No. 876,595. PATENTED JAN. 14, 1908.

L. A. SCHMIDT.

ELECTRICAL REGISTER AND SYSTEM THEREFOR.

APPLICATION FILED NOV. 2, 1903.

6 SHEETS—SHEET 1.

Fig. 1.

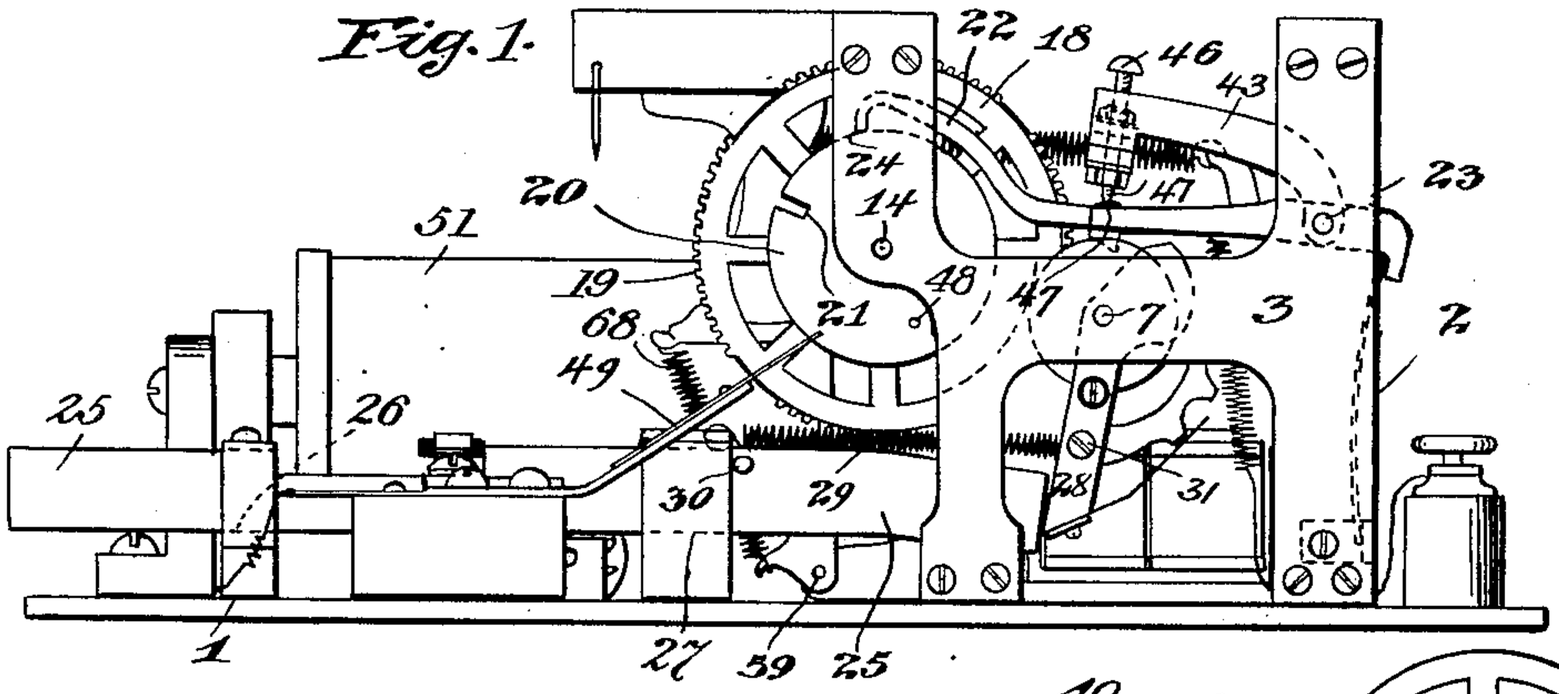
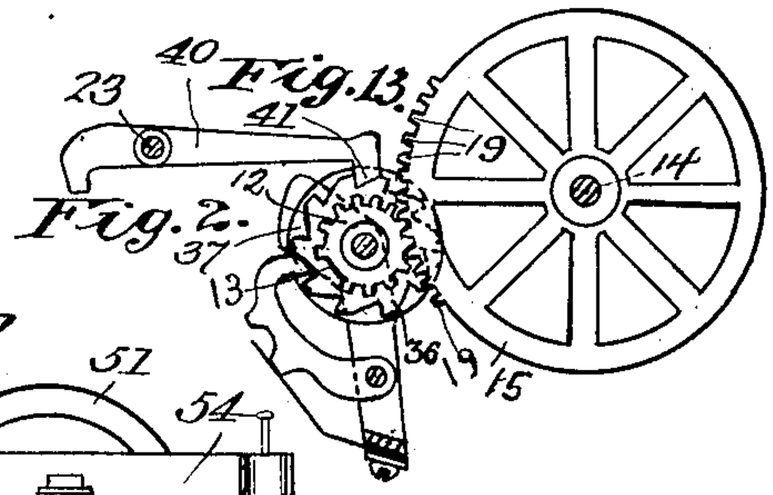


Fig. 2.



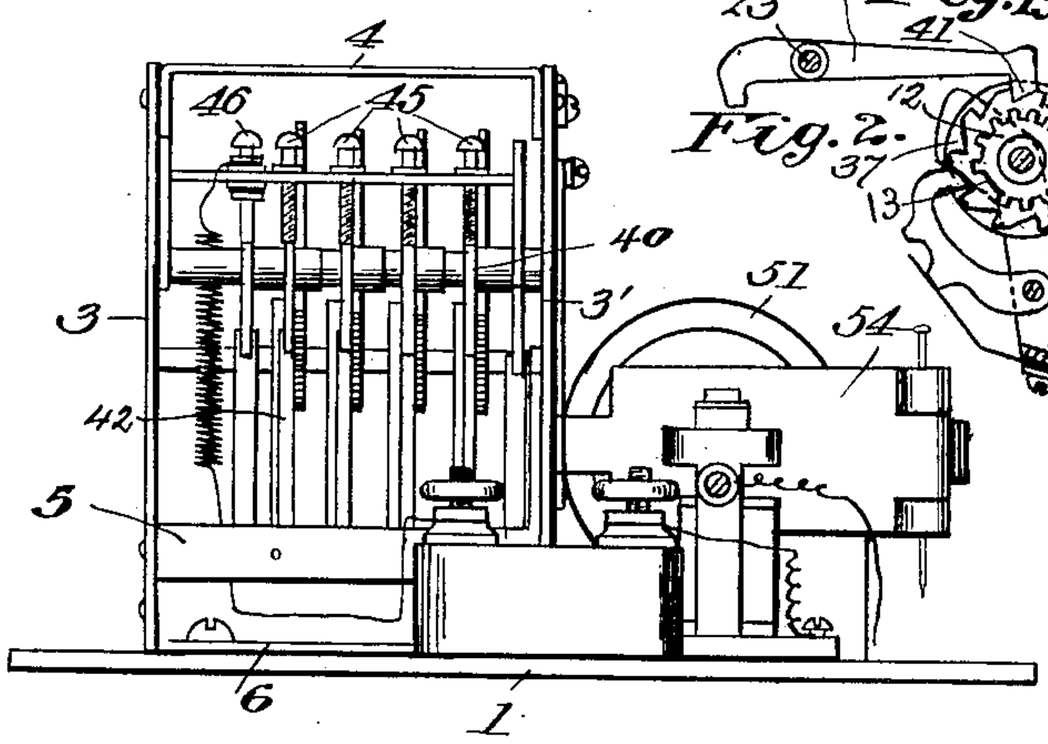
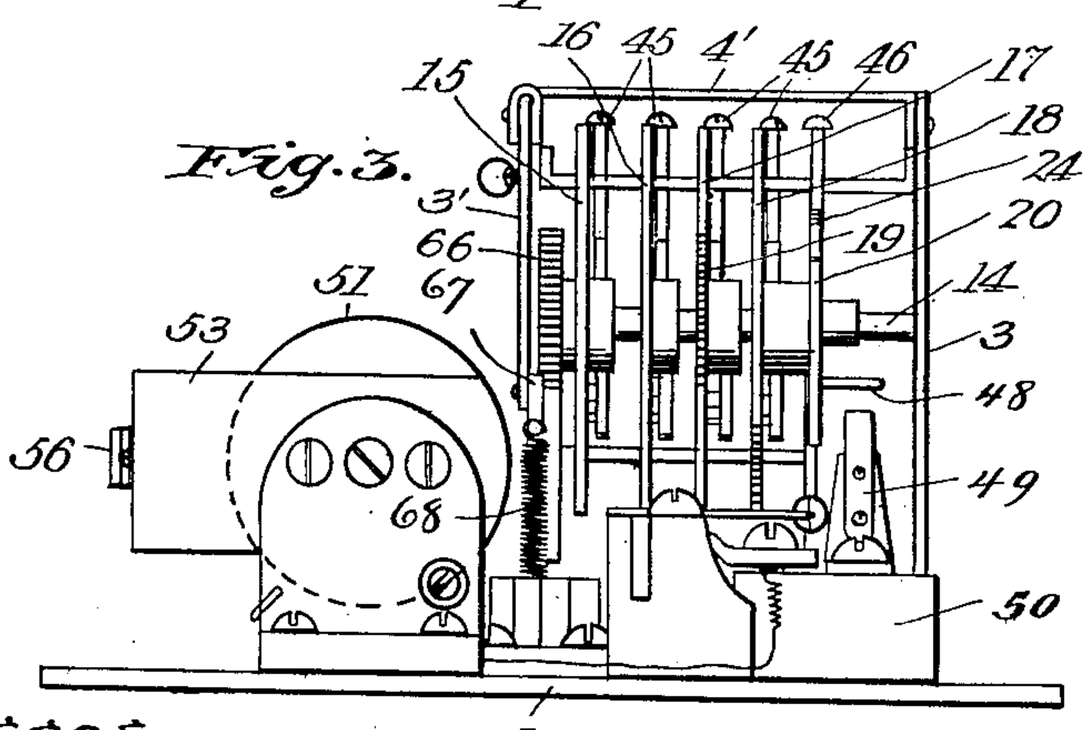


