J. ERICKSON.

TELEPHONE SYSTEM.

APPLICATION FILED DEC. 18, 1908. RENEWED MAY 29, 1916.

1,209,825.

Patented Dec. 26, 1916.

5 SHEETS—SHEET 1.

Fig. 1.

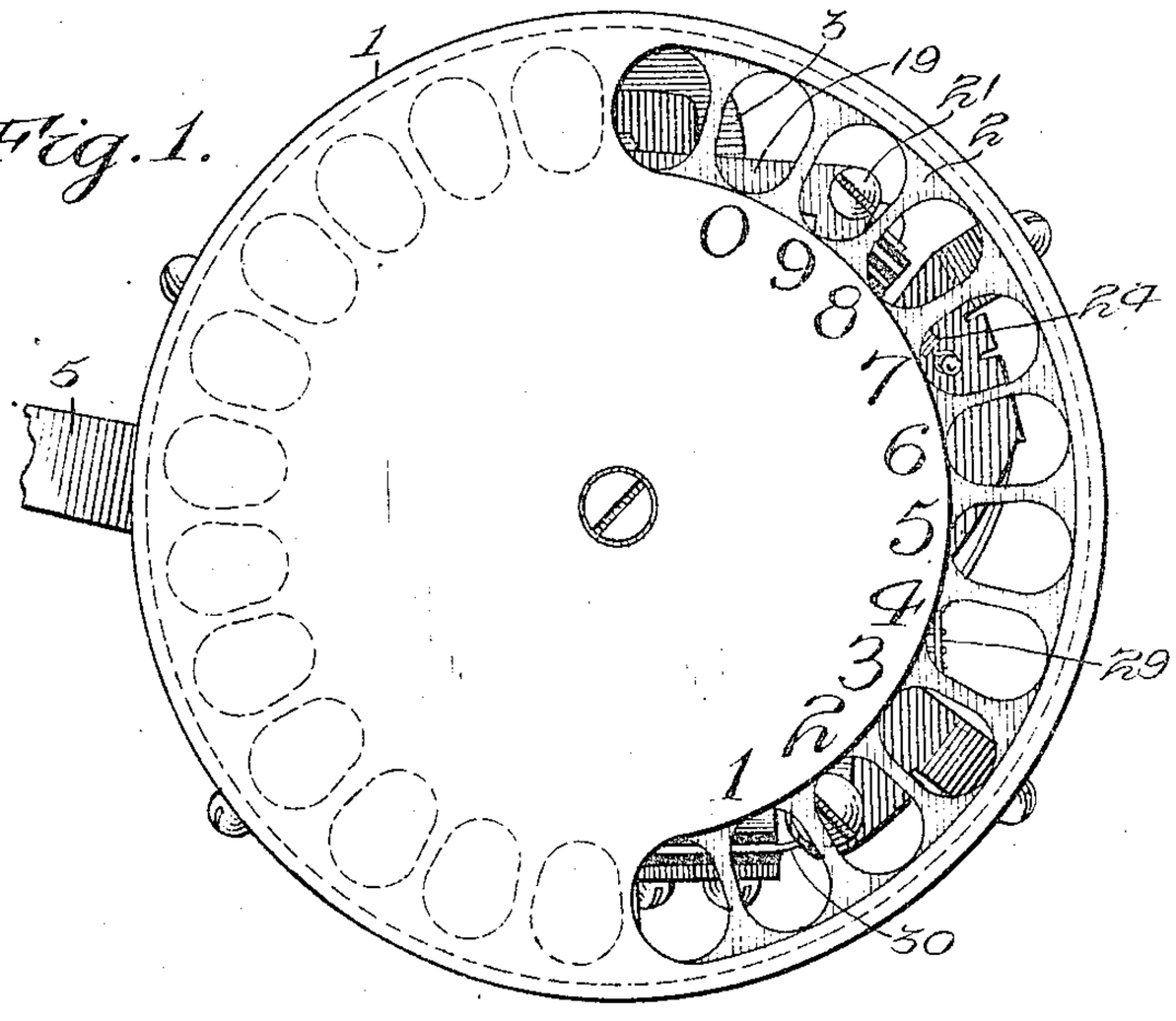
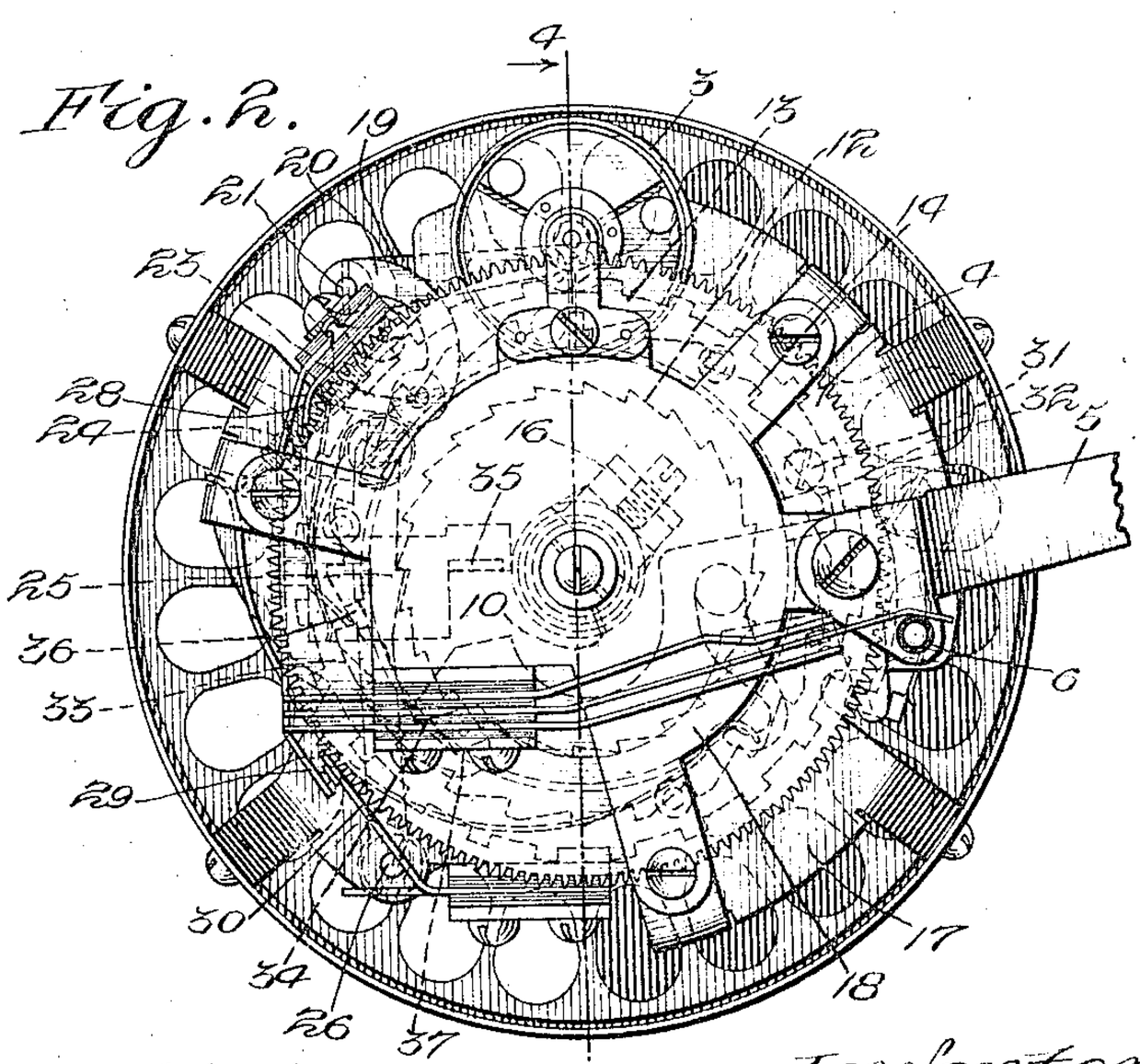


Fig. 2.



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5 SHEETS—SHEET 2.

Fig. 3.

