B. D. WILLIS.

MEASURED SERVICE TELEPHONE SYSTEM.

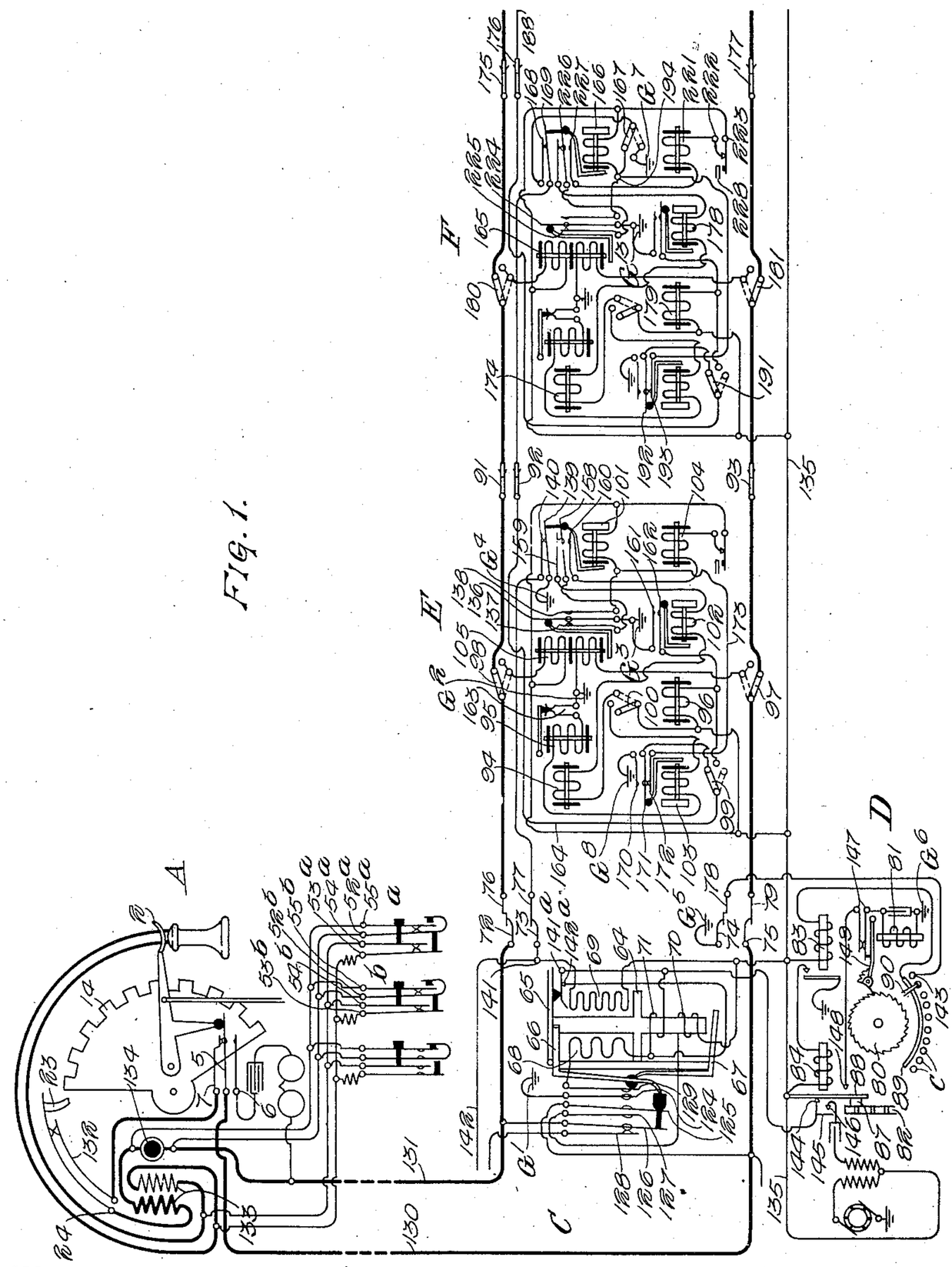
APPLICATION FILED AUG. 5, 1910.

1,186,462

Patented June 6, 1916.

6 SHEETS—SHEET 1.

FIG. 1.



WITNESSES

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6 SHEETS—SHEET 2.

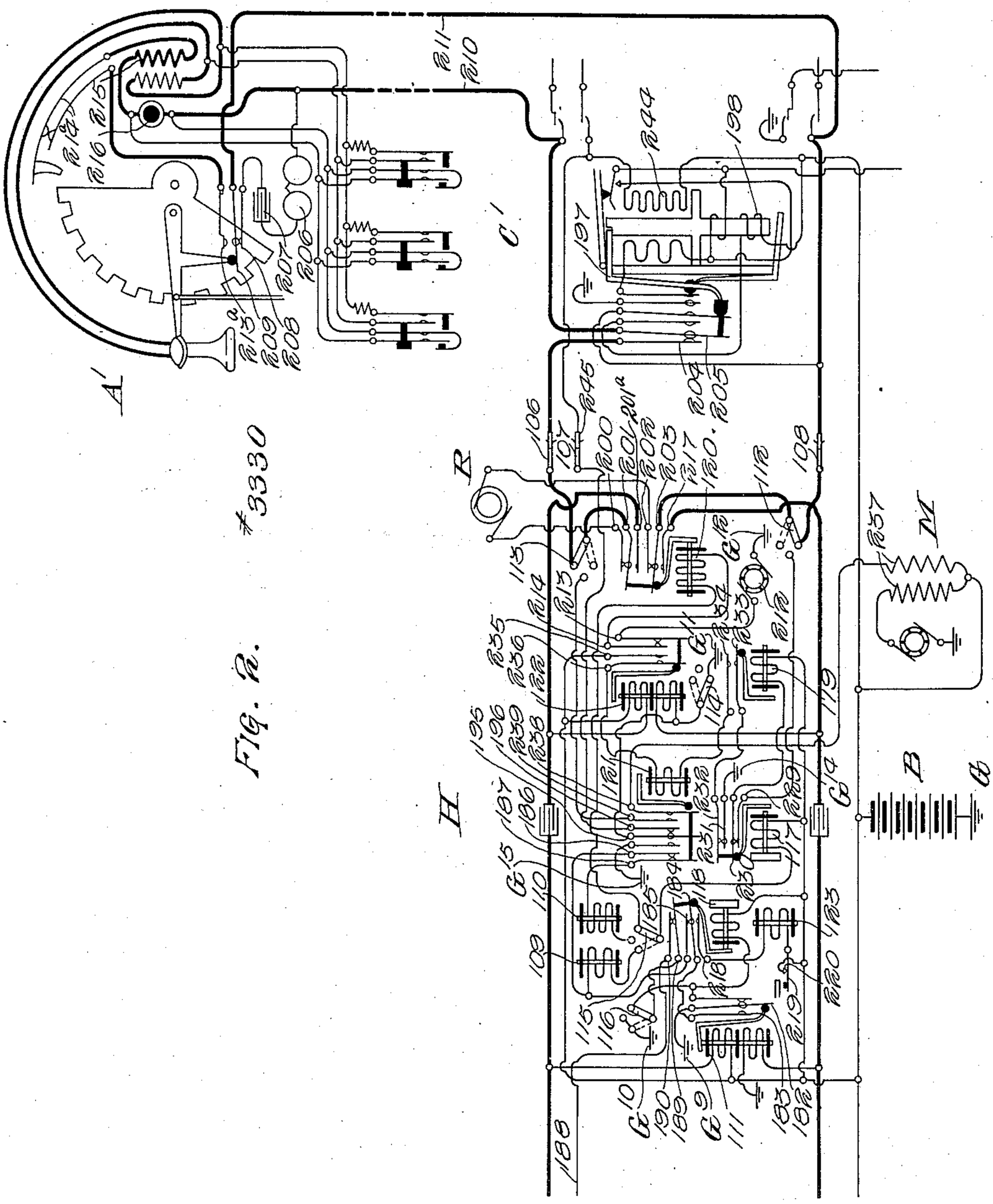

FIG. 2.

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6 SHEETS—SHEET 3.

FIG. 3.