Fig. 3.



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No. 876,595. PATENTED JAN. 14, 1908.

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6 SHEETS—SHEET 2.

Fig. 4.

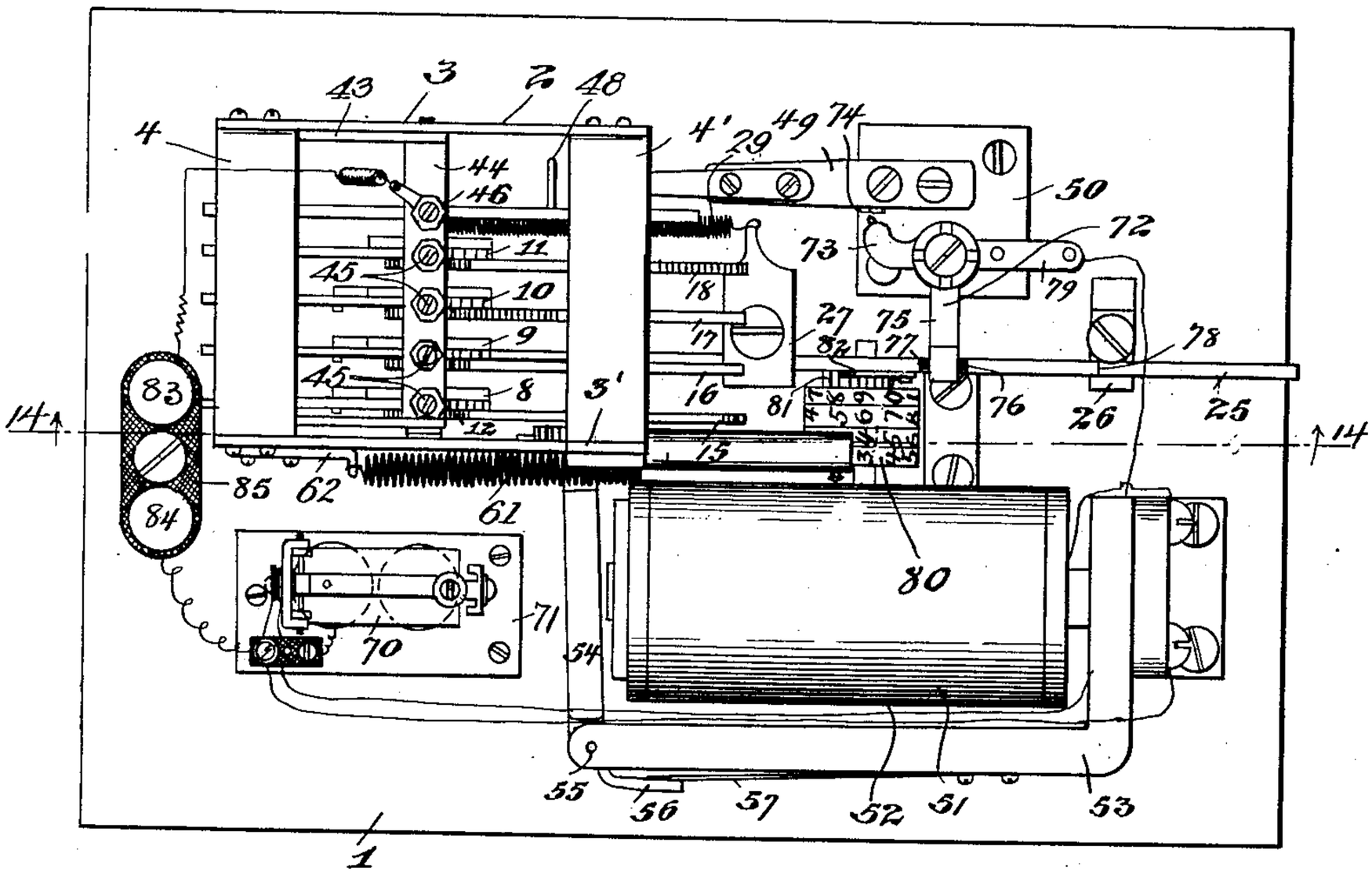
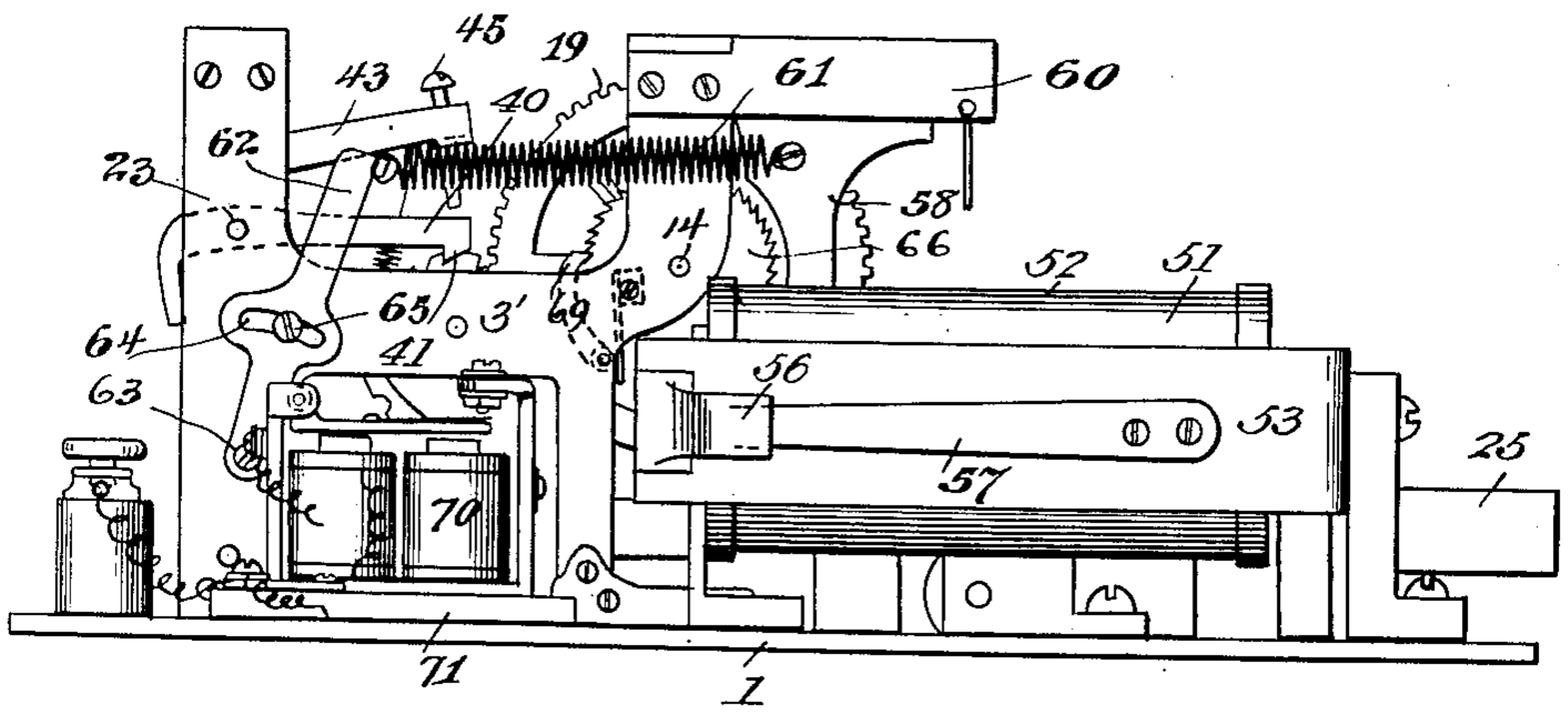


Fig. 5.