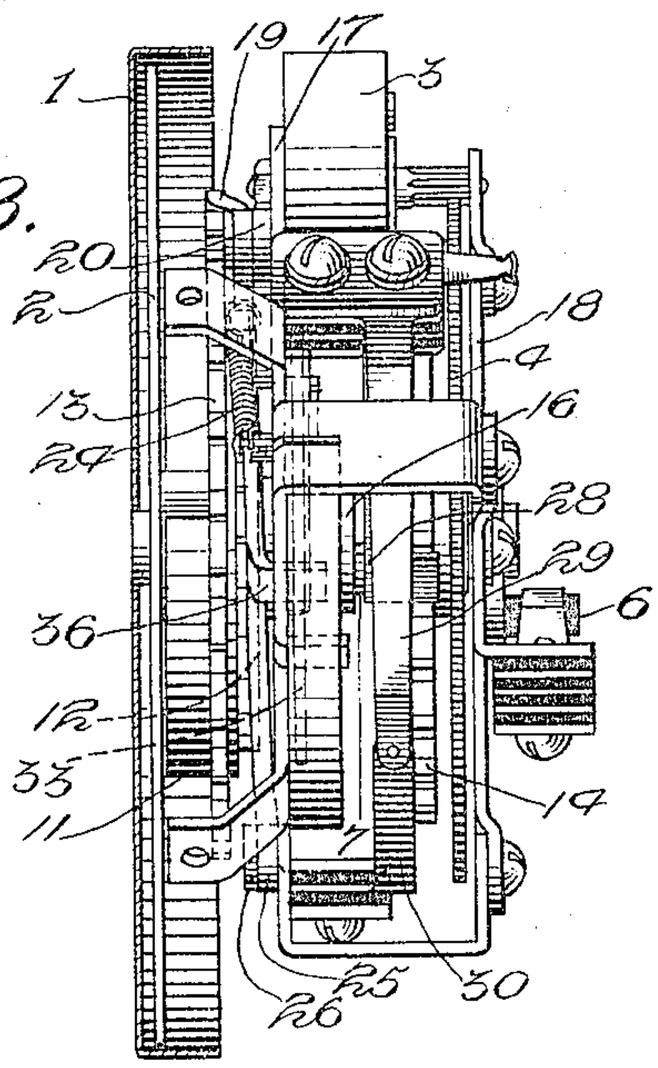
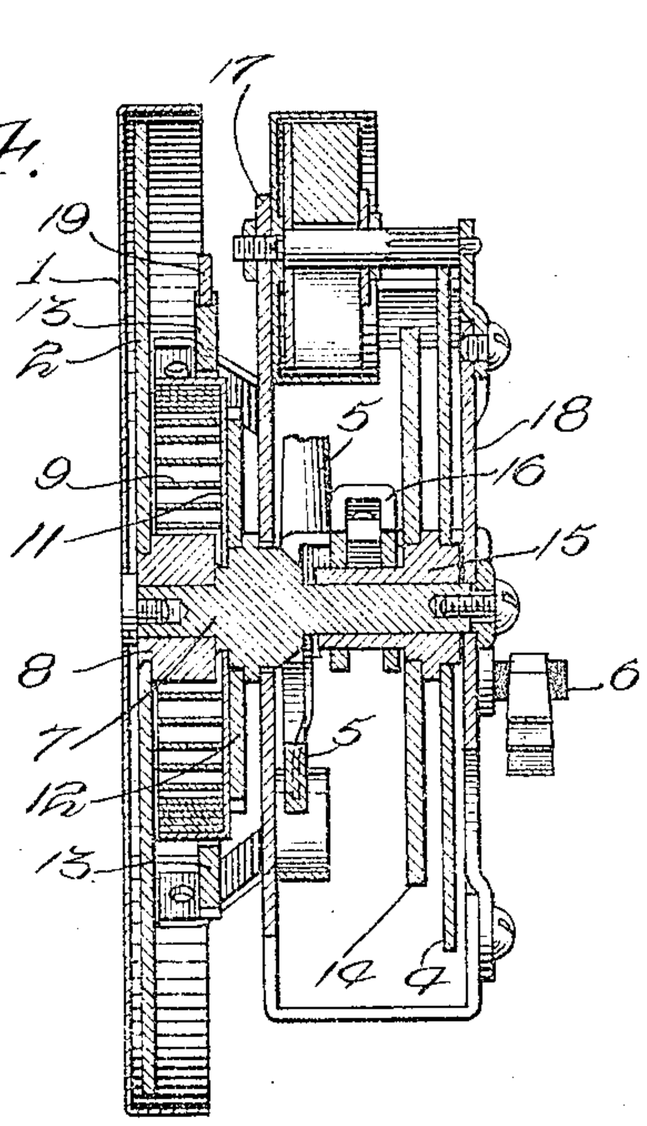


Fig. 4.



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5 SHEETS—SHEET 3.

Fig. 5.

