth of the wheel 67 and moves the spring 62 out of reach of the spring 61. After the arm 10 has moved far enough to allow the finger 14 to disengage the pin 7, the said arm and the impulse wheel are brought to rest by the

stop on the magnet 64. After a time the armature of the magnet 64 drops back and releases the impulse wheel, which continues its forward movement, and each time a tooth on said wheel passes under the spring 61 an impulse is transmitted to the line conductor 82. After a number of impulses corresponding to the digit called have been thus transmitted to the line 82, the finger 14 engages the first pin 7 which was pushed through the plate 5 by the arm 19 in its advanced position, and a second impulse is transmitted to the line 83 and the magnet 64. The magnet 64 again operates to lift the spring 62 out of reach of the spring 61 during its next operation and stops the impulse wheel for an instant. If, in the meantime, none of the other buttons 80 have been pressed, the impulse wheel and arm 10 move forward only a short step upon the following deënergization of the magnet 64, as the arm 10 will have caught up with the arm 23 and the springs 11 and 17 will be opened to allow the stop magnet 63 to deenergize and stop the mechanism. If, before the mechanism has thus been brought to rest, a second button has been pressed, the same cycle of operations as described above will be repeated, understanding, of course, that the number of impulses transmitted over the conductor 82 will correspond with the button pressed. During the time the impulse wheel 67 is moving forward the wheel 71 operates to transmit a series of impulses through the magnet 53 to advance the ratchet wheel 43 to keep up the tension in the spring 46.

While I have illustrated one particular embodiment of my invention, and have described its operation as particularly adapted for use in automatic telephone systems, it is, of course, understood that my invention, in certain respects, is of broader scope, as the impulse-transmitting device described is capable of use in any other electrical signaling system in which it is desired to transmit impulses over a circuit for some useful purpose. It is therefore to be understood that I do not wish to be limited to the exact construction shown and described.

What I claim as my invention is:—

1. In a telephone system, a circular series of movable contacts, a rotary member for actuating said contacts, a set of keys, electromagnets one individual to each key controlled by said keys for variably controlling the travel of said member, and means controlled by said contacts for transmitting electrical impulses.

2. In a telephone system, a circular set of movable contacts, a rotary member for actuating said contacts, a set of keys, electromagnets one individual to each key controlled by said keys for variably controlling the travel of said member, an electrically-operated mechanism, and means for traversing said contacts to control said mechanism.

3. In a telephone system, a calling device for transmitting impulses according to the digits of the called number, said device including a step-by-step operating arm, electromagnetic means for stopping the operation of said arm, and a continuously rotating arm adapted to follow after said first-mentioned arm and controlled thereby.

4. In a telephone system, a calling device comprising a plurality of operating keys, electromagnets controlled thereby, a circuit for each magnet, one of said keys individual to each circuit, a controlling arm adapted to be operated by said electromagnets, and means controlled by said arm for transmitting impulses according to the digits of the called number.

5. In a telephone system, a calling device including a plurality of keys, electromagnets controlled by said keys, an arm adapted to be controlled by said electromagnets, the movement of said arm varying in accordance with the electromagnet operated, means for transmitting impulses, and means controlled by said arm for controlling the number of said impulses transmitted.

6. In a telephone system, a calling device including a plurality of keys, electromagnets controlled by said keys, an arm adapted to be rotated varying distances according to the electromagnet operated, means for transmitting impulses, and means controlled by said arm for governing the number of impulses transmitted.

7. In a telephone system, a calling device including a plurality of keys, electromagnets controlled thereby, a controlling arm adapted to be operated varying distances, depending upon the electromagnet operated, a second arm adapted to rotate continuously, means controlled by said second arm for transmitting impulses, and means controlled by said first arm for controlling the number of impulses transmitted.

8. In a telephone system, a calling device including a controlling arm, electromagnetic means for operating said controlling arm a plurality of steps, one for each digit of the called number, a second arm, means for operating said second arm with a continuous motion during the transmission of impulses, and means controlled by said second arm for transmitting said impulses.

9. In a telephone system, a calling device including an impulse wheel, a continuously operating arm for controlling the operation of said wheel, a controlling arm, a plurality of keys, electromagnets controlled by said keys for operating said controlling arm a plurality of steps, one for each digit of the

called number, and means controlled by said controlling arm for governing the extent of operation of said first-mentioned arm.

10. In a telephone system, a calling device comprising a series of movable pins, an arm adapted to variously control said pins in accordance with the digits of the called number, a set of keys, electromagnets one individual to each key controlled by said keys for controlling the operation of said arm, and means controlled by said pins for governing the transmission of impulses in accordance with the digits of the called number.

11. In a telephone system, a calling device comprising a circular series of longitudinally-movable pins, an arm adapted to be rotated over said pins, the movement of said arm being dependent upon the number of impulses desired to be transmitted, a plurality of keys, electromagnets one individual to each key controlled by said keys for controlling the operation of said arm, means for transmitting impulses, and means controlled by said pins for controlling the number of impulses transmitted.