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6 SHEETS—SHEET 3.

Fig. 6.

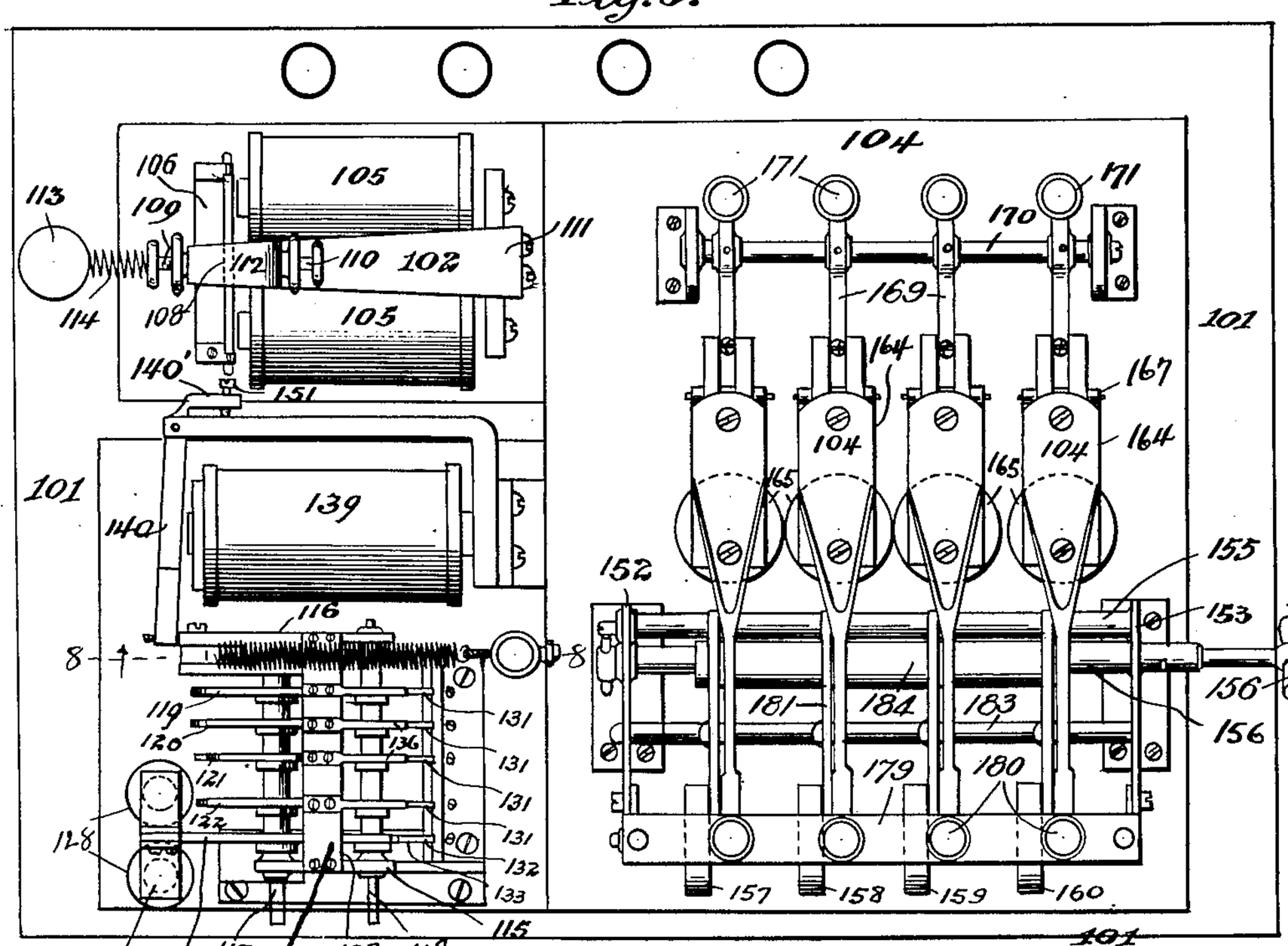

Fig. 6a.

Fig. 7.

Witnesses, Fig. 8.

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6 SHEETS—SHEET 4.

Fig. 9.

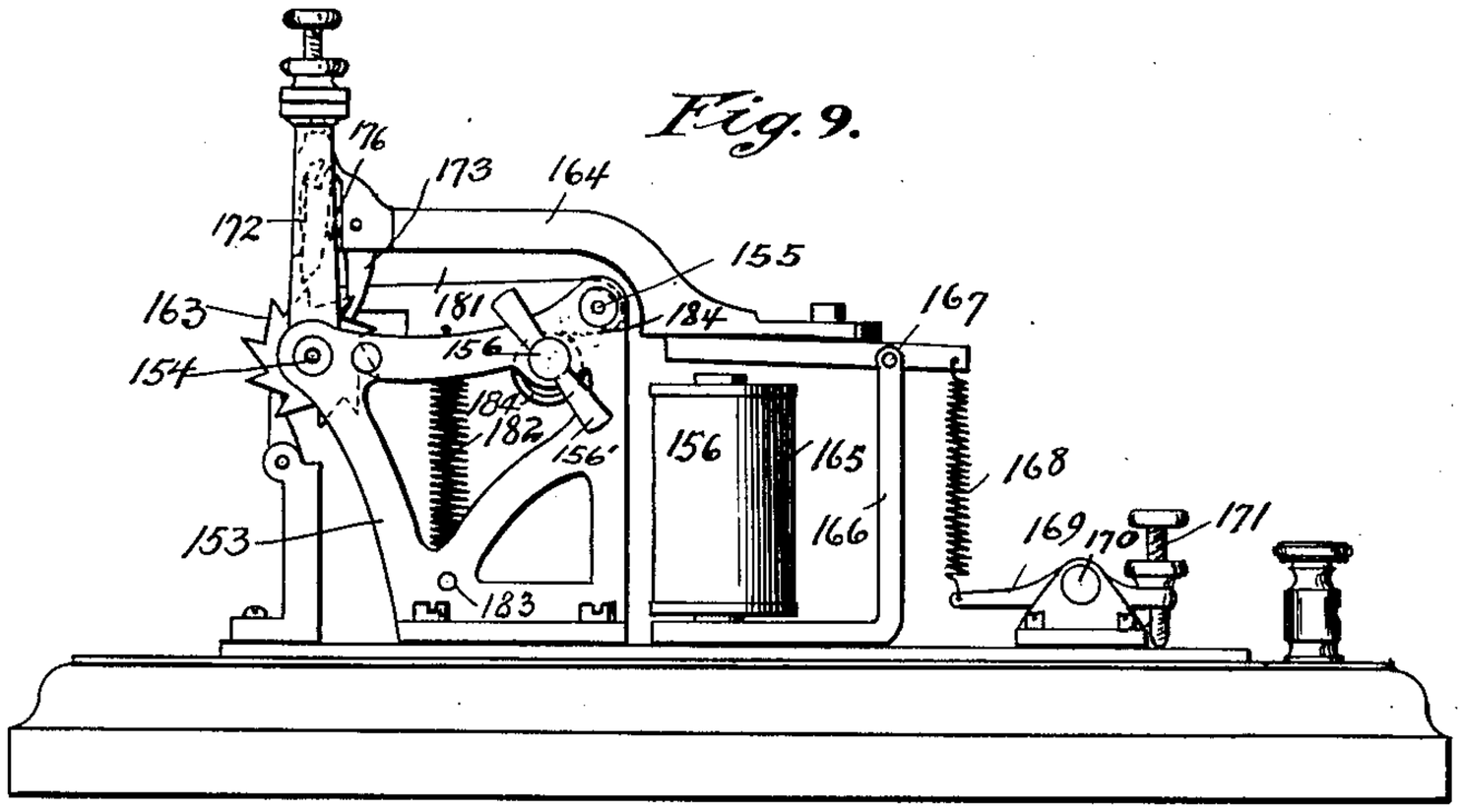


Fig. 10.