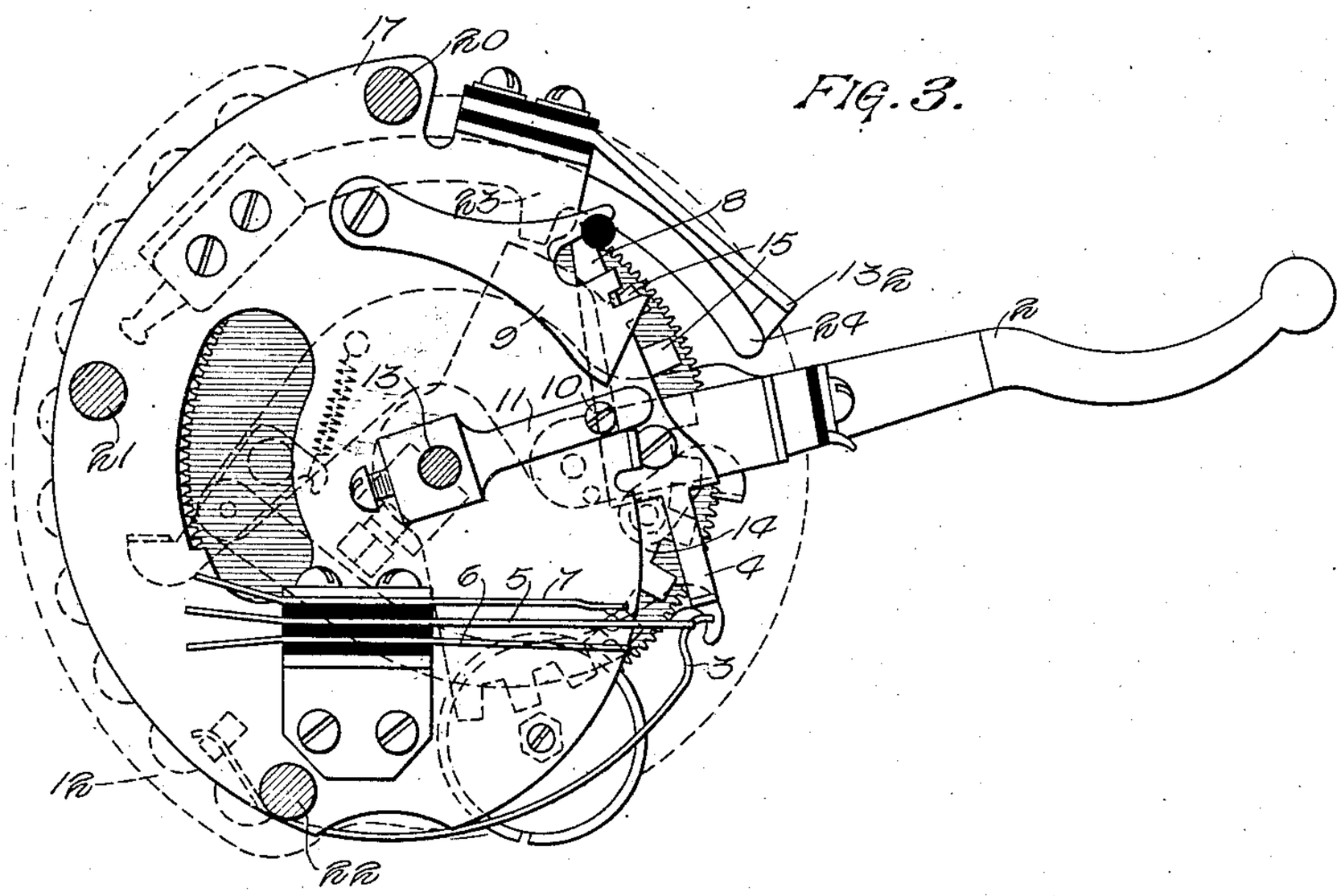
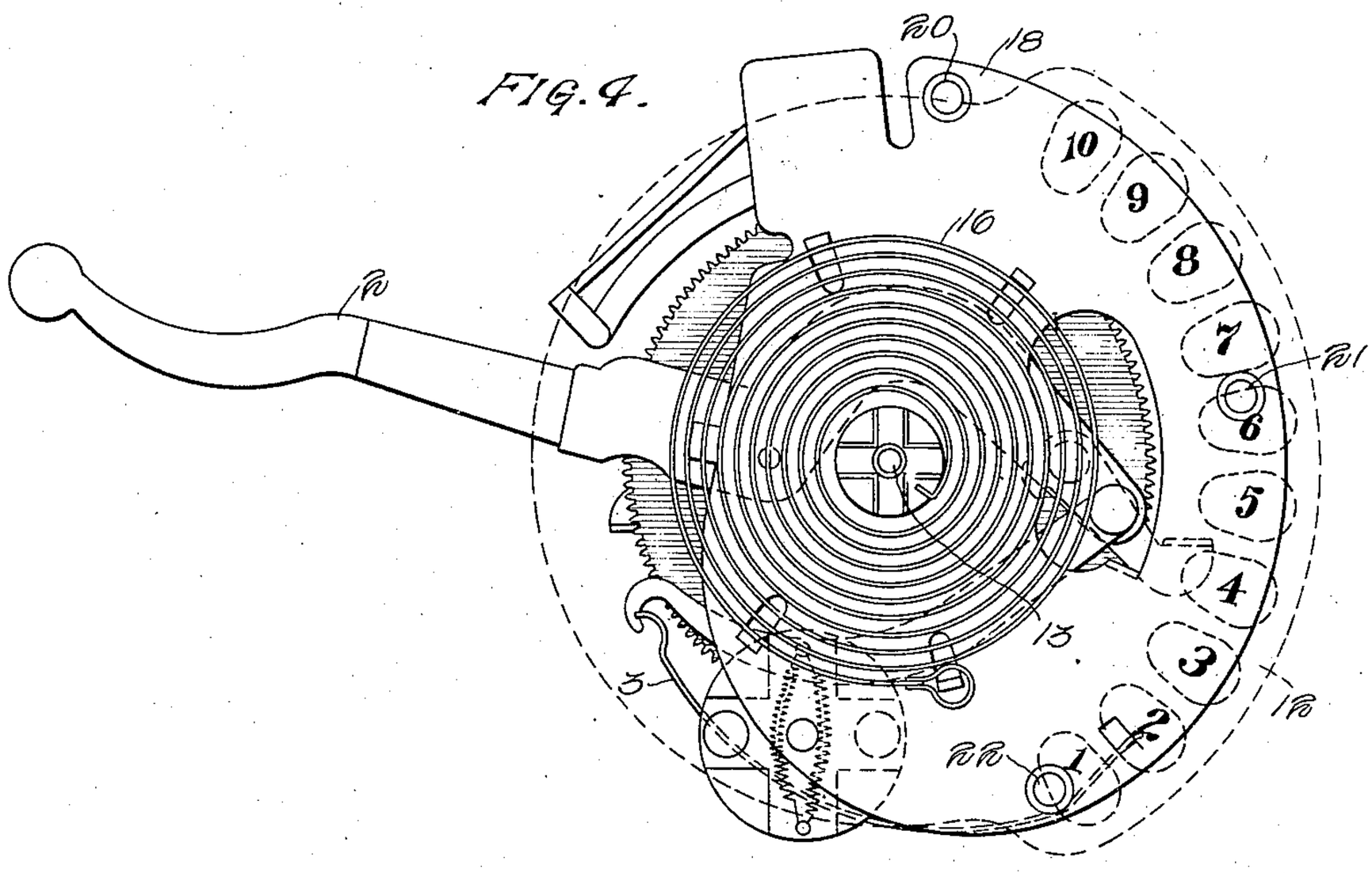


FIG. 4.



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6 SHEETS—SHEET 4.

FIG. 9.

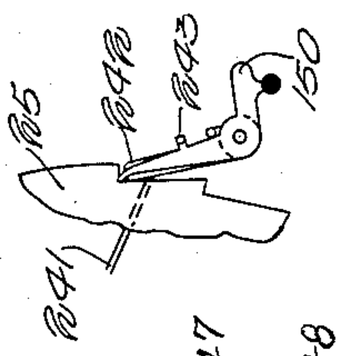


FIG. 10.

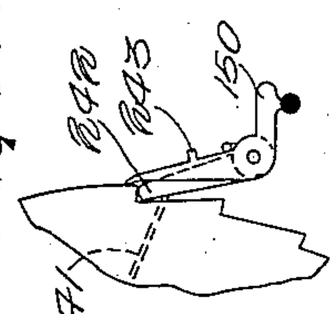


FIG. 6.

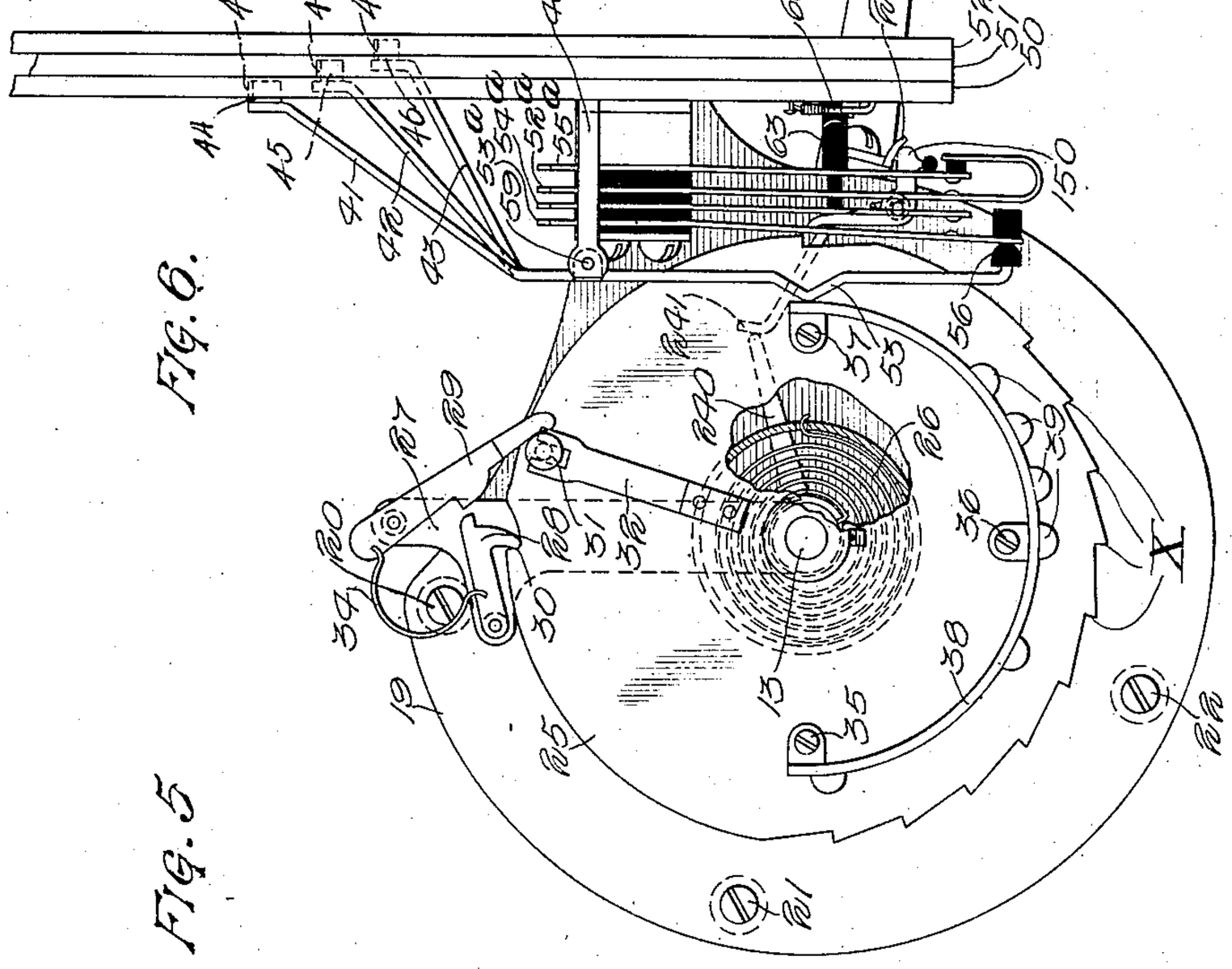
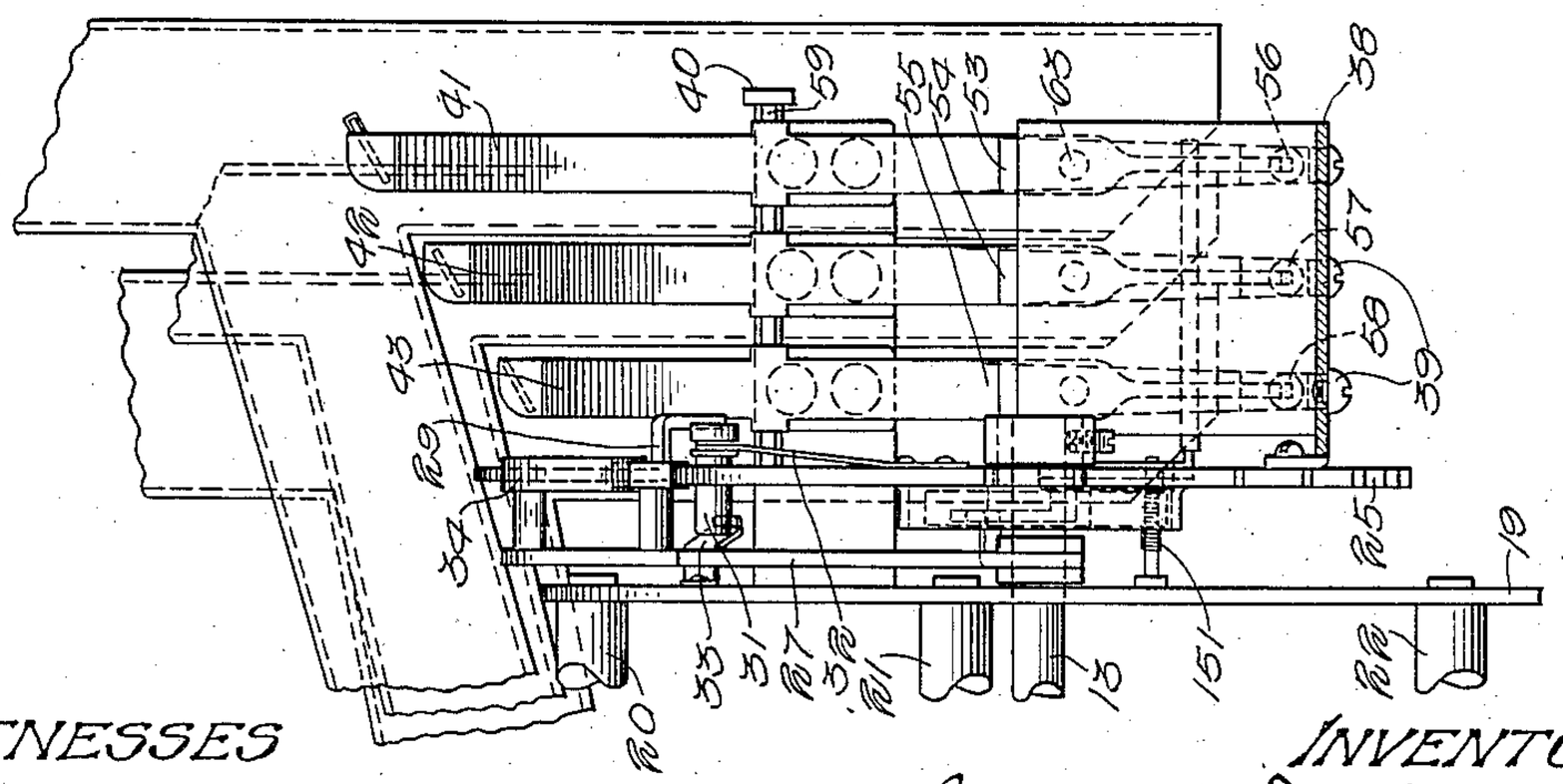