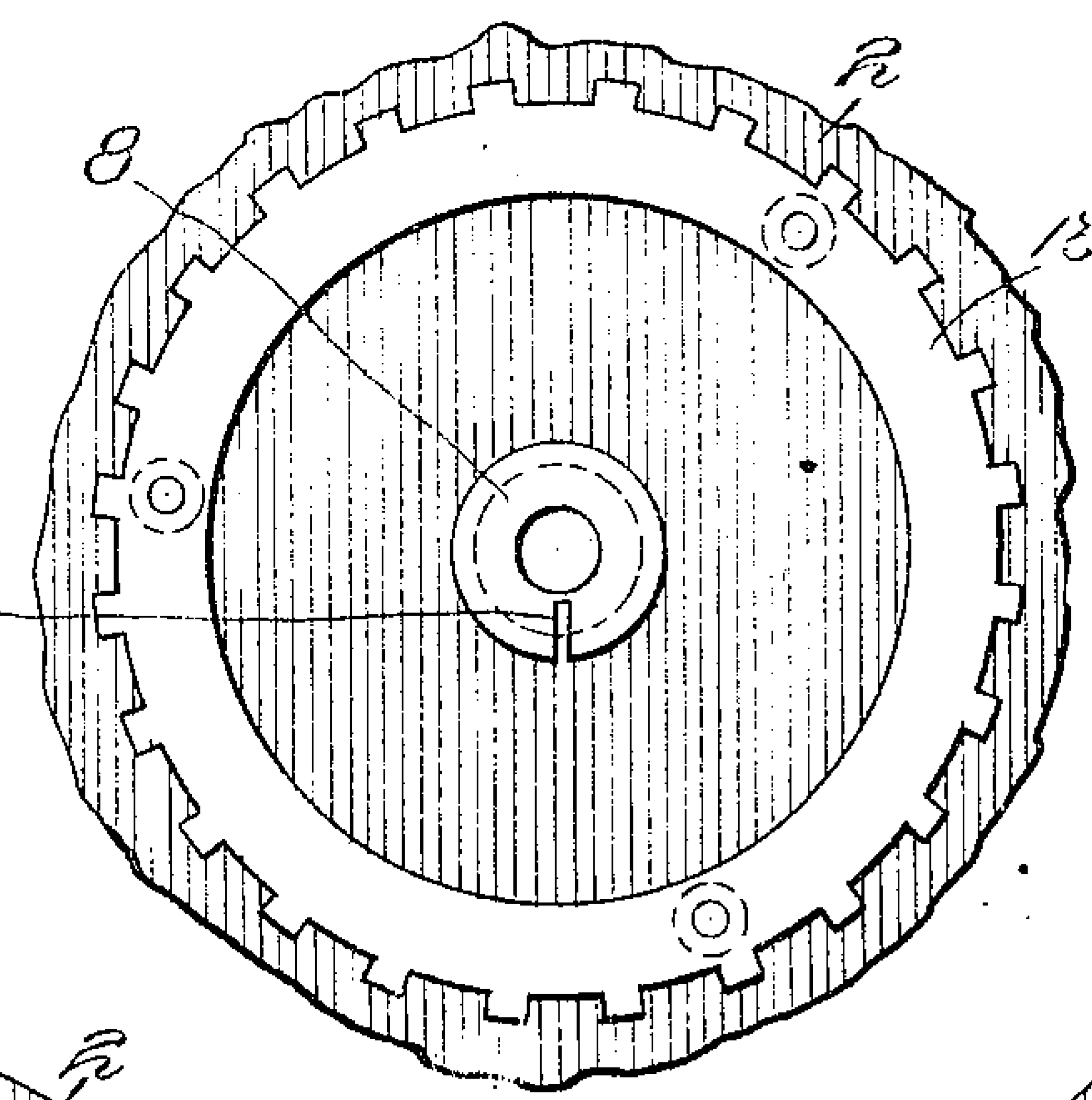


Fig. 6

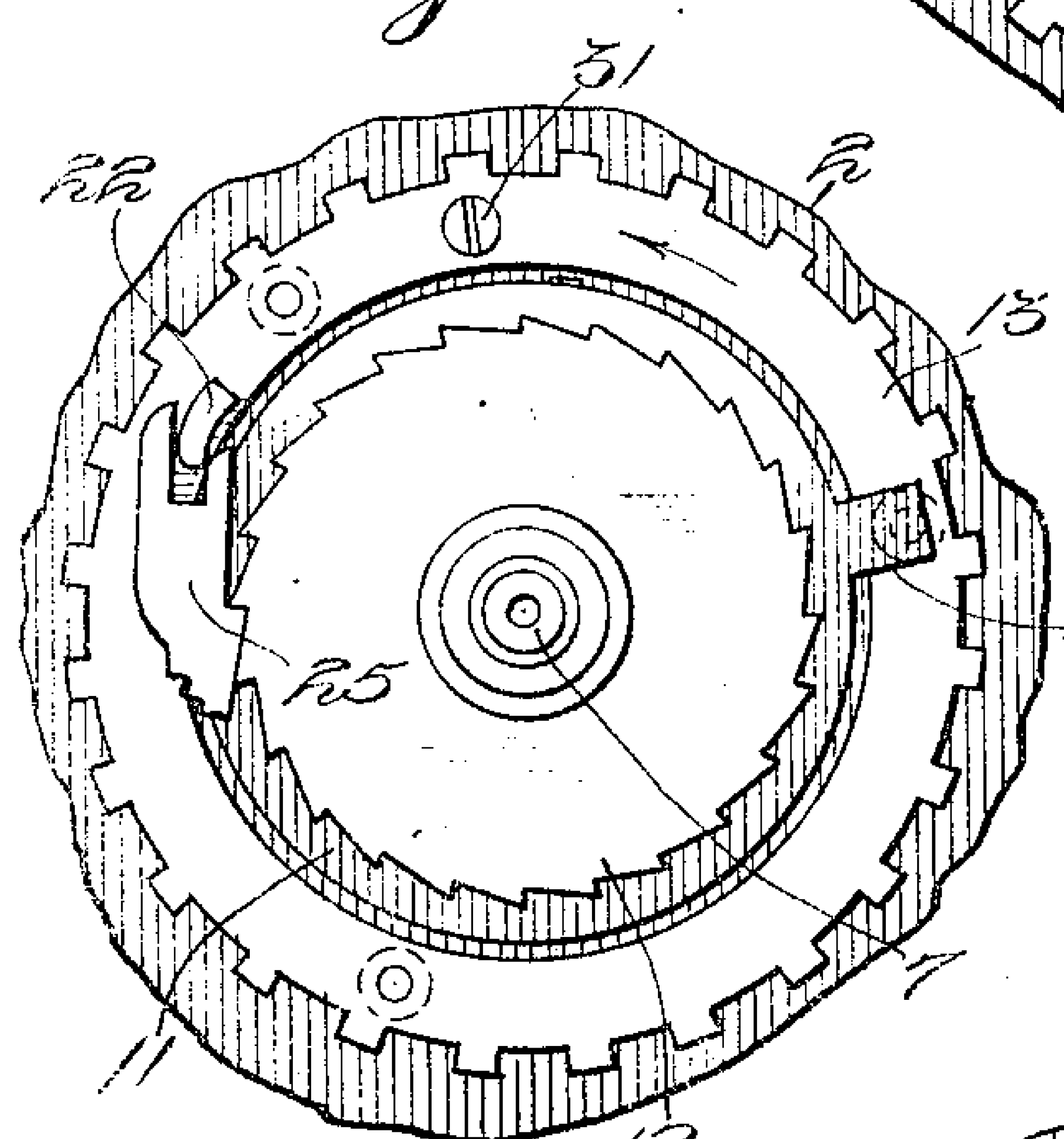


Fig. 7.

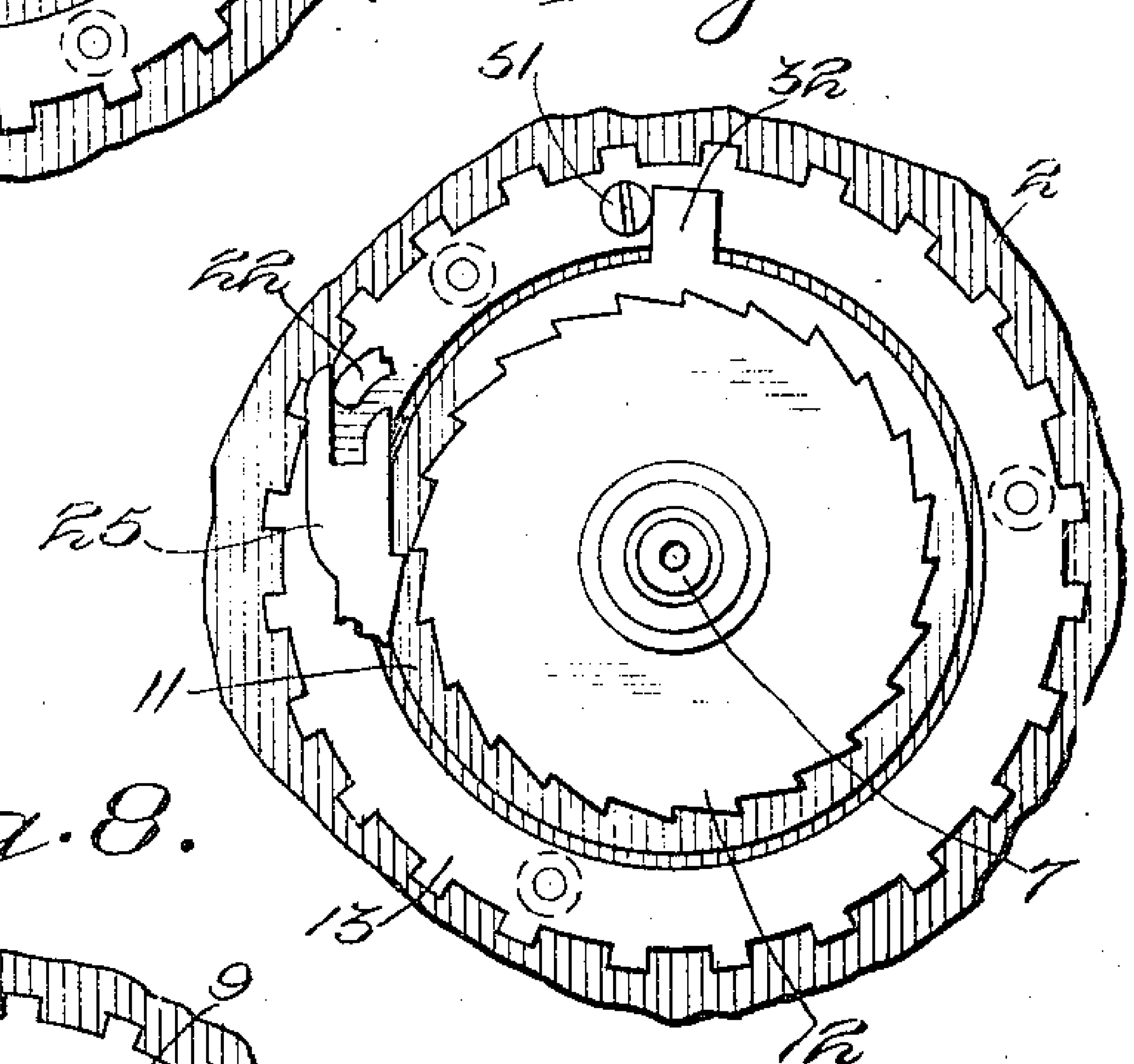
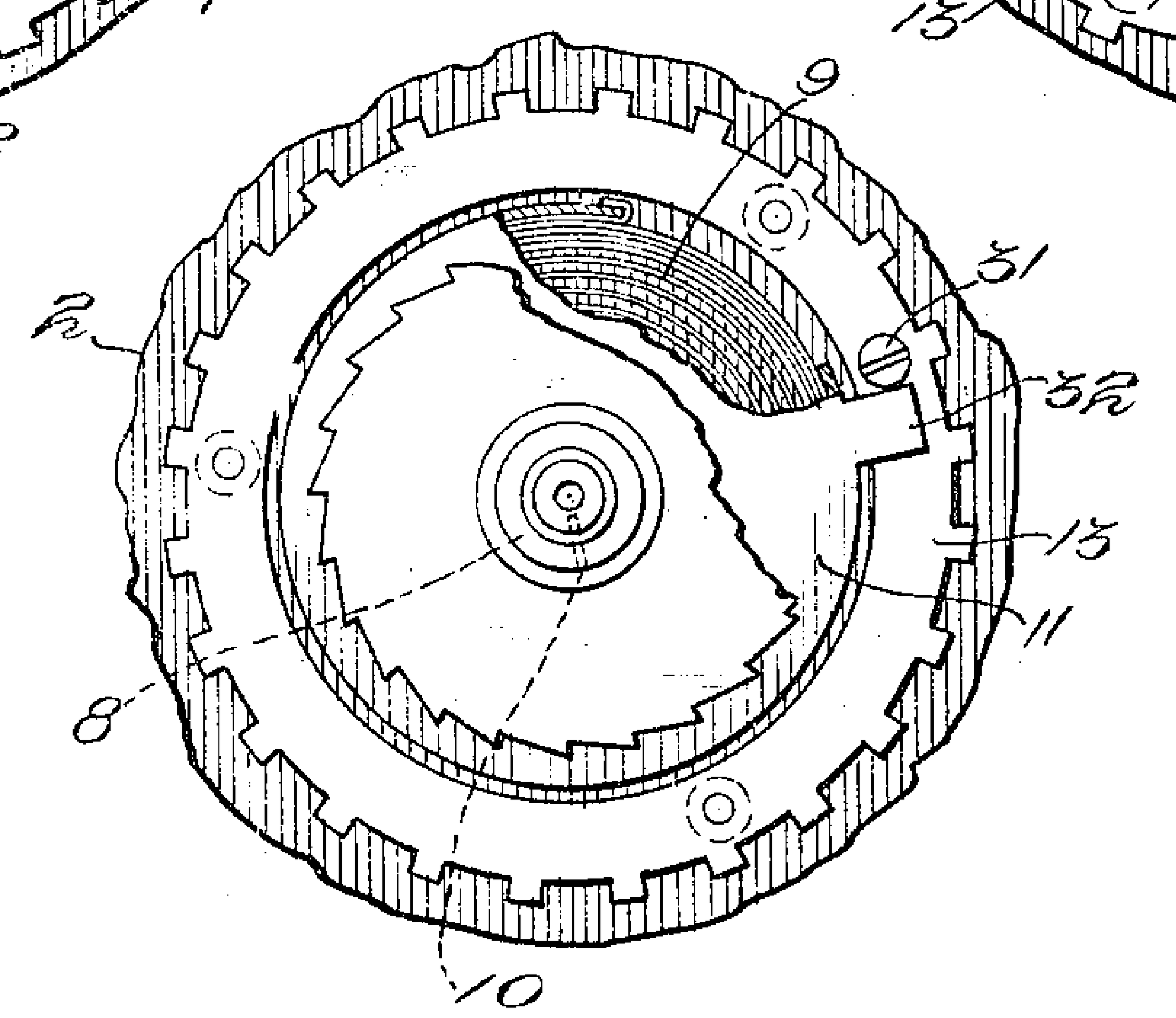