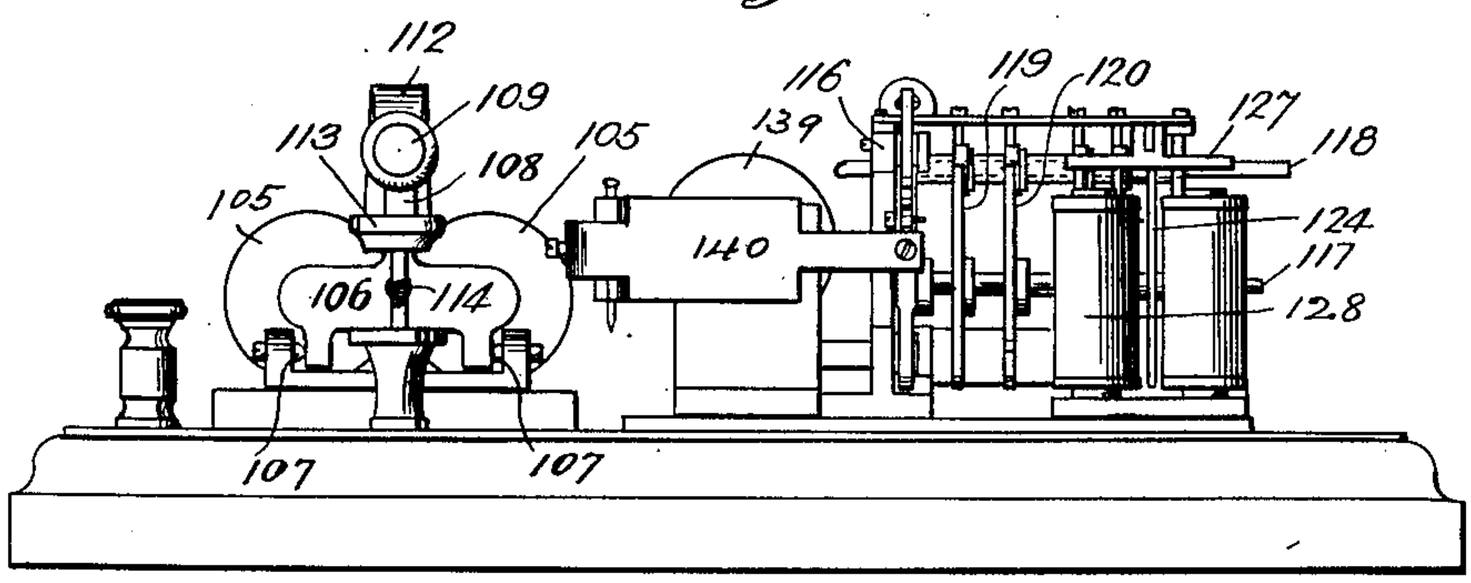
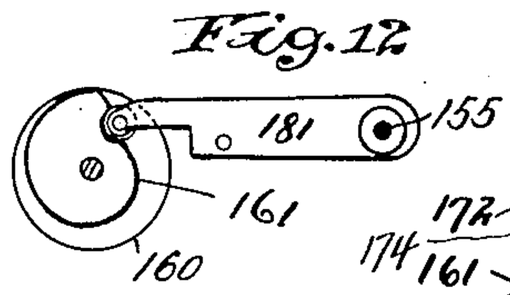


Fig. 12.



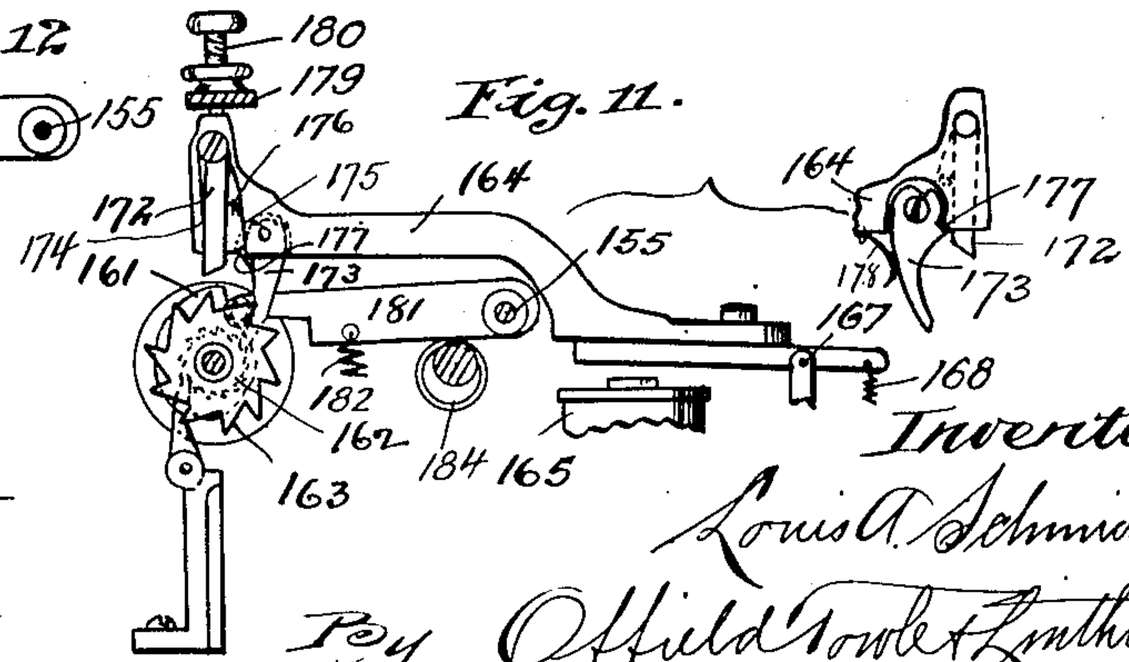


Fig. 11.

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6 SHEETS—SHEET 5.

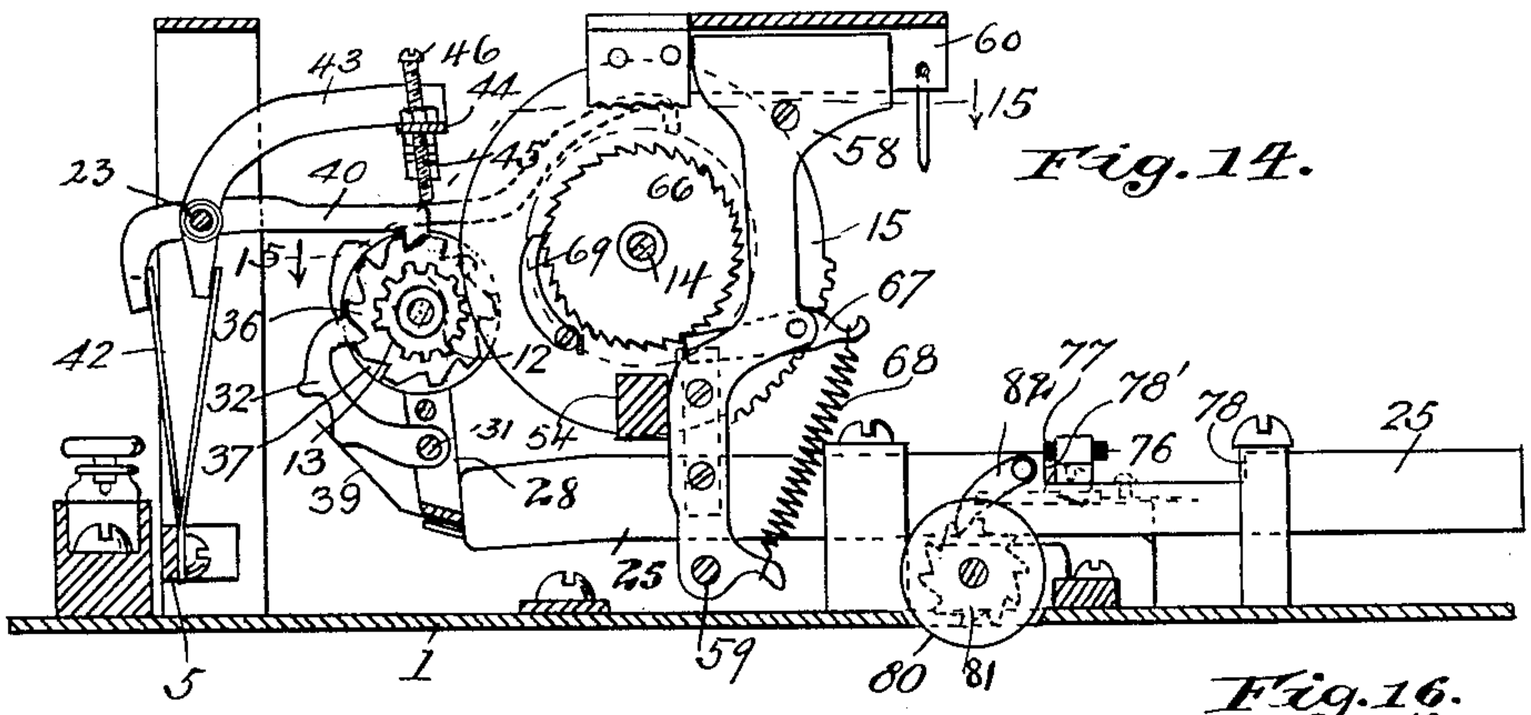


Fig. 14.