FIG. 5



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6 SHEETS—SHEET 5.

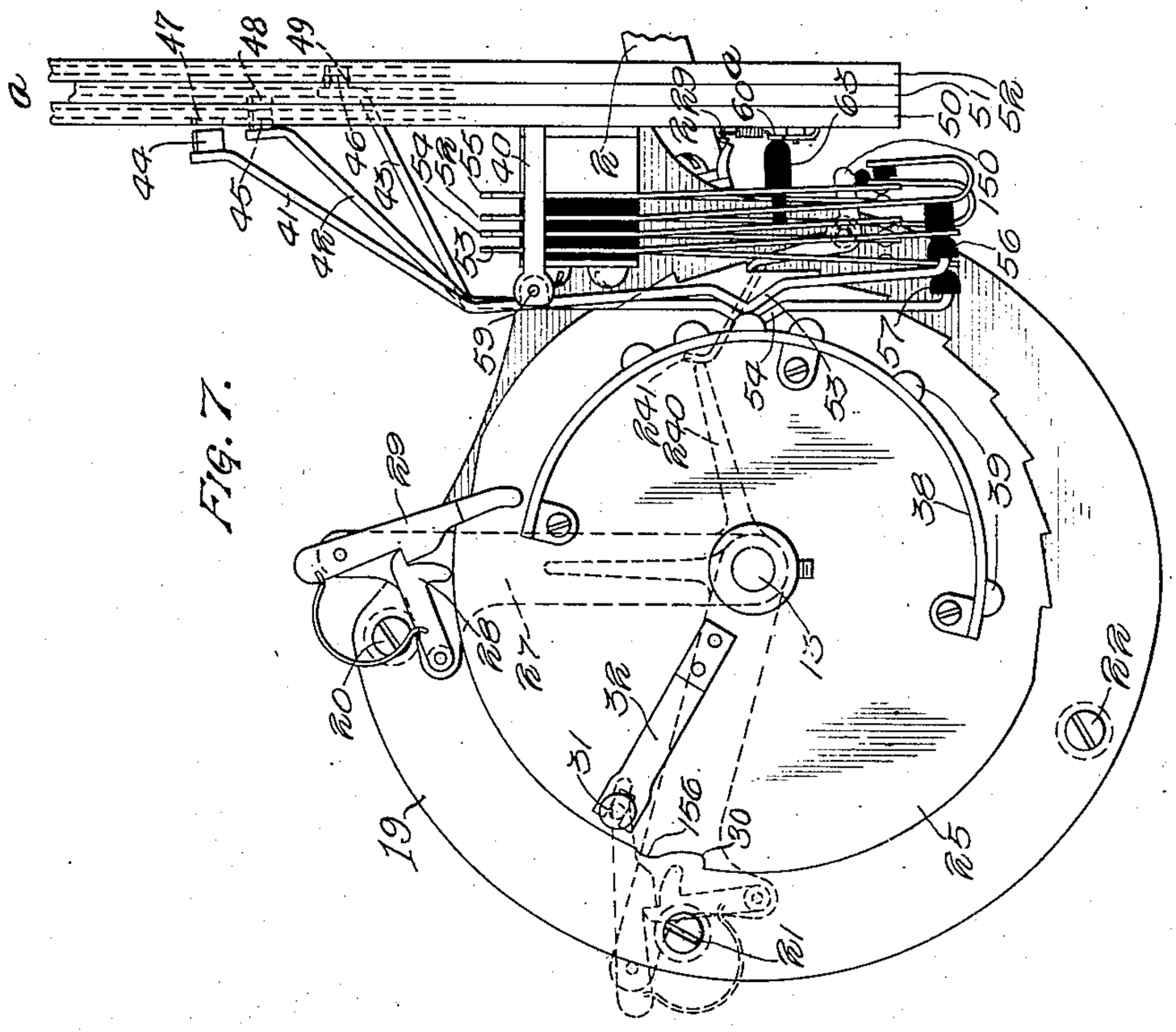

FIG. 7.

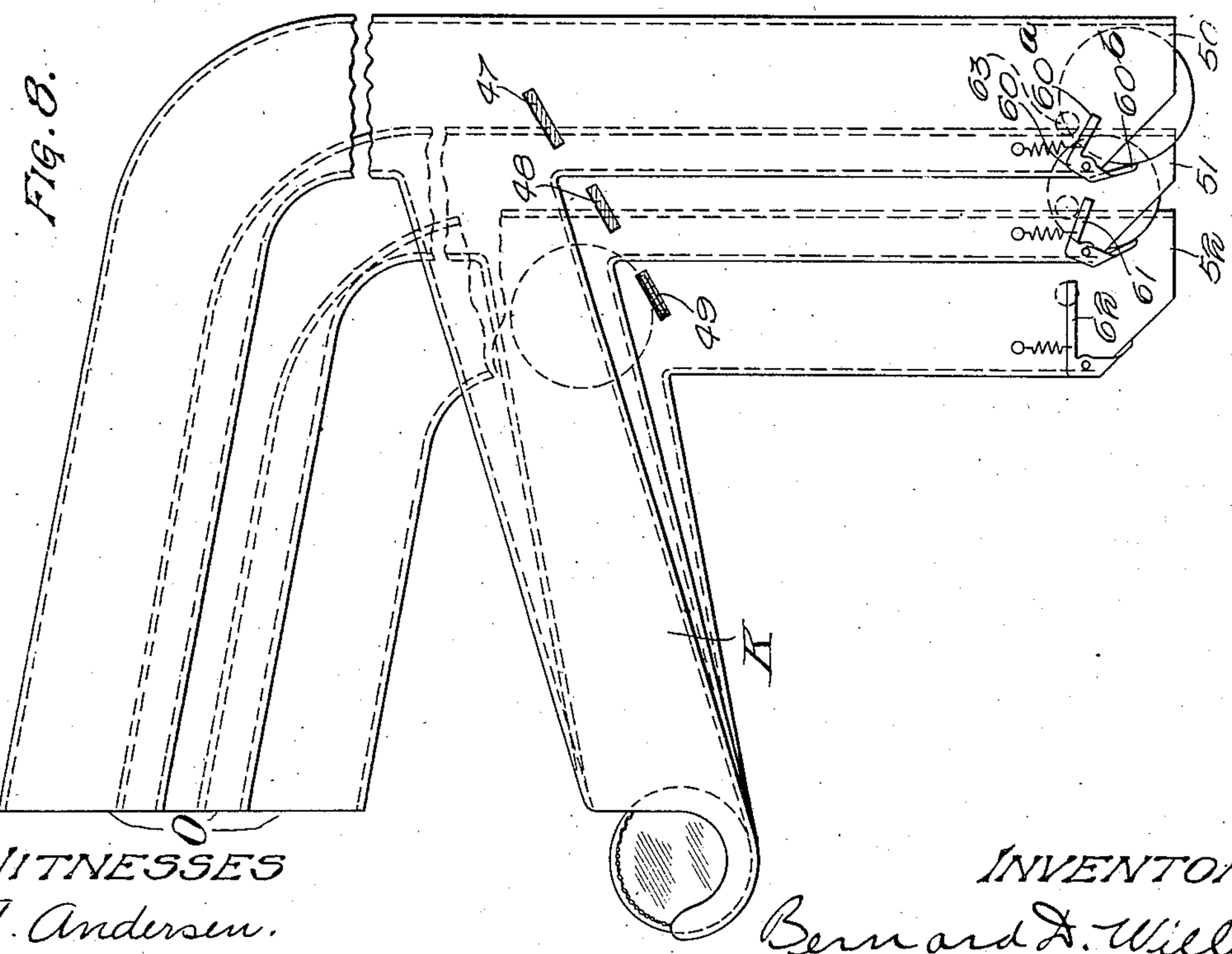

FIG. 8.