Fig. 8.



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5 SHEETS—SHEET 4.

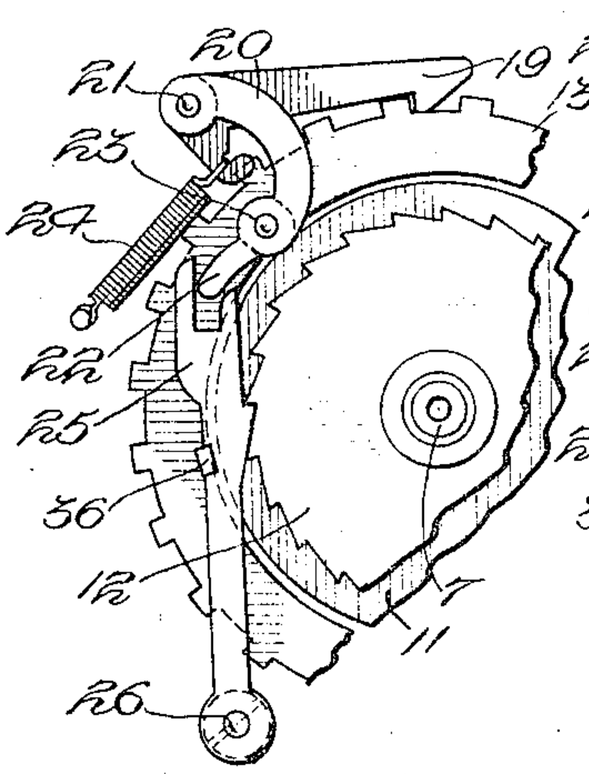

Fig. 9.

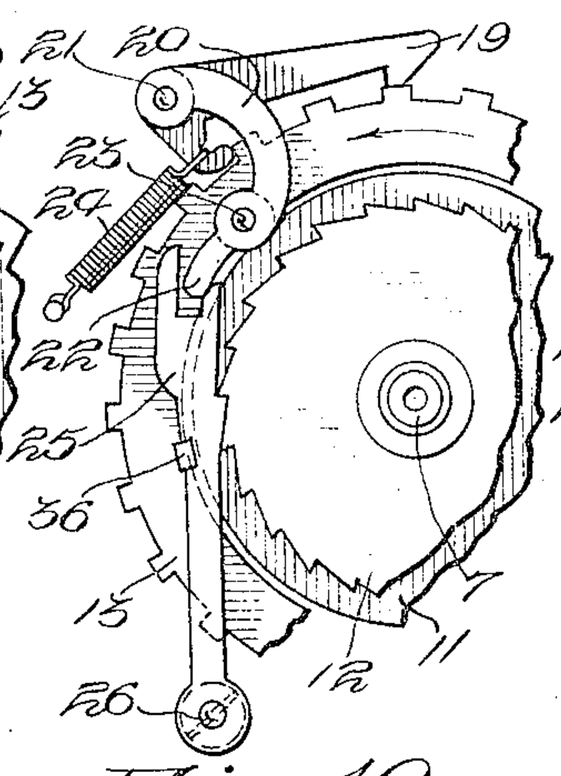

Fig. 10.

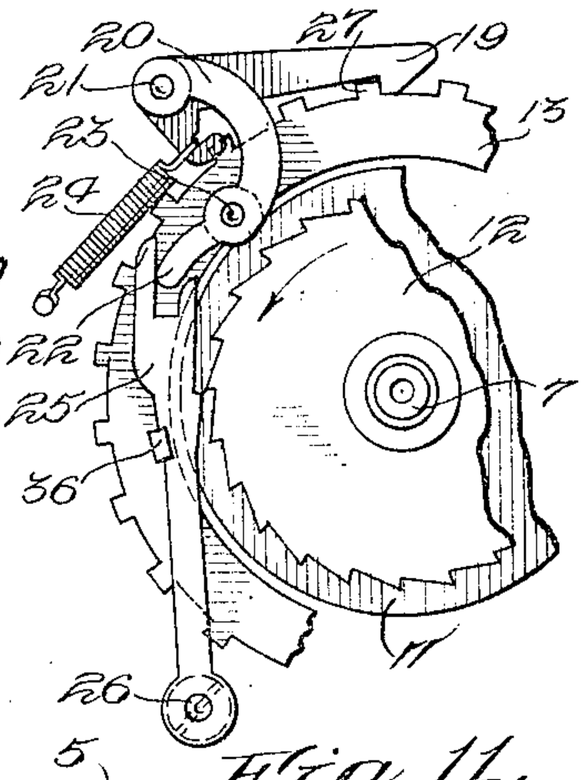

Fig. 11.