Fig. 15.

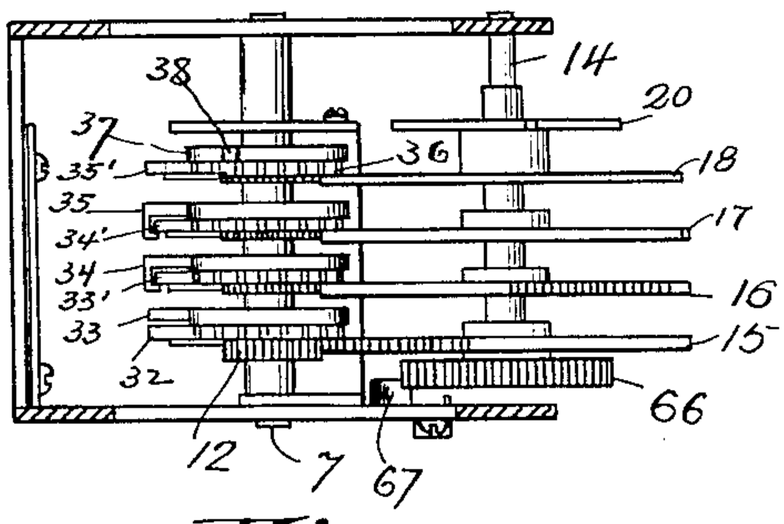


Fig. 16.

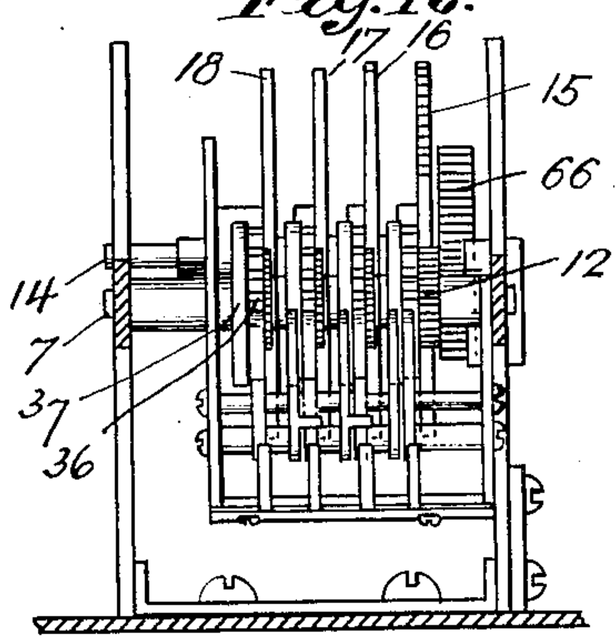


Fig. 17.

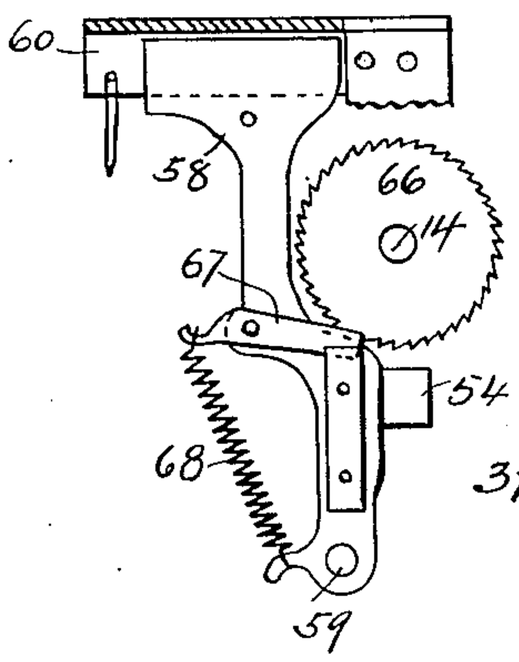


Fig. 19.

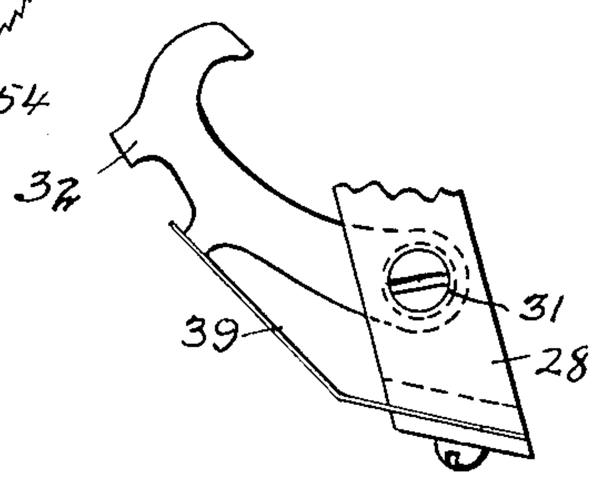
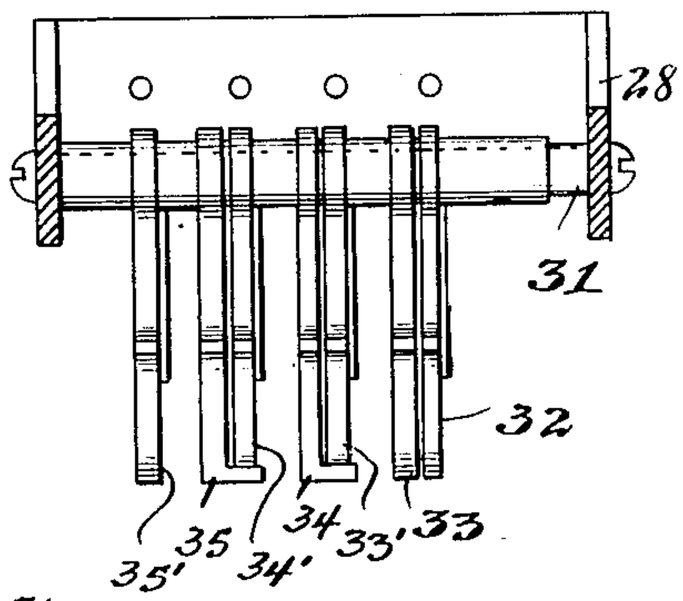


Fig. 18.



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No. 876,595. PATENTED JAN. 14, 1908.