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6 SHEETS—SHEET 6.

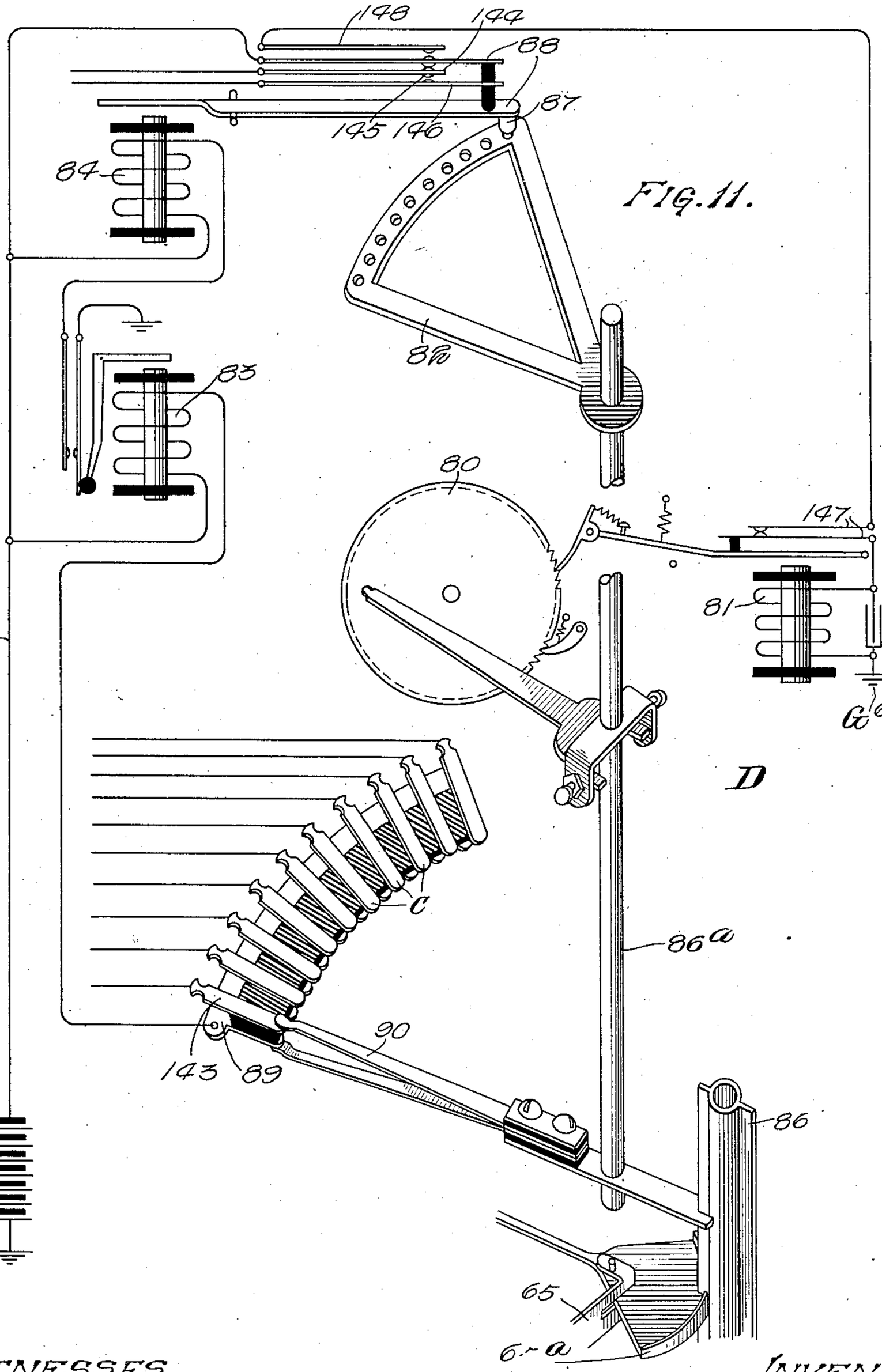

FIG. 11.

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MEASURED-SERVICE TELEPHONE SYSTEM.

1,186,462. Specification of Letters Patent. Patented June 6, 1916.

Application filed August 5, 1910. Serial No. 575,749.

To all whom it may concern:

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

My invention relates to measured service telephone exchange systems of that kind in which the connections are made either automatically or semi-automatically through the medium of switching apparatus of any suitable character. In systems which are purely manual—that is to say, in which the connections are all made by operators—it is old and very common to employ measured service devices of such character that different rates of toll can be assessed for different calls. A well known and familiar instance of this kind is the pay-station device that has three slots, one for nickels, the second one for dimes and the third for quarters, whereby the user of the telephone pays one rate for a local call and a higher rate for a long distance call. In a purely manual system of this kind the calling subscriber is instructed by the operator as to what the rate will be for the call, and is told to drop either a nickel or a dime or a quarter, depending upon the character of the call.

In an automatic system, or a semi-automatic system, in which all or at least a portion of the calling connection is established by the calling subscriber, the problem of a differential rate for measured service is not so easy, and this is especially true in a system in which the calling subscriber must establish the entire calling connection without the assistance of a single operator. However, in a system embodying the principles of my invention the connection may be made either automatically or semi-automatically, as the measured service device at the calling substation is controlled automatically and not by an operator, and is of such character that it automatically assesses toll in accordance with the character of the call, the rate being different for different calls. I accomplish this by combining the calling mechanism and the measured service devices at the substation in such manner that all calls which have the same first digit have the same rate—that is to say, any number which begins with the digit 1 may be called for five cents; any number that begins with the digit 2 may be called for ten cents; and a call for any number which begins with the digit 3 may require the deposit of a quarter in the mechanism. It is not necessary that all calls which have the same rate begin with the same digit, either at the same or different substations; but all calls which begin with the same digit must have the same rate. For example, all calls beginning with the digit 1 may be made for five cents, and in addition a deposit of five cents may also be required for all calls beginning with the digits 4, 5, 6, or any other digit which is not reserved for some other rate, and this can be true whether the said calls come from the same or different substations. The mechanism may also be arranged so that numbers beginning with certain digits may be called free—that is, without requiring the deposit of any coin at all. In this way the control of the measured service devices is entirely automatic, the toll being assessed in accordance with the value of the first digit of any called number and, therefore, in accordance with the extent of operation of the calling mechanism for such first digit. As will hereinafter more fully appear, the operation of the calling mechanism for the first digit not only controls the measured service device, but also, and through the medium of said device, controls the telephone instruments, whereby the calling subscriber cannot converse with the called subscriber in any way whatever until after the proper toll has been assessed, either by the deposit of a coin or the actuation of a coin register by the calling subscriber. As herein disclosed, the measured service mechanism takes the form of three coin controlled devices, one for each different rate of toll, whereby the calling subscriber cannot converse with the called subscriber until after the proper coin has been deposited in the said mechanism. It is obvious, however, that the calling subscriber may, instead of depositing a coin, simply push a button or perform some other operation which will register the call. In other words, there may be as many call registering devices as there are rates of toll to be assessed at the substation. It is evident that these and other variations may be employed without departing from the spirit of my invention.

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

In the accompanying drawings Figures 1 and 2 taken together represent diagrammatically a complete circuit connection established between two automatic substations in a system embodying the principles of my invention. Fig. 3 is a back elevation of the substation calling device in connection with which I have elected to illustrate my invention. Fig. 4 is a front elevation of the same device, with the apertured dial removed, showing in detail the spring which serves to rotate the dial backward. Fig. 5 is a side elevation of my improved coin-collecting device and a portion of the calling device which is used in conjunction therewith. Fig. 6 is a back view of the same apparatus, showing the calling device in normal position. Fig. 7 is a similar view showing the calling device operated; and also shows the coin-collecting device operated in readiness to receive two coins of different denomination. Fig. 8 is a side elevation of the coin chutes or troughs shown at *a*, Fig. 7. Figs. 9 and 10 are detailed views of the mechanism used in locking the ratchet wheel 25 in an operated position. Fig. 11 is a diagrammatic view of the essential features of the master switch D (Fig. 1).

I will first briefly describe the operation of the calling device shown in Figs. 3 and 4. The calling device is of the general type shown in Patent No. 909,382, issued to John Erickson, Jan. 12th, 1909, but is specially modified to operate in a system in which the switches at the central office are operated by impulses delivered over the two sides of the line in series, instead of being sent from ground over each side of the line separately. The switch hook spring assembly, releasing assembly and impulse devices are modified accordingly. Secured rigidly to the rear of the calling device by means of pins 20, 21 and 22 is the plate 19 shown in Figs. 6 and 7. The main shaft 13 extends through said plate 19 and is rotatably mounted. A detailed description of above apparatus will hereinafter follow. Assuming, for example, that the subscriber desires to call the digit 5, he first removes the receiver from the hook 2. The hook then rises, being forced up by spring 3. As the switch hook rises the cam arm 4, which is securely fastened thereto, also rises and permits spring 5 to disengage spring 6 and engage spring 7, the function of which will be hereinafter more fully explained. The cam arm 8 is also secured to the switch hook 2 and in rising strikes the locking dog 9, forcing it from behind the pin 10 on the end of the cam 11, thereby permitting the shaft 13 to be rotated. The subscriber, having removed the receiver, now inserts a finger in hole number 5 in the dial, shown dotted at 12. This dial, which is secured to the shaft 13, is then rotated in a clockwise direction until the finger strikes a finger stop (not shown). The impulse wheel 14, which carries on its periphery the so-called impulse teeth 15, is also secured to the shaft 13. Therefore, as the dial is rotated for the digit 5, the impulse wheel rotates in the same direction until five of the teeth 15 are carried past the cam 23 on the impulse spring 24. The dial, upon being released by the subscriber, is forced back, due to the tension of the spring 16. As it rotates backward the teeth 15 strike the cam 23 on the spring 24, and forces springs 24 and 132 out of engagement, thereby opening the line to the central office five times.