12. In a telephone system, a calling device including a plurality of operating keys, electromagnets one individual to each key controlled thereby, a controlling arm adapted to be operated by said electromagnets, means controlled by said arm for transmitting a plurality of series of impulses, and means for spacing apart the impulses of each series.

13. In a telephone system, a calling device, a plurality of keys, electromagnets controlled thereby, an arm controlled by said electromagnets, the movement of said arm varying in accordance with the electromagnet operated, means for transmitting a plurality of series of impulses, means controlled by said arm for controlling the number of impulses in each series, and means for spacing apart each series of said impulses.

14. In a telephone system, a calling device including a plurality of keys, electromagnets controlled thereby, an arm adapted to be rotated varying distances, according to the electromagnet operated, means for transmitting a plurality of series of impulses, means controlled by said arm for governing the number of impulses in each series, and means for spacing apart each series of impulses.

15. In a telephone system, a calling device comprising a plurality of keys, electromagnets controlled thereby, a controlling arm adapted to be operated varying distances, depending upon the electromagnet operated, a second arm adapted to rotate continuously, means controlled by said second arm for transmitting a plurality of series of impulses, means controlled by said first arm for controlling the number of impulses in each series, and means for spacing apart each series of impulses.

16. In a telephone system, a calling device for transmitting a plurality of series of impulses, said device including a controlling arm, electromagnetic means for operating said controlling arm a plurality of steps, one for each series, a second arm, means for operating said second arm with a continuous motion during the transmission of impulses, means controlled by said second arm for transmitting said impulses, and means for separating each series of impulses.

17. In a telephone system, a calling device for transmitting a plurality of series of impulses, one for each digit of the called number, said device including an impulse wheel, a continuously operating arm for controlling the operation of said wheel, a controlling arm, a plurality of keys, electromagnets controlled by said keys for operating said controlling arm a plurality of steps, one for each digit of the called number, means controlled by said controlling arm for governing the extent of operation of said first-mentioned arm, and means for separating each series of impulses.

18. In a telephone system, a metallic line circuit, an impulse-transmitting device for transmitting a varying number of impulses over one side of said line, and a single impulse over the opposite side of said line, a plurality of keys, and electromagnets one individual to each key controlled thereby for controlling the operation of said impulse device.

19. In a telephone system, a metallic line circuit, an impulse device for transmitting a series of impulses over one side of said line, followed by one or more impulses over the opposite side of said line, a movable arm, a plurality of keys, and electromagnets one individual to each key controlled thereby for controlling the operation of said impulse device.

20. In a telephone system, a metallic line circuit, a calling device including a plurality of operating keys, electromagnets controlled thereby, a controlling arm adapted to be operated by said electromagnets, and means controlled by said arm for transmitting a plurality of series of impulses over one side of said line circuit and one or more impulses over the opposite side of said circuit between each of said series of impulses.

21. In a telephone system, a metallic line circuit, a calling device including a plurality of keys, electromagnets one individual to each key controlled thereby, an arm adapted to be controlled by said electromagnets, the movement of said arm varying in accordance with the key operated, means controlled by said device for transmitting a series of impulses over one side of said line circuit, followed by one or more impulses

over the opposite side thereof, and means controlled by said arm for controlling the number of impulses in said series.

22. In a telephone system, a metallic line circuit, a calling device including a plurality of keys, electromagnets controlled thereby, an arm adapted to be rotated varying distances, according to the electromagnet operated, means controlled by said device for transmitting a series of impulses over one side of said line circuit, followed by one or more impulses over the opposite side thereof, and means controlled by said arm for governing the number of impulses in said series.

23. In a telephone system, a metallic line circuit, a calling device including a plurality of keys, electromagnets controlled thereby, a controlling arm adapted to be operated varying distances, depending upon the electromagnet operated, a second arm adapted to rotate continuously, means controlled by said second arm for transmitting a series of impulses over one side of said line circuit, followed by one or more impulses over the opposite side thereof, and means controlled by said first arm for controlling the number of impulses in said series.

24. In a telephone system, a metallic line circuit, a calling device including a controlling arm, electromagnetic means for operating said controlling arm a plurality of steps, one for each digit of the number called, a second arm, means for operating said second arm with a continuous motion, means controlled by said second arm for transmitting a plurality of series of impulses over one side of said line circuit, one series for each digit of the called number, and means likewise controlled by said arm for transmitting one or more impulses over the opposite side of said line circuit between each of said series of impulses.

25. In a telephone system, a metallic line circuit, a calling device including an impulse wheel, a continuously operating arm for controlling the operation of said wheel, a controlling arm, a plurality of keys, electromagnets controlled by said keys for operating said controlling arm a plurality of steps, one for each digit of the called number, means controlled by said controlling arm for governing the extent of operation of said first-mentioned arm, and means controlled by said impulse wheel for transmitting a plurality of series of impulses over one side of said line circuit, one for each digit of the called number and one or more impulses over the opposite side of said line circuit between each of said series of impulses.