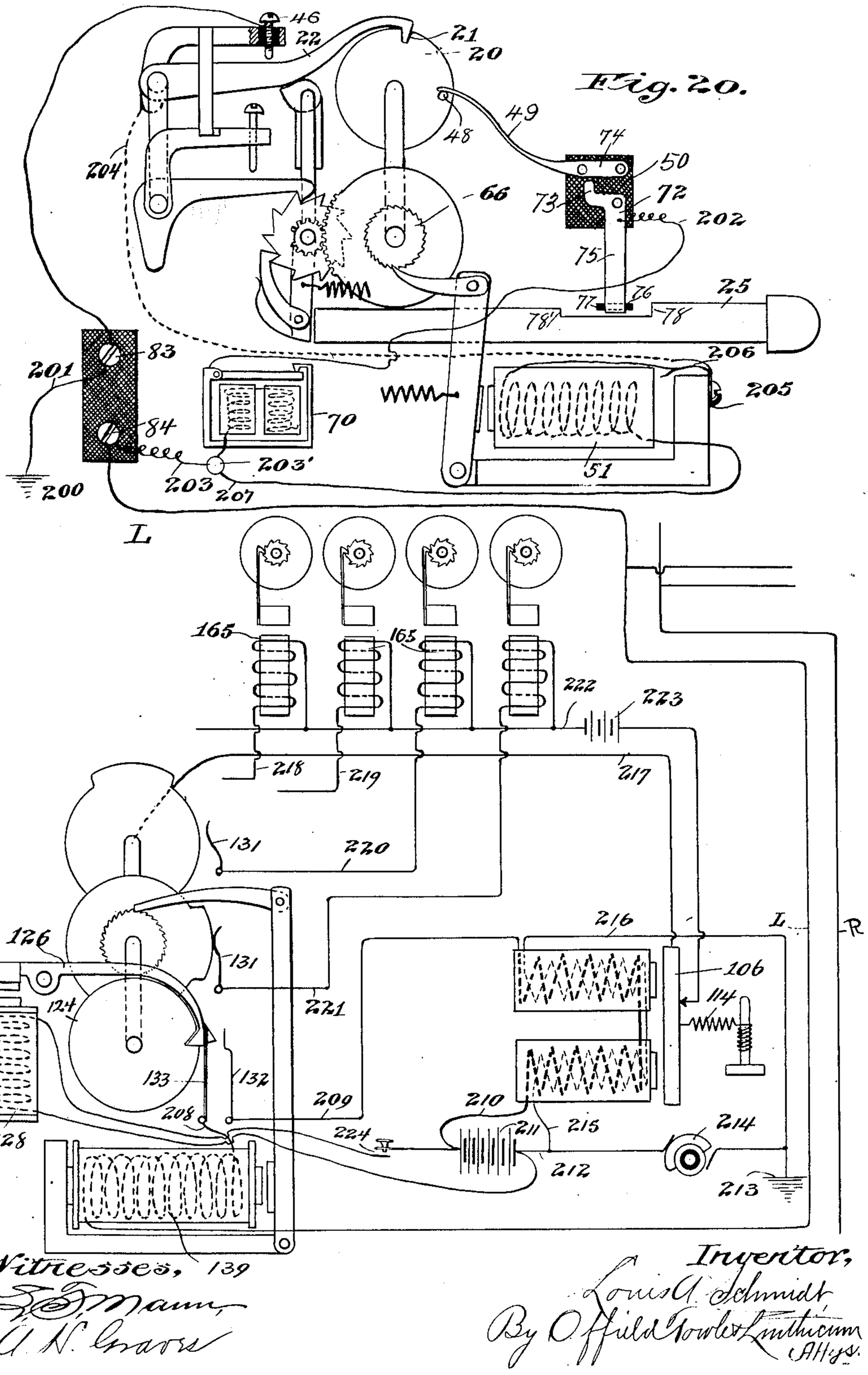
L. A. SCHMIDT.

ELECTRICAL REGISTER AND SYSTEM THEREFOR.

APPLICATION FILED NOV. 2, 1903.

6 SHEETS—SHEET 6.

Fig. 20.



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UNITED STATES PATENT OFFICE.

LOUIS A. SCHMIDT, OF CHICAGO, ILLINOIS.

ELECTRICAL REGISTER AND SYSTEM THEREFOR.

No. 876,595. Specification of Letters Patent. Patented Jan. 14, 1908.

Application filed November 2, 1903. Serial No. 179,569.

To all whom it may concern:

Be it known that I, LOUIS A. SCHMIDT, a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electrical Registers and Systems Therefor, of which the following is a specification.

This invention relates to a system of, and apparatus for electrically transmitting tallies, as, for example, for transmitting the accumulated calls tallied at a subscriber's station to the central exchange.

Among the salient objects of the invention are to provide an improved form of counter or tally device in which the number of calls are registered upon a counting train, and in taking a reading therefrom electrically, the positions of these several members of the counting train are read; to provide a mechanism of the character referred to which, upon the taking of a reading, operates to automatically send over the line a number of electrical impulses corresponding to the sum of the several digits or digit positions set up upon the counters, these impulses so separated from each other as to convey to the reading station information as to the order of the several numerals such groups represent; to provide a subscriber's station instrument which may be actuated electrically from central to take the reading, and which, when once started, will automatically continue in operation until a complete reading has been transmitted and then automatically stopped; to provide a receiving station recorder which will operate synchronously with the subscriber's instrument and will reproduce upon its counters a reading corresponding to that transmitted; to provide in conjunction with sending and receiving instruments of the general character referred to, complementary mechanism and connections whereby both instruments may be operated over a single line with grounding connections; to provide a system of the character referred to which may be readily used in conjunction with ordinary telephone lines without in anywise interfering with the regular use of such lines except during the brief interval of time required for taking a reading; to provide a system and apparatus in which the reading may be taken very rapidly so that the regular use of the telephone line is only momentarily interfered with; to provide in a system of the character referred to, a receiving instrument upon which the reading of the subscriber's instrument may be preserved and added to from time to time or at will, or the receiving instrument may be readily and quickly restored to zero position so that the same receiver may be employed for an indefinite number of different subscribers' lines.

To the above ends the invention consists in the matters hereinafter described and more particularly pointed out in the appended claims, and the invention will be readily understood from the following description, reference being had to the accompanying drawings forming a part thereof, and in which—

Figure 1 is a side elevation of a subscriber's instrument or counter; Fig. 2 is a rear or right-hand end elevation of the parts shown in Fig. 1; Fig. 3 is a front or left-hand end elevation; Fig. 4 is a plan view of the machine as mounted upon the base; Fig. 5 an elevation of the side opposite that shown in Fig. 1; Fig. 6 is a plan view of the recorder or receiving instrument; Fig. 6[a] is a detail showing the relation of certain parts of the repeater; Fig. 7 a front elevation of the same; Fig. 8 a transverse sectional detail taken approximately on line 8—8 of Fig. 6 and looking in the direction of the arrows; Fig. 9 is a right-hand side elevation of the recorder; Fig. 10 a left-hand side elevation of those parts located at that side of the device; Fig. 11 is a fragmentary side elevation of one of the counter mechanisms of the exchange recorder removed from the frame; Fig. 12 is a detail of the cam set-back mechanism; Fig. 13 is a detail showing one of the counters of the subscriber's instrument and coöperating parts; Fig. 14 is a detail sectional view taken approximately on line 14—14 of Fig. 4; Fig. 15 is a horizontal sectional view taken approximately on line 15—15 of Fig. 14 and looking downwardly upon the fractional gears and inter-connected counter-gears, the superposed mechanism being omitted to expose said parts; Fig. 16 is an elevation of the parts seen in Fig. 15 as viewed from the left; Fig. 17 is a detail showing arrangement of the pawl and pawl-actuating lever which actuates the group of fractional gears; Fig. 18 is an enlarged detail of parts shown in Figs. 15 and 16; Fig. 19 is a side elevation of the parts shown in Fig. 18; Fig. 20 is a diagrammatic view showing the circuit connections of a system employing the apparatus described herein.

Referring to the drawings, and describing first the counter, 1 designates a suitable base upon which are mounted the several instrumentalities going to make up the counter. Upon the base 1 is mounted an open generally rectangular frame 2 having parallel side frame members 3, 3′, upper cross frame members 4, 4′, and intermediate and lower cross frame members 5 and 6 respectively. Journaled between the side frame members is a shaft 7 upon which are mounted a plurality of counters 8, 9, 10 and 11, the four counters referred to constituting a counting train representing four orders of numerals. The units counter 8 transmits motion to the tens counter 9 in a familiar manner, and each succeeding counter to the next counter of higher order, as usual. Rigidly united with each counter is a pinion 12, which is provided at one point only with a blank or untoothed portion 13, as seen clearly in detail Fig. 13.

14 designates a second shaft journaled in the side frame members in front of, and parallel with the shaft 7, and upon this shaft is journaled a group of fractional gears, comprising four members designated 15, 16, 17 and 18 respectively. Each fractional gear is provided with a segmental set of teeth 19 corresponding in number with the teeth of the corresponding pinions of the counters and meshing with the same, so that one revolution of the fractional gears will impart a single revolution to the counters, or in case the latter have not been stepped forward a full revolution, will return them to their zero position. The group of fractional gears are connected to move together as a unit, and the segmental sets of teeth 19 are offset in angular relation to each other; the set of teeth of the gear 17 beginning just in rear (considered with reference to the direction of rotation) of the teeth of the gear 18, and so on across the group. A distinct space or angular interval is provided between the several sets of segmental teeth. It follows that when the group of gears is rotated, the counters will be returned to zero in successive order. As they reach their zero positions the blank spaces of the pinions and the corresponding blank peripheries of the larger gears prevent their further rotation. The group of gears is arrested and held in definite relation to the counter pinion after said group has performed a single revolution, by means of a disk 20 provided in its periphery with a notch 21 and with which coöperates a contact lever 22 pivoted to the main frame at 23 and provided with a down-turned lip 24 which engages said notch 21. The counting train is stepped forward by means of a push button mechanism comprising a push rod 25 mounted to reciprocate in suitable bearings 26 and 27 mounted upon the base and engaging at its connecting end a stirrup-like frame 28 (see particularly Fig. 1) which is pivotally mounted upon and suspended from the shaft 7. The frame 28 is normally held at its forward limit of movement by means of a coiled contractile spring 29; the push rod being provided with a cross pin 30 which limits its return movement and thus forms a stop to arrest the forward movement of the frame 28. Between the side members of the stirrup frame 28 is mounted a shaft 31, (Fig. 18) upon which are mounted pawls 32, 33, 33′, 34, 34′, 35 and 35′. Each counter comprises two ratchet wheel portions 36 and 37; (Fig. 15) the portion 36 comprising a circumferentially complete series of ten teeth, and the portion 37 having but a single notch 38. The pawl 32 engages the complete ratchet 36 of the units counter, while the pawl 33 engages the periphery of the corresponding ratchet member 37. The pawl 33′ is rigidly sleeved to the pawl 33, and has its acting end in peripheral alinement with the latter, so that when the pawl 33 drops into the notch of the ratchet member 37 of the units counter, the pawl 33′ will engage the corresponding tooth of the complete ratchet of the tens counter and thereby step the latter forward one step.