The plates 17, 18 and 19 (Figs. 3, 4 and 6), which are securely held in a parallel position by the pins 20, 21 and 22, form a frame upon which the shaft 13 is rotatably mounted, and to which the various other parts of the apparatus are secured.

The coin slots shown in Fig. 8, and at *a* in Fig. 7, are securely fastened to the side of the box which incases the calling device and the coin-collecting device.

Referring now especially to Figs. 5 and 6, it will be seen that just back of the plate 19, and loosely mounted on the shaft 13, there is a disk 25 which has on its periphery notches X corresponding in number and position to the impulse teeth on wheel 14. Between this disk and the plate 19 there is securely fastened to the shaft 13 an arm 27, on the left outer end of which there is carried a pawl 28, held normally in engagement with the notch 30 in the disk 25. The locking dog 29, which is also secured to the extreme outer end of arm 27, is normally held away from the pawl 28 by the pin 31. This pin, being loosely mounted in the disk 25, is pressed down by the spring 32 as soon as the disk 25 is rotated far enough to carry pin 31 off the lug 33. Thus it will be seen that as soon as the dial is rotated forward the plate 25 is also rotated forward and the dog 29 is forced against the cam or ratchet 28 by the spring 34. The notch in the locking dog 29 will not engage the notch in the dog 28, however, until the dial starts to rotate backward. The arm 240 is also securely fastened to the shaft 13. The object of this arm is to press on the spring 241 which is securely fastened to the pawl 242 (Figs. 9 and 10) when the dial is in normal position. The pawls 150 and 242 both operate to hold the notched wheel 25 in an operated position. The operation of these pawls is as follows: The pawl or ratchet 150 is operated only by the receiver hook, while the pawl 242 has a spring projecting in the path of the arm 240. The pawl 150 also has a pin 243 which projects over the pawl 242, thus making it

impossible for the pawl 242 to operate without operating the pawl 150. The end of the pawl 150 is made so as to closely fit the notches in the ratchet wheel whereby it can only be disengaged by the receiver hook and not by the pressure on pawl 242, while the pawl 242 is so made that it does not closely fit the notches in wheel 25, whereby it may be made to operate by the pressure of the arm 240 against spring 241 when the dial is in normal position. Should the pawl 150 be disengaged from the notch in wheel 25, as shown in Fig. 10, then the pressure on the pawl 242 when the dial returns to normal position will operate both ratchets 150 and 242 to force them out of the path of the wheel 25. To the notched wheel 25 there is secured by means of the screws 35, 36 and 37 a semicylindrical plate 38, on the outer surface of which are placed the lugs or screws 39. Securely fastened to the side of the coin chutes and extending outward therefrom are the arms 40. To the outer ends of these arms there are pivoted the arms 41, 42 and 43. The upper portion of these arms are bent back toward the coin chutes and have on their upper ends the lugs 44, 45 and 46, which normally extend through the openings 47, 48 and 49 into the chutes 50, 51 and 52, respectively. The lower portion of each of the arms 41, 42 and 43 is provided with a projection (53, 54 and 55, Figs. 5 and 7) which, when the apparatus is in normal position, rests against the surface of plate 38. The extreme lower ends of the arms 41, 42 and 43 are provided with bushings 56, 57 and 58 preferably composed of insulating material. The projections 53, 54 and 55 are, when the dial is turned, engaged by the lugs 39 on the plate 38, whereby the arms are rotated about the point 59. The lower end of each arm serves to close two electrical circuits, while the upper ends withdraw the lugs from their respective openings in the chutes. For example, when the projection 53 on arm 41 is engaged by one of the lugs 39, the said arm is rotated so as to withdraw the lug 44 from the coin chute 50 and the lower end of said arm forces springs 53 and 52 into contact with springs 54 and 55, respectively, as shown in Fig. 7. The springs 54 and 55 are under tension, tending to move them away from springs 53 and 52, but is prevented from doing so by the bushing 63 which engages an arm 60^a of the member 60. The member 60 is provided with another arm 60^b which extends across the lower opening of the coin chute. If, now, a coin be dropped down the chute 50 it will proceed down the vertical portion thereof and, striking the arm 60^b, force the arm 60^a out of engagement with the bushing 63, thereby allowing the springs 54 and 55 to pass out of engagement with the springs 53 and 52. If a coin be accidentally dropped into a chute, the corresponding arm 41, 42 or 43 of which is not operated (the chute 52, Fig. 8, for instance), the coin will strike the lug 49 and be deflected into the inclined chute K and thereby returned to the subscriber.

The lugs 39 are placed in positions on the surface of the plate 38, depending upon which of the arms 41, 42 and 43 is to be depressed when a predetermined digit is called. If it be desired that a number of different charges be levied I find it advisable to so arrange the lugs on the surface of the plate that when a number beginning with a certain digit is called, the coin chutes will be opened to receive the coins which will total the sum charged for all numbers beginning with this digit. For example, it will be assumed that a certain charge is levied or assessed for all numbers beginning with the digit 3, and if, in order to collect this charge, it is necessary to open the slots 50 and 51, it is evident that a lug will be placed on the surface of the plate 38 opposite the notch in the wheel 25 which corresponds to the digit 3, and also in the path of the projections 53 and 54, as the plate 38 rotates. Thus it is evident that when the first digit 3 is called, only the cams 44 and 45 will be lifted from their respective slots.

The complete operation of the coin-collecting device is as follows: When the switch hook rises, upon the removal of the receiver therefrom, the projection 229 disengages the pawl 150, allowing it to come into engagement with the notched periphery of the disk 25. When the dial is rotated forward for the first digit, the disk 25 is also rotated forward by reason of the pawl 28 engaging the notch 30. As soon as the disk 25 leaves its normal position the pin 31 disengages the lug 33, allowing said pin to be forced out of engagement with arm 29 by spring 32. The arm 29 is then forced against the end of the pawl 28. When the dial begins to rotate back toward normal position, the pawl 28 is carried back out of the notch 30 and raised up so that the notch on the end of the said pawl engages the notch on the arm 29, thereby locking the pawl 28 in its raised position to prevent it from engaging any of the notches of the disk 25 during subsequent operations of the calling device. The disk 25 is maintained in the position to which it was rotated by the operation of the dial for the first digit by the engagement of the pawl 150 with one of the notches X. If the first digit is 1, the pawl engages the first of these notches; if the first digit is 2 the pawl engages the second notch, etc. As shown in Fig. 7, the first digit called was 3, whereby the pawl 150 is in engagement with the third notch X of the disk 25. As shown in Fig. 7, there are placed two lugs 39 on the plate 38

in such a position that when the disk 25 has been advanced three notches these two lugs will operate the arms 41 and 42, but there is no lug to operate the arm 43. With this arrangement, whenever any number beginning with the digit 3 is called, coins must be deposited in the slots 50 and 51, to which belong the arms 41 and 42, before communication can be carried on with the called subscriber. A coin dropped in slot 52 will be returned to the calling subscriber. All numbers beginning with the same digit require the deposit of coins of the same denomination, the coins which must be deposited depending upon which of the arms 41, 42 or 43 is operated by the lugs 39 when the disk 25 is in the position corresponding to that digit. If none of the arms are operated no coins need be dropped. When the receiver is restored to the switch hook the projection 229 disengages the pawl 150 from the notch of the disk 25, allowing said disk to be returned to normal position by the spring 26, provided the dial is in normal position. If the receiver is hung up while the dial is out of normal position, however, the disk 25 will be held in its operated position by the pawl 242 until the dial returns to normal position and pawl 242 is forced out by the arm 240. When the pawl 150 is forced down by the switch hook it also forces the springs 54 and 55, and the corresponding springs of the other groups that are operated, back to normal position. The disk 25 is stopped in normal position by the engagement of the end of pin 31 with the upturned end of the lug 33. Also, the pin 31 is forced outward and strikes the arm 29, raising it sufficiently to unlock the pawl 28.

The line switch C shown in Fig. 1 is of the general type disclosed in British Patent #26,301 of 1906, and in the American Telephone Journal of New York of June 6, 1908, being of a somewhat modified construction. It comprises a magnet 64 which controls the usual plunger arm 65 and armatures 66 and 67. The magnet 64 consists of four windings, namely: The pull-in winding 68, cut-off winding 69, line winding 70 and auxiliary winding 71. The magnetic circuit of the windings 70 and 71 is separate from that of windings 68 and 69, due to the peculiar shape of the core. The winding 68 is of sufficient strength when energized to operate both the plunger arm 65 and the armature 66. The winding 69, however, will only operate the armature 66, but will hold the plunger arm 65 in an attracted position after it has once been operated by the winding 68. The plunger arm, upon being attracted, forces the plunger 65^a (Fig. 11) into a bank of springs 72, 73, 74, 75, 76, 77, 78 and 79, which springs, with other sets of similar springs, form terminals of trunk lines leading to first selectors similar to first selector E. Although only one set of these bank springs is shown, there are, however, a number of such sets in each bank.

The line switch C is one of a group of similar line switches, usually one hundred in number. There may, however, be any number of such lines switches in each group. As a rule the corresponding terminal in the different banks are multiplied; thus each line switch has access to all of the trunks leading from that group. Each group of line switches is controlled by a common mechanism D usually called a master switch. This master switch comprises essentially the ratchet wheel 80, motor magnet 81, locking plate 82 and relays 83 and 84. The motor magnet serves to rotate the ratchet wheel 80. This rotary motion of the ratchet wheel is, by suitable means shown in Fig. 11, transmitted to the plunger shaft 86, giving said shaft an oscillatory motion, thereby moving the plungers which are in engagement therewith back and forth in front of the terminals of the trunk lines leading to the selectors E. The locking plate 82, which has holes near the outer edge, as shown in Fig. 11, is securely fastened to the plunger shaft rod 86^a. Therefore, when the pin 87 on the armature 88 engages one of these openings, the shaft is locked against rotation. The master switch also comprises a bank consisting of the individual segments C and the common segment 89. The wiper 90 is securely fastened to the plunger shaft 86, and as it passes over the bank it serves to keep one of the individual segments in electrical connection with the common segment 89.