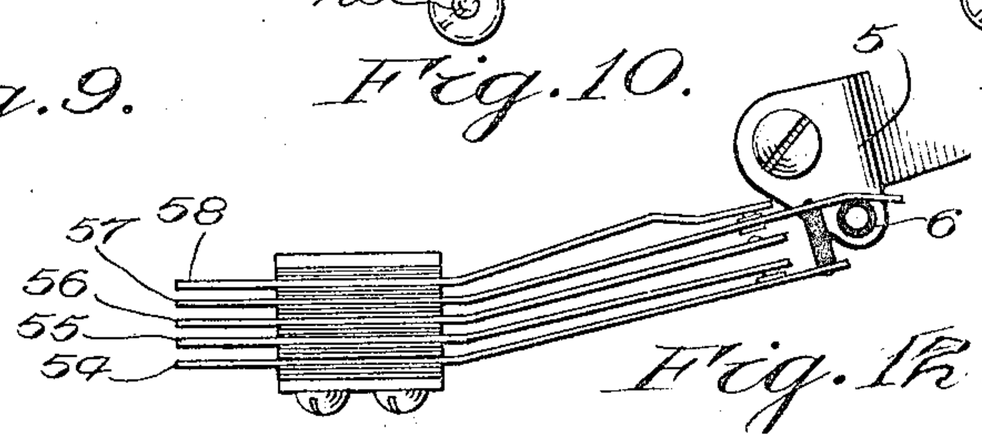

Fig. 12.

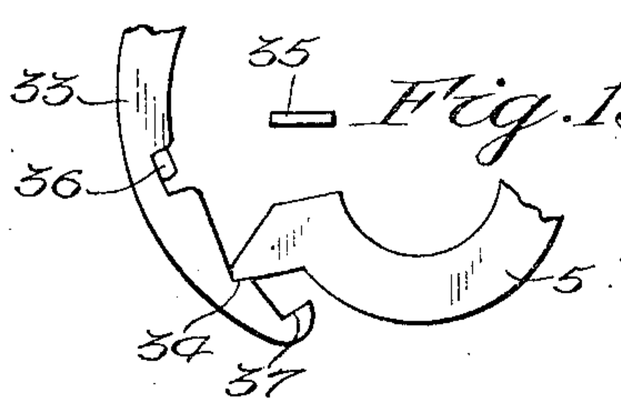

Fig. 13.

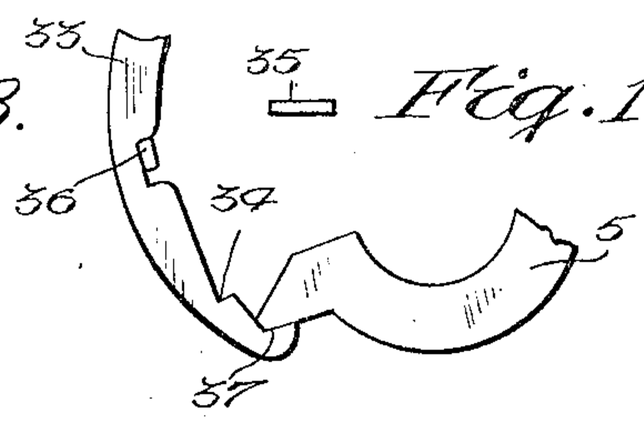

Fig. 14.

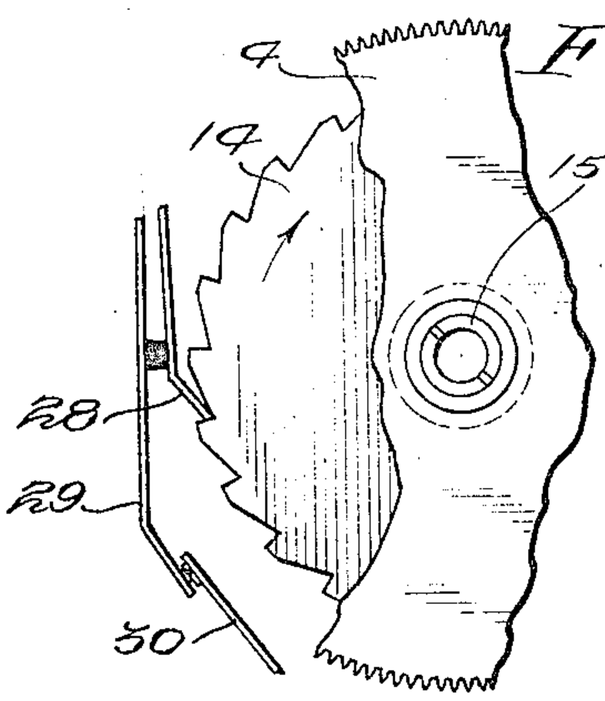

Fig. 15.

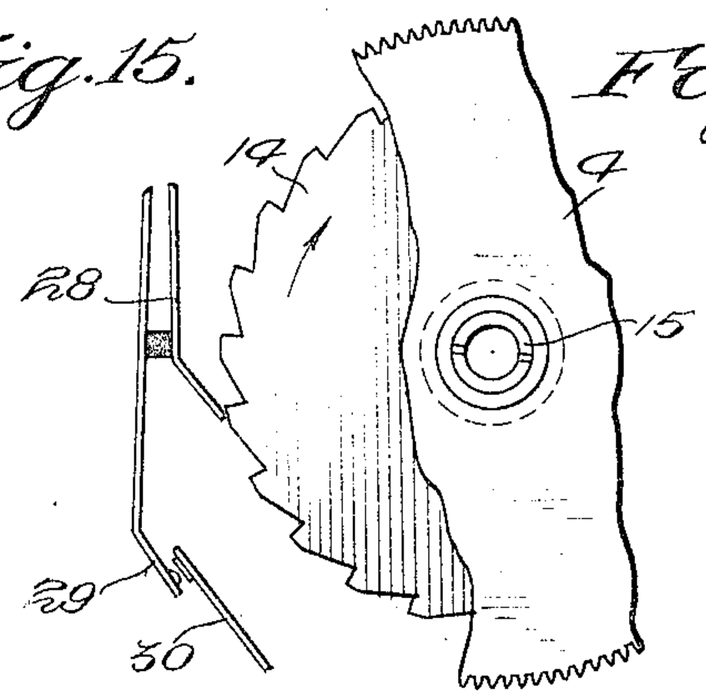

Fig. 16.

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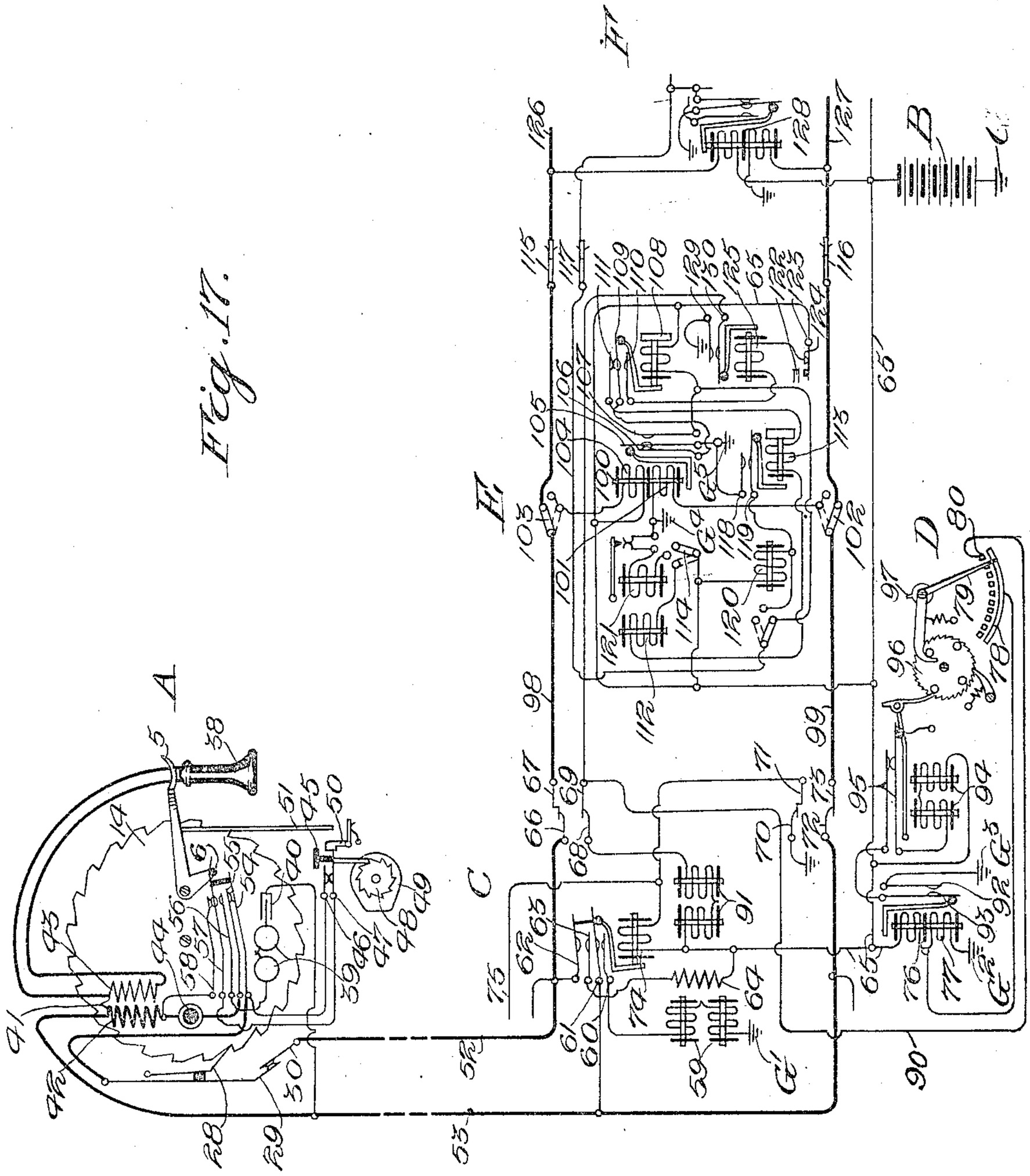
TELEPHONE SYSTEM.