The same relations obtain with reference to each of the succeeding counters, and accordingly the repeated actuations of the units counter results in actuating the whole series if the number reaches a sufficiently high order. It will be noted that the shapes of the engaging ends of the pawls are such that they actuate the counters upon the return stroke of the push rod and stirrup frame, and it will also be noted that individual springs 39 are provided for each of the pawls which engages the complete rachet members.

The ratchet teeth of the several counters are made to serve the function of cam projections which move contact actuating levers and serve to interrupt an electrical circuit during the operation of taking a reading. To this end the shaft or rod 23 upon which is mounted the contact lever 22 carries also four contact actuating levers designated 40, each being of approximately L-shape and arranged to rest at its forward end in yielding engagement with the corresponding complete ratchet member of the counter. The engaging ends 41 of said contact actuating levers are so shaped as to act also as detents, which prevent the backward movement of the ratchets. Springs 42 (Fig. 14) mounted upon the cross frame member 5 serve to hold the levers yieldingly in engagement with the ratchets.

43 designates as a whole a bail-shaped frame which is pivotally mounted upon the shaft 23, and is arranged with its swinging end overhanging the free ends of the contact actuating levers. Within the cross bar

member 44 of said bail are seated a series of adjustable tappet screws 45; one being mounted above each contact actuating lever, and said tappets being so adjusted that whenever its corresponding lever is lifted by the rotation of a ratchet tooth past its engaging end, the upper side of the lever will engage the tappet and thus lift the bail frame upwardly. The bail frame is also provided with a contact screw 46 (see Fig. 1) which is insulated from the frame and is adapted to form contact at its lower end with the contact 22, as indicated at 47. The contact 46 is so adjusted that when the lever 22 rests within the notch 21 of the disk 20 the circuit will be open, but whenever the contact lever is lifted out of the notch 21, and rests upon the periphery of said disk, the contact screw will rest upon the lever. The tappet screws are so adjusted that the bail frame will be lifted and the contact between the screw 46 and lever 22 interrupted each time any one of the contact actuating levers is moved by a corresponding ratchet tooth.

It is necessary to have an initial circuit through the main contact lever 22 and contact 46 while the lever is resting within the notch 21; this initial circuit being for the purpose of imparting the first step of the return or reading movement to the group of fractional gears. To this end a contact stud 48 (see Fig. 3) is mounted upon the disk 20, and the contact spring 49 is mounted upon an insulating base 50 in position to engage at its free end with the contact stud while the disk stands in its normal stationary position. The spring 49 is so disposed as not to interfere with the forward rotation of the disk.

Next describing the mechanism for rotating the group of fractional gears to take a reading, (see Figs. 4 and 14) 51 designates as a whole a magnet comprising a spool 52 wound to a relatively high resistance, a heel piece or frame 53 and an armature 54. The armature is pivotally mounted upon the frame 53, as indicated at 55, and is provided with a rigid angular extension 56 engaged by a spring 57 of relatively weak tension and tending to move the armature to a closed position. Adjacent to the swinging end of the armature is a vertically disposed lever 58 pivotally mounted at its lower end at 59 to a suitable part of the main frame moving at its upper end within a guide 60. 61 designates a contractile spring connected at its forward end to the lever 58, and at its rear end to an adjustable support 62 having the form of a lever pivoted at its lower end, as indicated at 63, slotted intermediate its length, as indicated at 64, and provided with a set-screw 65, whereby it may be set in any adjusted position to vary the tension of the spring 61. The latter spring is so adjusted as to overcome the tension of the spring 57, and in addition thereto rotate the group of fractional gears through the medium of a ratchet mechanism now to be described. The armature 54 engages the lever 58, (see Fig. 14) and draws it back against the tension of the spring 61 when the magnet is energized. The ratchet mechanism referred to comprises a ratchet disk 66 mounted concentrically with, and rigidly upon the group of fractional gears, and a pawl 67 pivotally mounted upon the intermediate part of the lever 58 and engaging the lower periphery of said ratchet disk. The pawl is held yieldingly against the ratchet by means of a spring 68. A detent 69 is arranged to yieldingly engage the rear side of the ratchet disk to prevent backward rotation of the latter. It will be noted that the teeth of the ratchet disk 66 are relatively small and close together, so that the group of fractional gears is stepped forward but a slight distance upon each reciprocation of the armature; the relations being such that upon each forward step of the fractional gears that one of the counters at the moment in mesh therewith will be rotated just far enough to carry a given ratchet tooth pertaining to that counter past the coöperating contact actuating lever.

A buzzer mechanism is provided (see Fig. 4) through which a circuit is closed momentarily each time the push rod is actuated by the subscriber to tally or register a call. 70 designates as a whole the buzzer, which is of common construction and need not be described in detail; said buzzer being mounted upon an insulating block 71. Upon the insulating block 50 is pivotally mounted a bell crank lever 72, one arm of which, 73, is adapted to form electrical contact with a fixed anvil 74 forming part of the contact spring 49 hereinbefore described. The other end 75 of said lever carries two tappet projections 76 and 77 of insulating material, and is arranged to lie in the path of a pair of shoulders 78 and 78′ upon the upper edge of the push rod 25. The relative position of the shoulders 78 and 78′ is such that as the push bar almost reaches its limit of movement when depressed, the shoulder 78 engages the tappet 76 and closes the contact between arm 73 and contact 74. Upon the return movement of the push rod the circuit is opened as the rod reaches its limit of outward movement. A suitable contact strip 79 is mounted upon the block 50 in electrical connection with the bell crank lever 72 and to which a suitable conductor may be attached.

In order that the subscriber may at any time know how many calls have been accumulated upon his counter, a set of ordinary counting disks 80 is mounted adjacent to the push rod, a ratchet 81 being connected with the units disk and the latter arranged to operate the rest of the train in an ordinary and well understood manner. A pawl 82 mounted

upon the push rod engages and actuates the ratchet 81. The peripheries of these disks project within, and are exposed through an opening formed in the base plate 1. It will be understood that in use the instrument will be provided with a casing inclosing the mechanism, and of which casing the base plate 1 will form one side. 83 and 84 designate a pair of terminals mounted upon an insulating block 85, to which terminals conductors are connected, as hereinafter described.

Next describing the exchange recorder or receiving instrument, and referring to Figs. 6, etc., 101 designates a suitable base upon which are mounted three mechanisms, namely, a relay 102, an instrument 103 responsive to, and moving synchronously with the counter at the subscriber's station and hence, for brevity, designated a repeater, and a counter 104 controlled and actuated by the repeater. The relay 102 may be of any ordinary and suitable construction, that shown herein being a common form of relay comprising a pair of spools 105, an armature 106 pivoted at its lower end between screw points 107 and provided with an upward extension 108, the upper end of which constitutes a contact device and vibrates between a pair of adjustable contact screws 109 and 110, which are threaded through the opposite sides of a goose-neck 112 forming the end of an arm or bracket 111. A standard 113 is provided at a point opposite the armature of the relay, and serves to support one end of a contractile spring 114, the opposite end of which is connected with the armature and tends to hold the latter in open position, or in bearing with the contact screw 109.