At E there is shown a first selector which is, as before stated, accessible to the line switches of the group of which the switch C is a member. This switch E is of the general type described in United States Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson, being slightly modified, however, to operate in a two-wire system. By "two-wire system" is meant a system in which there is no ground connection at the substation, the apparatus being operated over the two sides of the line in series. The first selector E comprises the usual shaft carrying the wipers 91, 92 and 93, which have a vertical motion controlled by the vertical magnet 94 and a rotary motion controlled by the rotary magnet 95. The private magnet 96 controls the side switch carrying the wipers 97, 98, 99 and 100 in the usual and well known manner. The relays shown at 101, 102 and 103 are slow acting. The release of the switch mechanism is brought about through the medium of the release magnet 104. The operation of the switch is controlled by the subscriber through the medium of the double-wound line relay 105. The selector F is similar to selector E. The connector H

shown in Fig. 2 is of the general type disclosed in United States Letters Patent #815,176, granted March 13, 1906, to Keith, Erickson and Erickson. Like the selectors, however, it is modified to operate in conjunction with a two-wire system. Like the selectors, it comprises the shaft and shaft wipers 106, 107 and 108, vertical magnet 109, rotary magnet 110, double-wound line relay 111, also the side switch wipers 112, 113, 114, 115 and 116, show relays 117 and 118, private magnet 119, ringer relay 120, busy locking relay 121, double-wound relay 122 and release magnet 123.

The substation A′ and line switch C′ are similar to substation A and line switch C.

At B a battery is shown with its positive terminal preferably grounded at G.

At M a busy signaling machine is shown, and at R a ringing current generator is shown.

To give a better understanding of my improved coin-collecting device and the system in which it is used, I will explain in detail the operations that occur when one party, subscriber at substation A for instance, calls another party, subscriber at substation A′, for example, whose number we will assume to be 3330.

Upon the removal of the receiver at substation A the spring 5 disengages spring 6 and engages spring 7, as before stated. The disengagement of springs 5 and 6 breaks the circuit of the bells, while the engagement of springs 5 and 7 closes a circuit through the line winding 70 of the line switch C. This circuit extends from ground G′ through springs 124 and 125, line conductor 130, springs 5 and 7 of substation A, impulse springs 132 and 24, primary of induction coil 133, transmitter 134, line conductor 131, springs 126 and 127, line winding 70 to battery lead 135, thence through battery B to ground G. The line winding 70, upon energizing, closes a circuit through the pull-in winding 68 extending from ground G′ through springs 124 and 129, winding 68, auxiliary winding 71, contact 144 and armature 88 to battery lead 135, thence through battery B to ground G.

The current through the pull-in winding operates the plunger arm 65 and the armature 66. The plunger arm 65, upon being attracted, forces the plunger which is attached to the end thereof into the bank of trunk terminals to which it has access, forcing springs 72, 73, 74 and 75 into engagement with springs 76, 77, 78 and 79, respectively. The engagement of springs 72 and 75 with springs 76 and 79, respectively, closes a circuit through the relay 105 of the selector E. This circuit extends from ground G^2 through lower winding of relay 105, side switch wiper 97, springs 79 and 75, thence to and through the substation A, as before traced, back over line conductor 131, springs 72 and 76, side switch wiper 98 and upper winding of relay 105 to battery lead 135. The relay 105, upon energizing, shifts the spring 136 out of engagement with the spring 137 and into engagement with the spring 138. The engagement of the springs 136 and 138 closes an energizing circuit through the slow relay 101. This circuit extends from ground G^3 through the springs 136 and 138 and the relay 101 to the battery lead 135. The energizing of the relay 101 closes a circuit extending from ground G^4 through the springs 139 and 140, bank springs 77 and 73 to the point 141, thence one branch extends over the conductor 142 to the private bank contact of the calling line in the banks of all of the connectors that have access to the calling line. This guarding potential prevents any party from calling the substation A when said substation is calling. Another branch extends from the point 141 through the winding 69 of the line switch C to the battery lead 135. This circuit through the winding 69 is closed before the armature 67 falls back after the circuit through the line winding 70 is broken by the attraction of the armature 66. The armature 67 does not fall back immediately upon the pulling up of the armature 66, due to the fact that simultaneous with the attraction of the armature 66 is the pulling up of the plunger arm 65, which short-circuits the auxiliary winding 71 by forcing the spring 141^a into engagement with the spring 142^a This short-circuiting of the winding 71 tends to retard the demagnetization of the core, and thus the armature 67 is held in an operated position until enough time has elapsed for the circuit through the winding 69 to be closed, whereby the plunger arm 65 is held in an operated position.

The engagement of the springs 74 and 78 upon the forcing of the plunger into the bank closes an energizing circuit through the relay 83 of the master switch D, assuming, in this case, that the master switch D is holding the idle line switches opposite the first trunk, which trunk leads to the selector E. This circuit extends from ground G^5 through the springs 74 and 78, individual contact 143 of the master switch bank, wiper 90, common segment 89 and the relay 83 to battery. The relay 83, upon energizing, closes the circuit of the relay 84. The relay 84, upon pulling up, disconnects battery from the line windings of the idle switches of the group of which the switch C is a member by breaking engagement of the armature 88 and contact 144. This prevents any of the line switches from being operated while the master switch D is operating. The engagement of the springs 145 and 146 supplies a busy signal

to these idle lines, whereby any party attempting to call while the master switch is operating will receive the busy signal. The attraction of the armature 88 also lifts the pin 87 out of engagement with the locking plate 82 and closes a circuit through the motor magnet 81. This circuit extends from ground G^6 through the motor magnet 81, interrupter springs 147, contact 148 and armature 88 to battery. The motor magnet 81 energizes upon the closure of this circuit and attracts its armature 149. The attraction of the armature 149 breaks the circuit of the motor magnet at springs 147 and rotates the ratchet wheel one step. This rotation of the ratchet wheel causes the opening in the plate 82 to be carried from under the pin 87. Therefore, the circuit is held closed through the motor magnet after the wiper 90 passes off the contact 143 by the pin 87 riding on the plate 82, holding the armature 88 and contact 148 in engagement. The holes in the plate 82 are so positioned that the pin 87 will engage one of them only when the plungers stand directly opposite the terminals of a trunk line, at which time the wiper 90 is resting on one of the individual segments *a*. The motor magnet deënergizes upon the breaking of its own circuit, but is immediately energized again; thus it acts in the manner of a buzzer to move the plungers to the next trunk, at which time the pin 87 again engages an opening in the plate 82, locking it against further movement. Should the next trunk be busy, the wiper 90 will find the next trunk grounded and the circuit through the relay 83 will again be closed, thereby causing the master switch to be operated in the manner described above to move the plungers to the next trunk, and so on until the plungers are moved to a position in front of an idle trunk.

The foregoing is an explanation of the operation of the central office mechanism immediately upon the removal of the receiver at the substation A.

For convenience of explanation it will be assumed that the coin slots 50, 51 and 52 are designed to receive five, ten and twenty-five cent coins, respectively. It will also be assumed that a charge of fifteen cents is required for all numbers beginning with the digit 3. In other words, a five and a ten cent piece must be deposited in the chutes before a calling subscriber can converse with any called subscriber whose number begins with the digit 3. Since it has been assumed that the number of substation A′ is 3330, it will require the deposit of a five and a ten cent piece at substation A before conversation can be carried on. The subscriber at substation A now operates his dial for the first digit 3 of the required number. The operations at the substation are as follows: The subscriber, after having removed his receiver, inserts a finger in hole number 3 in the dial and rotates the dial forward until the finger strikes the stop (not shown), at which time three of the impulse teeth will have passed the cam 23 on the spring 24. The forward rotation of the teeth does not separate the impulse springs 24 and 132, however. They are only separated upon the backward rotation of the impulse wheel. The forward rotation of the dial for the digit 3 also rotates the wheel 25 forward until three notches in its periphery have passed the pawl 150. The pawl 150 now engages the third notch in the wheel 25 and is held in the notch by the coil spring 151. As has been previously described, in this position, when the digit 3 is called, the two arms 41 and 42 are acted upon by the lugs 39. When the arm 41 is depressed the springs 52^a and 53^a (Fig. 1) are forced into engagement with the springs 55^a and 54^a, respectively. The operation of the arm 42 forces the springs 53^b and 52^b into engagement with the springs 54^b and 55^b, respectively. The engagement of these springs short-circuits the transmitter and shunts the receiver. This short-circuit remains until the coins are dropped, as will be explained later. The shunt across the receiver does not prevent the calling subscriber from hearing when the called party answers, but due to the short-circuit on the transmitter, the called subscriber is unable to hear the calling subscriber. The object in shunting the receiver is to prevent the calling party from talking to the called party through the medium of the receiver.

The foregoing operations in the substation have occurred as the dial was rotated forward for the digit 3. The finger is now removed from the dial and it is allowed to return to normal position, due to the tension of the coil spring 16 (Fig. 4). The backward rotation of the impulse wheel 14, when the dial is released, causes the springs 24 and 132 to be momentarily separated three times. The separation of these springs breaks the circuit of the double-wound relay 105 of the selector E three times. The relay 105, upon thus being momentarily deenergized, closes a circuit through the vertical magnet 94 three times. This circuit extends from ground G^3 through springs 136 and 137, 158 and 159, slow relay 102, vertical magnet 94 and side switch wiper 100 to battery lead 135, thence through battery B to ground G. The relay 102 energizes upon the first impulse, but being slow acting does not deënergize until after the last impulse has been delivered. The vertical magnet energizes three times and operates to raise the vertical shaft and shaft wipers three steps to a position opposite the

third level of contacts in the bank of the first selector. The energization of the relay 102 closes a circuit through the private magnet 96. This circuit extends from ground G^3 through springs 161 and 162 and private magnet 96 to battery. The relay 102 deenergizes a moment after its circuit has been broken for the last time, thereby breaking the circuit of the private magnet 96. The deënergization of the private magnet 96 allows the side switch wipers to pass to second position. The circuit of relay 101 was momentarily broken upon the deënergizing of the double-wound line relay 105 but, as it is slow acting, it did not deënergize during this momentary interruption of its circuit. The side switch wiper 100, in passing from the first to the second position, shifts the battery connection from the vertical to the rotary magnet 95. A circuit is now closed from ground G^2 through the interrupter springs 163, rotary magnet 95, slow relay 103, side switch wiper 100 to battery lead 135. The rotary magnet energizes over this circuit to rotate the shaft and shaft wipers one step, press down the private magnet armature and break its own circuit at the springs 163. If the first trunk leading to a selector F is idle, the rotary magnet, upon deënergizing after breaking its own circuit, will allow the private armature to rise, which in turn permits the side switch to pass to the third position, at which time the line is completed to the second selector F by the wipers 97 and 98. If, however, the first trunk to a selector F is busy, the first bank contact upon which the private wiper 92 passes will be grounded in a manner hereinafter more fully explained. A circuit is then closed extending from this grounded contact through private wiper 92, conductor 164, wiper 99 (in second position) and private magnet 96 to battery. The private magnet energizes, locking the side switch in second position. With the side switch thus locked in the second position the rotary magnet, upon deënergizing, allows its circuit to be closed, whereby it is again energized and rotates the shaft wipers to the second contact. If the second contact is busy, the operation will be repeated and the shaft wipers rotated to the third trunk, and so on until the wipers strike an idle trunk, at which time the side switch wipers will be allowed to pass to third position, as before described.