APPLICATION FILED DEC. 18, 1908. RENEWED MAY 29, 1916.

1,209,825. Patented Dec. 26, 1916.

5 SHEETS—SHEET 5.

Fig. 17.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

1,209,825. Specification of Letters Patent. Patented Dec. 26, 1916.

Application filed December 18, 1908, Serial No. 468,141. Renewed May 29, 1916. Serial No. 100,702.

To all whom it may concern:

Be it known that I, JOHN ERICKSON, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Telephone Systems, of which the following is a specification.

My invention relates to automatic or semi-automatic telephone exchange systems in general, but more particularly to those in which the substations are provided with rotary calling dials, and especially to systems in which the said dials are used for controlling the operations of switches that have one motion to select groups and another motion to connect with a line in any selected group, as, for example, selectors that have one motion to select groups or divisions of the exchange and another motion to automatically select an idle trunk line in the group or division selected by the calling subscriber, or a connector that operates in the same manner, except that its second motion is under the control of the calling subscriber to seize or find the called line.

An object of my invention, broadly speaking, is to provide an improved arrangement whereby the dial cannot be forced or so manipulated as to accelerate the impulse-transmitting mechanism, and which will make the proper transmission of the impulses a matter of greater certainty, especially in cases where the subscribers are inclined to be careless about the way in which they use the calling dials.

More specifically considered, an object of my invention is to provide a calling dial which can only rotate in one direction, and which is operatively connected with the impulse-transmitting mechanism, whereby the dial cannot be forcibly turned backward to unduly accelerate the transmission of electrical impulses.

Another object is to provide a measured-service system of such character that the calling subscriber is required, by means of improved mechanism, to remove a short-circuit or shunt from around his transmitter, and to thereby register the call, before he can converse with the called subscriber.

To these and other useful ends my invention consists in matters hereinafter set forth and claimed.

In the accompanying drawings Figure 1 is a front elevation of the keyboard, showing the rotary dial. Fig. 2 is a rear elevation of the keyboard. Fig. 3 is a side view thereof as seen from the right in Fig. 1 Fig. 4 is a cross-section on line 4—4 in Fig. 2. Figs. 5, 6, 7, 8, 9, 10, 11, 13, 14, 15 and 16 are detail views of the keyboard mechanism. Fig. 12 shows a switch-hook spring combination. Fig. 17 is a diagram of the substation A comprising a keyboard of the character shown in the preceding figures. Said substation is connected with automatic switching apparatus in a central office, said apparatus being of the character designed to be operated by the said keyboard, the said switching apparatus, as shown, comprising a line switch C, a controlling master switch D and a first-selector E, and there being a central battery B for supplying all operating and talking current.

My improved calling device comprises a dial guard *l* upon which there are placed numbers for aiding the subscribers in selecting the proper finger-hole in the dial 2. The calling device also comprises the usual governor 3, gear wheel 4, and switch-hook 5 which controls the switch-hook springs (Fig. 12) by means of the cam arm 6 (Fig. 2).

In Fig. 4 is shown how the rotatable parts are mounted upon the shaft 7. The dial 2 is secured to the hub 8, but the hub in turn is loosely mounted upon the shaft 7, so that the dial may be turned without rotating the shaft. One end of a coil spring 9 engages a slot 10 in the hub 8 (Fig. 8). The other end of this spring is secured to the spring box 11, to which latter is also fastened the impulse wheel ratchet 12. The members 11 and 12 are firmly secured to the shaft 7, and hence when the ratchet wheel 11 is turned the shaft and all the parts secured thereto are rotated. Also fastened to the dial on the inner side is the dial ratchet wheel 13. The gear wheel 4, together with the impulse-transmitting wheel 14, are secured to the hub 15, and the hub 15 in turn is rigidly fastened to the shaft 7 by a screw clamp 16. The shaft 7, carrying all the parts secured thereto, is adapted to rotate in bearings in the front and back plates 17 and 18. The pawl 19, which controls the ratchet wheel 13 (Fig. 9) is pivotally secured to the link 20 at the point 21, and the link 20, which is provided with the arm 22, is pivotally mounted on the front plate 17 at the point 23. The special spring 24 provides the ten-

sion for the pawl 19 and arm 22. The lever 25, which is pivoted at the point 26, is arranged to normally engage the ratchet 12 when the dial is turned forward.

In Fig. 9 the parts are shown in their normal relative positions, the dial and ratchet wheel being at rest. In Fig. 10 there are shown the positions these same parts assume when the dial, to which is secured the ratchet wheel 13, is turned in the direction indicated by the arrow. Since there is spring-connection between the dial and ratchet wheel 13 with the wheel 12, there is a tendency for this latter wheel to follow in the direction of the dial, but this is not permitted by the lever 25 at this time. In Fig. 11 there are shown the relative positions these parts assume when the dial is released. When the dial is released the wheel 13, which is rigid with the dial, due to the tension placed on the spring 9 (Fig. 4), tends to rotate in a direction opposite to that indicated in Fig. 10. A tooth 27, however, immediately engages the pawl 19 and carries the latter back a trifle, thereby moving the pawl 19 and link 20 against the tension of the spring 24 about the point 23. When this occurs the arm 22 presses against the outside lip of the lever 25, thereby carrying the latter out of engagement with the ratchet wheel 12. The wheel 12 and shaft 7 then respond to the tension in the coil spring 9 (Fig. 4) and move in the direction indicated by the arrow in Fig. 11. The dial ratchet wheel 13 remains locked at this time. Upon the other end of the shaft 7 (as shown in Fig. 4) is mounted the impulse wheel 14 and gear wheel 4, as explained. The impulse wheel 14, in turning counter-clockwise (Figs. 15 and 16), presses against the spring 28, thus separating the impulse springs 29 and 30 each time a tooth passes the spring 28. When the dial is turned, as explained, the stop screw 31 upon the wheel 13 (Fig. 6) is carried away from the member 32, and when the dial is released the shaft 7 and all the parts secured thereto follow or rotate in the same direction as the dial until the member 32 reaches the stop screw 31 (Fig. 7). The distance or arc that the stop screw advances from the member 32 is accurately and definitely determined by the finger-holes in the dial. Therefore, when the dial is turned for the digit 5 the stop screw 31 is advanced through an arc such that the member 32, in coming to normal position again, permits the impulse wheel 14 (Fig. 15) to break the normal contact between the springs 29 and 30 five times. The gear wheel 4 engages the pinion of the governor 3, which latter controls the rapidity with which impulses are transmitted.