26. In a telephone system, a metallic line circuit, a calling device including a circular row of longitudinally-movable pins, an arm adapted to be rotated over said pins, a plurality of keys, electromagnets one individual to each key controlled by said keys for controlling the extent of operation of said arm, means for transmitting a plurality of series of impulses over one side of said line circuit, means controlled by said pins for governing the number of impulses in each series, and means for transmitting one or more impulses over the opposite side of said line circuit between each of said series of impulses.

27. In a signaling system, an impulse transmitter, a combined impulse current controller and impulse transmitter controller, and magnetic means for starting the latter in operation.

28. In a signaling system, an impulse transmitter, a circuit for receiving the impulses from said transmitter, a controller for controlling the delivery of the current impulses to the circuit and for controlling the impulse transmitter, and magnetic means for starting said controller.

29. In a signaling system, a circuit and a circuit interrupter having a traveling member and an adjustable coöperating device associated therewith, a second traveling member for adjusting said device, said traveling members so related that when they are at rest they assume a normal relative position to each other, and when the second member is operated it advances and permits the first member to follow until it overtakes the second member and assumes the normal at-rest position, the second traveling member adapted each time it is operated to adjust portions of the adjustable device into the path of the first traveling member to be engaged thereby, whereby each time an engagement takes place the circuit is interrupted, and magnetic means for starting said second traveling member in operation.

30. In a signaling system, a circuit and a circuit closure having a traveling member and an adjustable coöperating device associated therewith, a second traveling member for adjusting said device, said traveling members so related that when they are at rest they assume a normal relative position to each other, and when the second member is operated it advances and permits the first member to follow until it overtakes the second member and assumes the normal at-rest position, the second traveling member adapted each time it is operated to adjust portions of the adjustable device into the path of the first traveling member to be engaged thereby, whereby each time an engagement takes place the circuit is closed, and magnetic means for starting said second traveling member in operation.

31. In a signaling system, a transmitter having a circuit controller and an impulse generator, said circuit controller having a traveling member provided with a speed governor, a second traveling member, said first and second members having a normal

relative position with regard to each other, a compression member between the two tending to drive the said second member forward, a latch for holding the second member, a tension member connected to the said first member, automatic means for maintaining the tension in the tension member approximately constant, and magnetic means for starting said second traveling member in operation.

32. In a signaling system, a transmitter having a circuit controller and an impulse generator, said circuit controller having a traveling member provided with a speed governor, a second traveling member, said first and second members having a normal relative position with regard to each other, a compression member between the two tending to drive the said second member forward, a latch for holding the second member, a tension member connected to the said first member, automatic means for maintaining the tension in the tension member approximately constant, magnetic means for starting said second traveling member in operation, and means manually controlled for automatically unlatching the second member and permitting it to advance a distance under the action of the compression member and automatically latching it again, and for automatically releasing the first member and permitting it to advance under the action of the tension member and to automatically restore the force in the compression member.

33. In a signaling system, a line, an impulse transmitter therefor having a circuit controller, an impulse generator, a digit index, means whereby the digit index may be operated for two or more digits and through its medium the circuit controller set and the impulse generator started to send a series of impulses to the line divided into a plurality of groups, the operation of the digit index adapted to be completed before the last group of impulses is begun, and magnetic means for starting said digit index in operation.

34. In an electrical system, a line, an impulse transmitter therefor having a circuit controller, an impulse generator, a digit index, said digit index adapted to be operated for two digits and through its means the circuit controller set to cause a series of impulses from the generator to be transmitted to the line, said impulses divided into groups, the operation of the index being adapted to be completed before the first group of impulses is completed, and magnetic means for starting said digit index in operation.

35. In a telephone system, a calling device for transmitting impulses according to the digits of the called number, said device including a step-by-step operating arm, electromagnetic means for starting the operation of said arm, and a continuously rotating arm adapted to follow after said first-mentioned arm and controlled thereby.

36. In a telephone system, a calling device for transmitting impulses according to the digits of the called number, said device including a step-by-step operating arm, electromagnetic means for starting and stopping the operation of said arm, and a continuously rotating arm adapted to follow after said first-mentioned arm and controlled thereby.

37. In a telephone system, a calling device including a controlling arm, electromagnetic means for operating said controlling arm a plurality of steps, said means comprising a magnet for each digit of the called number, a second arm, means for operating said second arm with a continuous motion during the transmission of impulses, and means controlled by said second arm for transmitting said impulses.

Signed by me at Chicago, Cook county, Illinois, this 25th day of July, 1912.

JOHN G. BLESSING.

Witnesses:
ARTHUR J. RAY,
ALBERT ANDERSEN.