The relay 165 energizes in the same manner as did the relay 105 of the selector E to close the circuit of the relay 166. The energization of the relay 166 puts a guarding ground back onto the private bank contacts of the trunks leading to the selector F in the banks of all the selectors that have access to said selector F. This guarding circuit extends from ground G^7 through the side switch wiper 167 and springs 168 and 169 to the said private bank contacts. A short period of time elapses after the side switch wipers of the selector E pass to third position, and before the guarding potential is placed on the private bank contacts, as described above. During this time the relay 103, which is in the rotary magnet circuit, supplies ground to the said private bank contacts. It is energized upon the first impulse through the rotary magnets, but, being slow acting, does not deënergize for a moment after the side switch wipers pass to third position, whereby a guarding potential is supplied to the private bank contacts over a circuit extending from ground G^8 through the springs 170 and 171, wiper 99, conductor 164 to the private wiper 92, thence on to the contacts before mentioned. After the relay 103 deënergizes, it being quicker in its action than the relay 101, it closes a holding circuit for the relay 101 extending from ground G^7 of the selector F, over the circuit before traced to the wiper 99 of the selector E, thence through the springs 171 and 172, conductor 173 and relay 101 to battery. The subscriber at substation A now operates the calling device for the second digit 3.

The backward rotation of the dial for the second digit 3 opens the line at the calling device three times. This opening of the line breaks the circuit of the double-wound relay 165 of the selector F three times which, like the selector E, deënergizes to close the circuit of the vertical magnet 174, which in turn energizes to raise the shaft and shaft wipers 175, 176 and 177 three steps opposite the third level of bank contacts which are terminals of trunk lines leading to the connector H. A moment after the last impulse has been delivered to the relay 178, in series with the vertical magnet, the relay 178 deenergizes and allows the private magnet 179 to deënergize, which permits the side switch wipers to pass to second position. When the side switch wipers are in the second position the operation of the selector is the same as was that of the selector E to rotate the shaft wipers on to an idle trunk line leading to the connector H.

The subscriber at substation A now operates the calling device for the third digit 3. The circuit of the double-wound relay 111, which was closed as soon as the trunk lines were completed from the substation A to the connector by the wipers 180 and 181 of selector F passing to the third position, is broken three times. The deënergization of this relay completes the circuit of the vertical magnet 109 in series with the slow relay 117, as in the selectors, whereby the shaft carrying the wipers 106, 107 and 108 is raised three steps to a point opposite the third level of bank contacts. As in the se-

lectors, the private magnet 119 is allowed to deënergize upon the deënergization of the relay 117, which deënergized a moment after the last impulse was sent through it, whereby the side switch is permitted to pass to the second position. When the wiper 115 passes to second position battery is shifted from the vertical to the rotary magnet 110. The subscriber at substation A now operates the calling device for the last digit 0. The line relay 111 deënergizes ten times to close a circuit through the rotary magnet 110 in series with the relay 117. This circuit extends from ground G^9 through the springs 182 and 183, springs 184 and 185, springs 186 and 187, magnet 110, wiper 115 and relay 117 to battery. The rotary magnet energizes ten times to rotate the shaft and shaft wipers onto the line of the called subscriber. If the called line is idle the private magnet permits the side switch to pass to third position upon the deënergization of the slow relay 117. The wiper 116 (in first position) puts a holding ground back over the release trunk 188 for the relays 166 and 101. This circuit extends from ground G^{10} through the wiper 116, springs 189 and 190, conductor 188, private wiper 176, side switch wiper 191, springs 192 and 193 to point 194, thence a part of the current passes through the relay 166 to battery and a part continues on through the wiper 167, thence over a circuit before traced through the relay 101 of the selector E to battery. This ground also puts a guarding potential on the bank contacts of the connector H in the banks of all the selectors that have access to the said connector. The side switch wiper 116, in passing to third position, shifts this holding and guarding ground from ground G^{10} to ground G^9. The wiper 115, in passing to the third position, shifts battery from the rotary magnet 110 to the ringer relay 120. The wiper 114, in passing to the third position, puts a ground onto the private bank contacts of the called line and also closes an energizing circuit through the cut-off winding 244 of the line switch C′. The circuit through the winding 244 extends from ground G^{11} through the wiper 114, springs 195 and 196 to the private wiper 107, thence to and through the winding 244 to battery. This ground potential also goes to all of the private bank contacts of the called line in the banks of all the connectors that have access to the called line. This prevents any other party from getting connection with the substation A′ after the latter has been called. The winding 244, upon being energized, attracts its armature 197. The armature 197, upon pulling up, closes the line to the called substation and also disconnects the lines of the substation A′ from the line winding 198 of the line switch C′. It will be remembered that the shifting of the wiper 115 closed the circuit of the ringer relay 120. This circuit extends from ground G^{12} through the interrupter 212, springs 213 and 214, relay 120, wiper 115 and relay 117 to battery. The ringer relay is intermittently energized over this circuit to disconnect the calling from the called subscriber, and to connect the ringing current generator R with the line of the called subscriber A′. Ringing current then flows from one side of the generator R through the springs 200 and 201, wiper 113, shaft wiper 106, springs 204 and 205, conductor 210, bells 206, condenser 207, springs 208 and 209, line 211, shaft wiper 108, side switch wiper 112 and springs 203 and 202 to the other side of the generator. The subscriber at substation A′ removes the receiver from the hook in response to this signal and receives talking battery current over a circuit extending from ground G^{11} through the side switch wiper 114, lower winding of the relay 122, springs 217 and 203, wipers 112 and 108, thence over the line 211 to the substation A′, through the springs 209 and 213^a, impulse springs 214^a, primary winding 215 of the induction coil, transmitter 216, back over the line 210, springs 205 and 204, wipers 106 and 113, springs 201 and 201^a and upper winding of the relay 122 to battery. The relay 122 is energized over this circuit and opens the circuit of the ringer relay 120. As hereinbefore stated, it was assumed that the charges to converse with subscribers whose numbers begin with the digit 3 was fifteen cents. The subscriber at substation A, upon hearing the answer of the subscriber at substation A′, proceeds to place the five and ten cent pieces in their respective slots. It is assumed that chute 50 is for the five cent piece, then when the coin is dropped in the chute it will strike the latch or cam 60, and by knocking it out of engagement with the bushing 63 it allows the springs of group *a* (Fig. 1) to disengage; likewise, when the ten cent piece is dropped into the chute 51 it strikes the cam 61 and thereby permits the springs of the group *b* to disengage, whereby the short-circuits are removed from both the receiver and transmitter and the subscribers may carry on an uninterrupted conversation.

The release of the switches at the central office in initiated by the hanging up of the receiver at the calling substation, the release being brought about in the following manner: The replacing of the receiver on the hook opens the circuit of the double-wound relay 111 of the connector by breaking the engagement of springs 5 and 7. The relay 111, upon deënergizing, opens the circuit of the slow relays 118, 166 and 101 of the connector, second and first selectors, respectively. These relays deënergize to close the circuits of their respective release magnets. The circuit through the con-

nector release magnet extends from ground G^9 through springs 182 and 183, springs 184 and 218, release magnet 123 and off-normal springs 219 and 220 (which springs were permitted to engage as soon as the shaft was raised one or more steps), thence to battery. The magnet 123 energizes to immediately release the switch. The circuit through the release magnet 221 of selector F extends from ground G^{13} through springs 224 and 225, springs 226 and 227, magnet 221 and off-normal springs 222 and 223 to battery. The switch releases upon the closure of this circuit, and as in the first selector and connector the circuit of the release magnet is again broken when the shaft reaches its lowest position by the arm 228, disengaging spring 223 from spring 222. The circuit through the magnet 104 is similar to the circuit just traced. The deënergization of the relay 101 breaks the holding circuit of the winding 69 of the line switch C, thereby allowing the plunger arm 65 to return to normal position. Thus the switches are all restored to normal position and are in readiness for another call. The wheel 25 at the calling substation is also released by the lug on the receiver hook 2 striking the lower end of the cam or ratchet 150, thereby disengaging it from the ratchet wheel 25. Of course, the ratchet 242 is also immediately forced away by the tension of the spring 241, as has been described. If the called line had been busy when called by substation A, the wiper 107 would have found the private bank contact 245 grounded in the manner hereinabove explained, and a circuit would have been completed extending from this ground on the private bank contact through wiper 107, springs 196 and 195 of relay 121, lower winding of relay 122, ringer springs 217 and 203, side switch wiper 112 (in second position), springs 229 and 230 of the relay 117 and the private magnet 119 to battery. The spring 230 engages the spring 229 before breaking from the spring 231, when the relay 117 deënergizes, whereby if the called line is busy there is no break in the circuit of the private magnet as the relay 117 deënergizes after the last impulse has been delivered. The simultaneous energization of the private magnet and the relay 122 closes a circuit extending from ground G^{14} through the springs 231 and 232, springs 233 and 234, relay 121 and springs 236 and 235 to battery. The relay 121 energizes and shifts the holding circuit of the private magnet and relay 122 from ground at the private bank contact to ground G^{15}, and also opens the rotary magnet circuit and puts a busy signal onto the line of the calling subscriber. This busy circuit extends from battery through the primary of the induction coil 237, springs 238 and 239, wiper 113 (in second position), thence over the heavy conductor to and through the substation A, back over the heavy conductor, through the lower winding of the relay 111 to ground. The subscriber at substation A, upon hearing the busy signal, hangs up the receiver, thereby restoring the switches to normal position, as hereinbefore described. Of course, should the line be busy there is no necessity for placing the different coins in their respective chutes.