In Figs. 13 and 14 it will be seen that there are two notches or positions in the lever 33 for the end of the switch-hook 5. This provision is made in order that certain telephone circuits may be controlled through the switch-hook springs. When the receiver is removed from the switch-hook the end of the latter occupies the position shown in Fig. 13, and when the dial comes to rest after a digit has been called the switch-hook rests in the position shown in Fig. 14. This operation is brought about as follows: When the receiver is removed the end the switch-hook rests in the notch 34. Normally, however, before the receiver is removed, the switch-hook rests against the stop 35. After the dial is turned and then comes to rest, the pawl mechanism, as explained, presses the lever 25 out of engagement with the ratchet wheel 12. Also, when this happens the finger 36 upon the lever 25 presses the lever 33 outwardly a trifle (Figs. 11, 13 and 14), thereby permitting the switch-hook 5 to fall to the notch 37.

In the foregoing the mechanical construction and arrangement of the different parts of my calling device have been explained. It will now be pointed out how the calling device may be used in connection with a subscriber's telephone for operating the switches of an automatic central office. As shown in Fig. 17, the substation A comprises, in addition to the calling device, the receiver 38, ringer 39 in series with the condenser 40, an induction coil 41 comprising the primary winding 42 and secondary winding 43, and a transmitter 44.

In Figs. 12 and 17 the switch-hook spring combination is arranged for the operation of a meter or registering device at the telephone. If the meter or registering device is not used, then the two lower springs 54 and 55 are not used, and the switch-hook spring combination is the same as shown in Figs. 1, 2 and 3. In addition there is shown a meter or registering mechanism consisting of the push-button 45 which, when pressed, disengages the springs 46 and 47 and also moves the ratchet wheel 48 of the meter 49 one step. Furthermore, when the button is thus operated the pawl 50 falls over the end of the spring 47 and locks the latter in its operated position until the receiver is restored to the switch-hook, thereby unlocking the push-button spring when the rod 51 engages the pawl 50. The line conductors 52 and 53 of the substation A terminate in the line switch C, which is of the general type of line switch disclosed in English Patent No. 26,301 of 1906, and in the *Western Electrician* published at Chicago, Illinois, U. S. A., January 25, 1908. The controlling master switch D is also disclosed in the above references. The selector switch E is of the general type of selector switch shown in United States Letters Patent No. 815,321, issued to Keith, Erickson and Erickson March 13, 1906. As shown in

Fig. 17, all of the switches and the telephone A are wired with circuits such that they will operate on a two-wire system—that is, there is no operating ground at the subscriber's station, the impulses being made by opening and closing the two line conductors in series, so that the ground connections are employed at the central office only. When the subscriber removes the receiver 38 from the switch-hook 5 the springs 54 and 55 engage and the springs 56 and 57 disengage. The spring 57, however, does not engage the spring 58 until the dial is turned, when the switch-hook 5 engages the lower notch 37 (Fig. 14) as explained. The engagement of the springs 54 and 55 closes an energizing circuit through the trip magnet 59 of the line switch C. This circuit extends from ground G′ at the line switch through the trip magnet 59, bridge-cut-off springs 60 and 61 to the line conductor 53, through the primary winding 42, transmitter 44, springs 55 and 54, impulse springs 29 and 30 to the conductor 52, bridge-cut-off springs 62 and 63, resistance coil 64 to the battery lead 65, thence through battery B to ground G. The trip magnet 59, upon energizing, attracts its armature and permits the plunger to engage an idle bank terminal, thereby pressing the springs 66 and 67, 68 and 69, 70 and 71, and 72 and 73 into contact. The engagement of the springs 70 and 71 establishes and energizing circuit through the bridge-cut-off relay 74 which operates to disconnect the line conductors 52 and 53 from the line switch connections. Also, when the springs 70 and 71 engage, then a positive guarding potential is established over the conductor 75 at the connector private bank contact corresponding to the line of substation A. The engagement of the bank springs 68 and 69 closes an energizing circuit through the motor magnet relay 76 of the master switch D. This circuit extends from ground G^2 through the winding 77 to the common segment 78 of the master switch bank wiper 79, to the individual contact 80 (assuming that this contact corresponds to the bank terminal just engaged by the line switch C), conductor 90, bank springs 69 and 68, winding of the release magnet 91 to the battery lead 65, thence through battery B to ground G. Although this circuit includes the windings of the release magnet, the said magnet does not operatively energize, since the winding 77 of the relay 76 is of such comparatively high resistance that a very small current is flowing. The relay 76, upon energizing, presses the springs 92 and 93 into contact, thereby closing an energizing circuit through the motor magnet 94 extending from ground G^3 through the springs 92 and 93, interrupter spring 95, motor magnet 94 to the battery lead 65, thence through battery B to ground G. The motor magnet energizes and operates the ratchet wheel 96 one step, assuming the next trunk line is idle, whereby the shaft 97 carries the idle plungers opposite the next idle bank terminal and the wiper 79 into engagement with the individual contact corresponding to the idle trunk. The engagement of the bank springs 66 and 67 and 72 and 73 extends the substation line conductors 52 and 53 to the trunk line conductors 98 and 99, respectively, which lead to the selector switch E. An energizing circuit is immediately closed through the line relay 100 extending from ground G^4 through the winding 101, side switch wiper 102, conductors 99 and 53, through the substation to the conductors 52 and 98, side switch wiper 103, winding 104 to the battery lead 65, thence through battery B to ground G. This line relay energizes and separates the spring 105 from the spring 106, and closes the springs 105 and 107 in contact. The engagement of the latter springs closes an energizing circuit through the slow-acting release relay 108 which operates to in turn carry the spring 109 out of engagement with the spring 110 and into engagement with the spring 111. The line relay 100 remains in this energized position as long as the line at the substation is closed, but when the dial is rotated, and in turn the impulse wheel 14, the impulse springs 29 and 30 are then separated momentarily, thereby intermittently breaking the energizing circuit of the line relay 100. The deënergizing of the line relay 100 permits the spring 105 to engage the spring 106, thus closing a circuit through the vertical magnet 112. This circuit extends from ground G^5 through the springs 105 and 106, springs 109 and 111, private magnet relay 113, vertical magnet 112, side switch wiper 114 to the battery lead 65, thence through battery B to ground G. The vertical magnet energizes and operates to carry the shaft wipers 115, 116 and 117 in a vertical direction one step at a time for each impulse. Since the vertical magnet circuit includes the private magnet relay 113, it also energizes and places the springs 118 and 119 in contact, thereby closing a circuit through the private magnet 120 from ground G^5. The private magnet relay 113 energizes upon the first vertical impulse to the vertical magnet and, being slow-acting, remains in this energized position until all of the vertical impulses are set, and then, since the energizing circuit is no longer maintained, the relay 113 restores to normal position, breaking the energizing circuit for the private magnet 120 which operates to pass the side switch to second position. The side switch wiper 114, upon passing to second position, closes an energizing circuit through the rotary magnet 121 which operates in the usual

manner to carry the shaft wipers in a rotary or circular direction and into engagement with the bank contacts of an idle trunk line leading to the next succeeding switch. Furthermore, when the switch shaft is given a vertical step the normal arm 122 permits the spring 123 to engage the contact point 124, thereby connecting the main battery lead with one terminal of the release magnet 125. When the side switch wipers 103 and 102 pass to third position the line conductors 52 and 53 are extended to the shaft wipers 115 and 116, respectively, and to the trunk conductors 126 and 127, thereby closing an energizing circuit through the line relay 128 of the switch F in the same manner in which the circuit was closed through the line relay 100 of the switch E. The calling subscriber may operate the line relay 128 of the switch F in accordance with the next digit of the desired number. After having operated the dial for each digit and established connection with the desired line, the two subscribers may carry on communication. The subscriber at substation A, however, before he can successfully talk with the called party, must press the button 45, thereby separating the springs 46 and 47 and operating the meter one step, as explained. It will be seen that before the meter button is pressed there is a shunt around the transmitter 44 through the springs 58 and 57 to the spring 54. The calling subscriber, moreover, may hear the called party answer, but before the calling subscriber can reply, the transmitter shunt must be removed by pressing the button which registers the call. The meter mechanism, when once operated, remains in its operated position until the calling subscriber restores his receiver to the switch-hook and thereby unlocks the locking pawl 50. The restoration of the central office switching apparatus occurs when the calling subscriber restores his receiver to the switch-hook and opens the energizing circuit for the line relay of the connector switch. The line relay, upon deënergizing, breaks the energizing circuit for the slow-acting release relay, which in turn also falls back, thereby removing the ground potential from the private bank contact engaged by the private wiper 117. The removal of this ground also breaks the energizing circuit of the slow-acting relay 108 of the selector E. This relay then falls back, placing the spring 109 in contact with the spring 110, thereby closing an energizing circuit through the release magnet 125 extending from ground G^5 through the springs 105 and 106, springs 109 and 110, through the release magnet 125, normal springs 124 and 123 to the battery lead 65, thence through battery B to ground G. The release magnet, upon energizing, restores the switch shaft and side switch to normal position. When the switch shaft reaches normal position the normal arm 122 upon the shaft carries the normal springs 123 and 124 out of engagement, thereby breaking the energizing circuit for the release magnet. The release magnet, when energized, holds the springs 129 and 130 in contact, thus closing the energizing circuit for the release magnet 91 of the line switch C. The release magnet 91 energizes and operates the release mechanism to withdraw the plunger from the bank terminal and permit the bank springs to restore to normal position. At the subscriber's station, when the receiver is restored, the switch hook springs return to normal position; also, the rod 51 presses the pawl 50 so that the meter button springs return to normal position.

From the foregoing it will be seen that there is no normal position for the dial and the impulse wheel—that is, the dial is rotated in one direction only, also the impulse wheel. When the dial is turned for any number, tension is placed in the dial coil spring. This tension is transmitted to the shaft, but the shaft is prevented from turning until the dial comes to rest, when a lever which holds the shaft locked is removed. The shaft being free then responds to the spring tension and rotates in the same direction that the dial was previously turned. The number of impulses transmitted is determined by the arc through which the dial is turned—that is, the impulse wheel, in response to the spring tension of the dial springs, rotates through an equal arc. It will be seen that the switch-hook 5 is permitted to pass from the position shown in Fig. 13 to the position shown in Fig. 14 by the action of the lever 25. This lever 25, by being pressed away from the gear 12, as shown in Fig. 11, through the medium of the pin 36, presses the catch 33 away from the switch-hook 5, thus permitting the said switch-hook to pass from one position to the other.

In the foregoing reference has been made to connector switches. It should, therefore, be stated that connector switches with which the selector E is adapted to establish connection for completing the circuit between the calling and called subscribers are of the general type disclosed in United States Letters Patent No. 815,176, issued March 13, 1906, to Keith, Erickson and Erickson. More particularly, however, the connector switches in this system are adapted to the particular character of system and circuits herein disclosed.

It will be seen that I provide a rotary impulse wheel and a rotary calling dial operatively connected together in such manner that the dial rotates first and the impulse wheel afterward, the rotation of the wheel always being coextensive with and determined by the rotation of the dial. The dial

is rotated for the different digits of the called number, and at the end of each rotation the impulse wheel is released and allowed to catch up with the dial—that is to say, the wheel and the dial are always normally in the same relation to each other, notwithstanding that the dial is rotatable while the wheel is standing still. The dial and the wheel rotate successively, one after the other, and the rotation of the wheel always corresponds in degree to the rotation of the dial. The dial rotates ahead, drawing away from the wheel, so to speak, but as soon as it stops the wheel is then released and allowed to catch up and regain its normal position relative to the dial. Thus the dial and the wheel rotate always in the same direction, the dial rotating first and the wheel afterward, the release of the wheel being effected by a very slight back rotation of the dial. Obviously, however, the dial is never rotated backward to an extent to bring it to its normal position. In view of its continuous rotation always in the same direction the dial is, therefore, provided with an endless series of finger-holes adapted to be used in the manner described. It will also be seen that the calling subscriber, after establishing connection through the automatic apparatus to the called line, cannot then converse with the called subscriber until after he has removed a short-circuit or shunt from around his transmitter. When the calling subscriber does this he at the same time registers the call, or collects the coin or check. For the broader purposes of my invention the measured-service device may be of any suitable character—that is to say, it may be a coin or check controlled mechanism or a call-registering device of any suitable, known or approved character. Whatever it may be, however, the use of the calling subscriber's transmitter to converse with the called subscriber is contingent upon the operation of such device.

What I claim as my invention is:—

1. In a calling device, an electrical impulse-transmitting mechanism, a rotatable dial connected for operating said mechanism, means for permitting the dial to rotate backward only a portion of its forward rotation, and means governed by the said limited backward rotation of the dial for causing the said mechanism to transmit the impulses.

2. In a calling device, an electrical impulse-transmitting mechanism, a dial rotatable to cause the operation of said mechanism, and means for preventing said dial from returning to normal position, the latter having an impulse wheel rotatable only in one direction.

3. In a calling device, a rotary impulse wheel, a calling dial connected for operating said wheel to transmit a plurality of series of impulses, means for preventing said dial from returning to normal position during said operation, means operative to cause the wheel to rotate in the same direction as the dial, after the latter has reached the limit of its rotation, and means for limiting the rotation of the wheel to the distance traveled by the dial, whereby the dial rotates first and the wheel afterward in the same direction.

4. In a calling device, a rotary impulse wheel rotatable in but on direction, a calling dial having no normal position, a spring arranged to be placed under tension by the forward rotation of the dial, and means for then permitting said spring to rotate the wheel in the same forward direction when the dial is released.

5. In a calling device, a manually-operated dial and an impulse wheel rotatable only in one direction, a spring for rotating the wheel a distance each time equal to the forward rotation of the dial, means for holding said wheel against rotation, and means for automatically releasing the wheel when the dial is released, whereby the dial and wheel always rotate successively and in the same direction.

6. In a calling device, an electrical impulse-transmitting mechanism rotatable in but one direction, a dial connected for operating said mechanism, and means for preventing said dial from rotatively returning to normal position when rotated forward to operate the said mechanism.

7. In a calling device, an electrical impulse-transmitting mechanism rotatable in but one direction, a rotatable dial connected for operating said mechanism, means for permitting the dial to rotate backward only a portion of its forward rotation, and means governed by the said limited backward rotation of the dial for causing the said mechanism to transmit the impulses.

8. In a calling device, an electrical impulse-transmitting mechanism, a dial rotatable to cause the operation of said mechanism, and means for preventing said dial from returning to normal position, the latter having an impulse wheel rotatable only in one direction, said dial including an endless series of finger holes.

9. In a calling device, an electrical impulse-transmitting mechanism comprising an impulse wheel, a dial connected for operating said wheel, said wheel rotatable in but one direction, means whereby a plurality of successive operations of said dial will operate said impulse wheel to transmit a plurality of series of impulses, and means for preventing said dial from returning to normal position during said operation.

10. In a calling device, a dial, an impulse wheel, a spring for rotating the wheel a distance each time upon the forward rota-

tion of the dial, means for locking said impulse wheel against rotation, and means controlled by the dial for releasing said wheel, whereby the dial and wheel rotate successively.

11. In a calling device, a dial, an impulse wheel, a spring for rotating the wheel a variable distance in accordance with the rotation of the dial, means for locking said impulse wheel against rotation, and means controlled by the dial for releasing said wheel, whereby the dial and wheel rotate successively.

12. In a calling device, an impulse transmitter comprising a dial and an impulse wheel, the dial having no normal position, a spring for rotating the impulse wheel a distance in accordance with the variable forward rotations of the dial, means for locking said impulse wheel against rotation, and means controlled by the dial for releasing the impulse wheel.

13. In a calling device, a dial provided with a continuous line of finger holds, an impulse wheel, means for rotating the impulse wheel a variable distance in accordance with the forward rotation of the dial, means for locking the said impulse wheel against forward rotation, and means controlled by the dial for releasing the impulse wheel, whereby the dial and wheel rotate successively.

14. In a calling device, a dial provided with a continuous line of finger holds, an impulse wheel rotatable only in one direction, connecting means between the impulse wheel and the dial for rotating the wheel a distance each time upon the forward rotation of the dial, means for locking the impulse wheel against rotation, and means controlled by the dial for releasing the impulse wheel.

Signed by me at Chicago, Cook county, Illinois, this 8 day of Dec., 1908.

JOHN ERICKSON.

Witnesses:

EDWARD D. FALES,

A. ANDERSEN.