From the foregoing it will be seen that toll is invariably assessed in accordance with the extent of operation of the calling mechanism for the first digit of the called number. One extent of rotation of the calling dial brings into operation one of the measured service devices, whereas another extent of operation of the said dial brings into use another of said devices. Thus the control of the measured service devices is entirely automatic, and no operator is necessary for the determination of the proper rate of toll—that is to say, the calling subscriber does not need to be told by an operator what the rate of charge is for any particular call. The subscriber simply makes the call and, having done so, there is then only one or several in combination of the measured service devices which he can use, and if he uses any other device the coin is returned and it is thus made evident that the wrong slot has been used, or the wrong coin deposited in the mechanism. The calling subscriber discovers for himself which rate of toll is necessary for any particular call, and the manner in which the mechanism and the measured service devices are combined precludes the payment of any other rate of toll for that call.

It will be seen that my invention relates to that type of system in which the two sides of the calling line are controlled in series to operate and release the automatic switches at the central station. In this way a ground is not necessary at the substation for either calling or releasing. Furthermore, my invention relates to that kind of an automatic system in which central energy is employed for talking purposes. This means, of course, that central energy is supplied to the measured service devices. With the arrangement shown the current is so controlled that the transmitter is completely short-circuited and cannot be used until after the proper toll is assessed. The receiver is shunted to the extent that it is still operative for hearing the reply of a called subscriber, but cannot then be used by the calling subscriber as a talking instrument.

What I claim as my invention is:—

1. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and devices associated

with said mechanism, controlled thereby, to assess toll of different values when calls are extended from the calling mechanism.

2. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and coin-controlled devices associated with said mechanism, controlled thereby, to assess cash tolls of different values.

3. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and a plurality of measured service devices associated with said mechanism, controlled thereby, and each controlled by a different sized coin and means responsive to said mechanism to select one of said devices.

4. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and devices associated with said mechanism, controlled thereby, to assess toll of different values when calls are extended from the calling mechanism, each of said devices requiring a different extent of operation of said mechanism to render it operative to assess the toll.

5. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and coin-controlled devices associated with said mechanism, controlled thereby, to assess cash tolls of different values, each of said devices requiring a different extent of operation of said mechanism to render it operative to assess the toll.

6. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and a plurality of measured service devices associated with said mechanism, controlled thereby, and each controlled by a different sized coin and means responsive to said mechanism to select one of said devices, each of said devices requiring a different extent of operation of said mechanism to render it operative to assess the toll.

7. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, devices associated with said mechanism, controlled thereby, to assess toll of different values, a telephone associated with said mechanism, and circuits controlled by said devices to render the said telephone inoperative until toll is assessed for the call.

8. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, coin-controlled devices associated with said mechanism, controlled thereby, to assess cash tolls of different values, a telephone associated with said mechanism, and circuits controlled by said devices to render the said telephone inoperative until toll is assessed for the call.

9. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, a plurality of measured service devices associated with said mechanism, controlled thereby, and each controlled by a different sized coin and means responsive to said mechanism to select one of said devices, a telephone associated with said mechanism, and circuits controlled by said devices to render the said telephone inoperative until toll is assessed for the call.

10. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, devices associated with said mechanism, controlled thereby, to assess toll of different values when calls are extended from the calling mechanism, and means for preventing control of said devices by said mechanism more than once for any called number.

11. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, coin-controlled devices associated with said mechanism, controlled thereby, to assess cash tolls of different values, and means for preventing control of said devices by said mechanism more than once for any called number.

12. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, a plurality of measured service devices associated with said mechanism, controlled thereby, and each controlled by a different sized coin and means responsive to said mechanism to select one of said devices, and means for preventing control of said devices by said mechanism more than once for any called number.

13. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, devices associated with said mechanism, controlled thereby, to assess toll of different values, and means limiting the control of said devices by said mechanism to the operation of the latter for the first digit of any called number.

14. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, coin-controlled devices associated with said mechanism, controlled thereby, to assess cash tolls of different values, and means limiting the control of said devices by said mechanism to the operation of the latter for the first digit of any called number.

15. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, a plurality of measured service devices associated with said mechanism, controlled thereby, and each controlled by a different sized coin and means responsive to said mechanism to select one of said devices, and means limiting the control of said devices by said mechanism to the operation of the latter for the first digit of any called number.

16. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and devices associated with said mechanism, controlled thereby, to assess toll of different values when calls are extended from the calling mechanism, said mechanism comprising a rotary dial, and means for variably limiting the rotation of said dial.

17. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and coin-controlled devices associated with said mechanism, controlled thereby, to assess cash tolls of different values, said mechanism comprising a rotary dial, and means for variably limiting the rotation of said dial.

18. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and a plurality of measured service devices associated with said mechanism, controlled thereby, and each controlled by a different sized coin and means responsive to said mechanism to select one of said devices, said mechanism comprising a rotary dial, and means for variably limiting the rotation of said dial.

19. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and devices associated with said mechanism, controlled thereby, to assess toll of different values, said mechanism having a ratchet wheel provided with the means for controlling said devices, and a dog engaging said wheel to prevent more than one rotation thereof for each called number.

20. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and coin-controlled devices associated with said mechanism, controlled thereby, to assess cash tolls of different values, said mechanism having a ratchet wheel provided with the means for controlling said devices, and a dog engaging said wheel to prevent more than one rotation thereof for each called number.

21. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and a plurality of measured service devices associated with said mechanism, controlled thereby, and each controlled by a different sized coin and means responsive to said mechanism to select one of said devices, said mechanism having a ratchet wheel provided with the means for controlling said devices, and a dog engaging said wheel to prevent more than one rotation thereof for each called number.

22. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and devices associated with said mechanism, controlled thereby, to assess toll of different values, each of said devices comprising a set of springs, circuits controlled by said springs, means for closing said springs by the operation of said mechanism for the first digit of the called number, and means for opening said springs when the toll is assessed for the call.

23. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and coin-controlled devices associated with said mechanism, controlled thereby, to assess cash tolls of different values, each of said devices comprising a set of springs, circuits controlled by said springs, means for closing said springs by the operation of said mechanism for the first digit of the called number, and means for opening said springs when the toll is assessed for the call.

24. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and a plurality of measured service devices associated with said mechanism, controlled thereby, and each controlled by a different sized coin and means responsive to said mechanism to select one of said devices, each of said devices comprising a set of springs, circuits controlled by said springs, means for closing said springs by the operation of said mechanism for the first digit of the called number, and means for opening said springs when the toll is assessed for the call.

25. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, devices associated with said mechanism, controlled thereby, to assess toll of different values, and a line the two sides of which in series are controllable by said mechanism to operate and release said means.

26. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, coin-controlled devices associated with said mechanism, controlled thereby, to assess cash tolls of different values, and a line the two sides of which in series are controllable by said mechanism to operate and release said means.

27. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, a plurality of measured service devices associated with said mechanism, controlled thereby, and each controlled by a different sized coin and means responsive to said mechanism to select one of said devices, and a line the two sides of which in series are controllable by said mechanism to operate and release said means.

28. In a telephone system, lines, a telephone for each line, a calling mechanism for each telephone, means responsive to said mechanism to extend a call from one line to another, devices associated with each mechanism, controlled thereby, to assess toll

of different values when calls are extended from the calling mechanism, and a central source of talking current for supplying current to said telephones.

29. In a telephone system, lines, a telephone for each line, a calling mechanism for each telephone, means responsive to said mechanism to extend a call from one line to another, coin-controlled devices associated with each mechanism, controlled thereby, to assess cash tolls of different values, and a central source of talking current for supplying current to said telephones.

30. In a telephone system, lines, a telephone for each line, a calling mechanism for each telephone, means responsive to said mechanism to extend a call from one line to another, a plurality of measured service devices associated with each mechanism, controlled thereby, and each controlled by a different sized coin and means responsive to said mechanism to select one of said devices, and a central source of talking current for supplying current to said telephone.

31. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and devices associated with said mechanism, controlled thereby, to assess toll of different values when calls are extended from the calling mechanism, said means having one motion to find a group of lines, and another motion in a plane at right-angles to the plane of the first motion to find the called line in the selected group.

32. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and coin-controlled devices associated with said mechanism, controlled thereby, to assess cash tolls of different values, said means having one motion to find a group of lines, and another motion in a plane at right-angles to the plane of the first motion to find the called line in the selected group.

33. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and a plurality of measured service devices associated with said mechanism, controlled thereby, and each controlled by a different sized coin and means responsive to said mechanism to select one of said devices, said means having one motion to find a group of lines, and another motion in a plane at right-angles to the plane of the first motion to find the called line in the selected group.

34. In a telephone system, a measured service mechanism comprising a plurality of devices each for a different calling rate, each device representing a different first digit of any called number, a digit transmitter, and means responsive to said transmitter for connecting a calling and a called line, said transmitter adapted to bring one of said devices into operation in accordance with the value of the digit transmitted, whereby all calls for which the same rate of toll is assessed at said mechanism have the same first digits.

35. In a telephone system, a plurality of measured service devices each for a different rate of toll, a calling mechanism, and means operated by said calling mechanism to selectively control said measured service devices when calls are extended from the calling mechanism.

36. In a telephone system, a plurality of measured service devices each for a different rate of toll, and substation-controlled means for selectively controlling said devices when connection is extended from the substation and means for extending connection from said station.

37. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and devices associated with said mechanism mechanically controlled thereby, to assess toll of different values.

38. In a telephone system, a calling mechanism, means responsive to said mechanism to extend the call, and devices associated with said mechanism at the telephone, controlled thereby, to assess toll of different values.

39. In a telephone system, a calling mechanism, means responsive to said mechanism to extend a call, and devices associated with said mechanism controlled thereby through the medium of a common means to assess toll of different values.

Signed by me at Chicago, Cook county, Illinois, this 14th day of July, 1910.

BERNARD D. WILLIS.

Witnesses:

EDWARD D. FALES,

ARTHUR J. RAY.