Next describing the repeater (see Figs. 6, 6ª and 7), 115 and 116 designate a pair of parallel side frame members suitably mounted upon the base plate and supporting two parallel shafts 117 and 118. Upon the shaft 117 is mounted a group of contact disks, 119, 120, 121 and 122, connected to move together and each provided on its periphery with a cam projection, as 123, of angular peripheral extent substantially equal to the angular peripheral extent of the fractional gears of the subscriber's counter. These cam projections are offset and bear the same relation to each other as do the teeth of the fractional gears to each other. Upon the shaft 117 and mounted to move with the group of cam disks is also mounted a controlling disk 124, which is provided at one point in its periphery with a notch 125, but is otherwise peripherally smooth. 126 designates an armature lever pivotally mounted upon the shaft 118, one end of said lever carrying an armature 127 which overhangs the pole pieces of a magnet 128, while the opposite end of said lever is curved downwardly and provided with a lip 129 adapted to cooperate with the controller disk in substantially the same manner as does the main contact lever 22 of the subscriber's instrument with the disk 20 thereof.

Upon a suitable insulating bar 130 are mounted a plurality of spring contacts designated 131, 132 and 133. The contact strips 132 and 133 constitute a pair arranged in register with each other and adapted to be forced into electrical contact with each other by an insulated tappet 134 upon the back of the armature lever 126 when the latter is in closed position; or in other words, when its lip 125 is riding upon the periphery of the controller disk 124. Upon the shaft 118 in vertical alinement with each of the cam disks is mounted a contact lever 135; these contact levers being of peculiar shape, as best shown in detail Fig. 6ª. The depending ends of the contact levers 135 are suitably shaped to coöperate with the peripheries of the respective cam disks, and are each provided with contact studs, as 137, adapted to engage the corresponding contact strips 131 when said contact levers are riding upon the cam projections of the respective disks. At other times the contacts are open between the said several strips and the contact levers. The contact levers are held yieldingly in bearing with their respective disks by means of springs 136 mounted upon a cross frame member 138, as seen clearly in Fig. 6ª.

The group of contact disks is actuated by means of a magnet designated as a whole 139, and generally similar in construction and arrangement to the main magnet of the subscriber's counter. The armature 140 of said magnet is arranged to engage and actuate a lever 141 (see Fig. 8) pivotally mounted as indicated at 142 upon the base portion of the instrument and rising in vertical alinement with a ratchet wheel 143 fixed upon the shaft 117. Near its upper end said lever is provided with a pawl 144, which engages and actuates the ratchet.

145 designates a change motion lever pivoted between its ends, as indicated at 146, to a suitable support arranged to overhang the upper end of the lever 141. With the upper end of said change motion lever is connected a contractile spring 147 which is adjustably connected at its other end with a standard 148. The lower end of the change motion lever engages behind a stud 149 seated in a recess or divided portion 150 in the upper part of the lever 141; the arrangement being such that the spring 147 acts in opposition to the closing movement of the armature 140 of the magnet. The pivoted end of the armature 140 is provided with an angular extension 140′ through which is extended a set screw 151 which serves to adjustably limit the closing movement of the armature.

Describing the counter 104, 152 and 153 designate parallel side frame members through which extend two supporting rods 154 and 155, and a rock shaft 156. Upon the rod or shaft 154 are mounted four counters designated 157, 158, 159 and 160 respectively. Connected to move with each counter is a cam 161, and also two ratchets, a smaller ratchet 162, which operates to step the counter forward, and a larger star-shaped ratchet 163 by means of which the counter is positively arrested.

164 designates a series of armature levers severally mounted in vertical register with the ratchets 163. Each armature lever is actuated by means of an independent magnet 165, these magnets being arranged in rear of the rock shaft 156 with their spools in upright position, as shown clearly in the drawings. The heel piece 166 of each magnet is extended upwardly to form a standard upon the upper end of which the corresponding armature lever 164 is pivotally mounted, as indicated at 167. The armature levers are normally held uplifted by means of springs 168 connected thereto; the opposite or lower end of each spring being connected with an adjustable tensioning lever 169. The several tensioning levers are conveniently mounted upon a rod 170 supported in suitable brackets; each lever being provided with a set-screw 171 extending through its end and impinging against the base plate whereby it may be held in adjusted position. Upon the forward end of each armature lever are mounted two downwardly depending pivoted pawls, as 172 and 173. The rear and lower one of these pawls 173 serves to engage the smaller ratchet 162 of the corresponding counter and turn the latter forwardly a step upon each depression of the armature lever; while the upper and forward pawl 172 serves as a detent which positively arrests the rotation of the counter and serves to bring its numerals into proper alinement. In order that it may thus act, the pawl 172 reciprocates within a recess or suitable mortise, the side walls 174 and 175 of which limit the extent of movement of the pawl. A spring 176 normally holds the pawl in bearing with the wall 174. The pawl 173 is provided at its front side with a suitable shoulder 177, which engages a corresponding surface upon the armature lever and holds the pawl in proper alinement, each pawl 173 being likewise provided with a spring 178. In order that the armature levers may be limited as to their upward movement, a cross frame 179 is arranged to overhang said levers, and through this cross frame are threaded set-screws 180 the lower ends of which form stops for the levers.

181 designates a series of restoring levers, one for each counter, which levers are mounted upon the supporting rod 155 and are arranged to overhang a rock shaft 156. At its outer end each lever carries a cam roller adapted to coöperate with cam 161 of the corresponding counter so as to return the counter to the zero position when the restoring lever is depressed. Each lever is provided with a contractile spring 182 connected at its lower end to a suitable cross rod 183, and in order to lift said restoring levers simultaneously and normally hold them out of bearing with the cams, an eccentric cam 184 is provided upon the rock shaft 156, said cam being of sufficient length to underlie all four of the restoring levers. The rock shaft is conveniently provided with a cross handle 156′, whereby it may be manipulated.

Referring now to diagrammatic Fig. 20, the system of electrical connections will be described; it being understood that the upper part of the figure represents diagrammatically connections at the subscriber's station, and the lower part of the figure the connections at central. In said figure, L and R respectively designate the main lines, of which only one (left in the present instance) is used for the purposes of the present invention; it being understood that the circuit is from ground at central to ground at the subscriber's station.

Starting from ground 200 at the subscriber's station, a conductor 201 leads to the binding post 83, thence to the insulated contact screw 45. When said contact screw engages the contact lever 22, the circuit may be traced through the disk 20, which in its stationary position is in contact with strip 49, and from the latter to lever 72 (when the latter is in closed position) the circuit extends by way of conductor 202 to the buzzer 70. From the buzzer a conductor 203 leads to binding screw 84, which is in turn connected with the left main line leading back to central. The circuit thus far described is the one which actuates the buzzer each time the push button is depressed by the subscriber to register a call.

Another circuit may be traced through the subscriber's instrument for the purpose of taking a reading, as follows: From ground to contact lever 22, as before, which contact lever is in metallic connection with the frame of the machine. From frame the circuit (represented by a dotted line 204) is to a binding screw 205, and thence by a conductor 206 to and through the main magnet 51, thence by a conductor 207 to the buzzer binding screw 203′, and thence to left main line over conductor 203.

At the central station the main line leads to and through the magnet 139 of the repeater, and thence by a conductor 208 to the contact strip 133 of the repeater, which contact coöperates with the contact strip 132. From strip 132 a conductor 209 leads back to and through the relay, and thence by way of a conductor 210 to battery 211. From the

opposite pole of the battery a conductor 212 leads to ground at 213, an interrupter 214 being interposed in the conductor 212. From a point between the battery and the interrupter 214 a conductor 215 leads to and through the relay, constituting a second winding of the latter, and thence a continuation 216 extends to ground at 213. The main winding of the relay, or that directly connected with the main line, is of relatively low resistance, while the second winding is of comparatively high resistance. For example: the main winding may be of 300 ohms resistance, while the secondary winding is of double that resistance. The magnet 139 of the repeater, and the magnet 51 of the subscriber's instrument will be made of proper resistance to respond to the interruptions of the interrupter whether the circuit for the moment be through one winding or through both of the relay; it being understood that these windings are not opposed to each other. The relay armature, however, operates independently, *i. e.*, the relay armature 106 will be so tensioned by means of the spring 114 that it will remain closed whenever there is current passing through the relay. The armature 106 is made to control another circuit which actuates the exchange recorder, and which circuit connections will now be described.

Permanently connected with the armature 106 is a conductor 217, which extends to the frame of the repeater. From each one of the contact springs 131 a conductor, as 218, 219, 220 and 221 leads to a corresponding magnet 165 of the counter. The opposite side of each magnet 165 is connected with a common return conductor 222, as shown clearly in the diagram. A battery 223 is shown interposed in this circuit, but it will be understood that the circuit may be in multiple with the main battery 211 or other source of power.

The main operatng circuit is normally interrupted at the contacts 132 and 133. In order to afford means for closing the circuit at this point to control the operation of the apparatus, the lever 126 is provided, actuated by means of the magnet 128, as hereinbefore described. The circuit which operates magnet 128 may be, and is shown in the present instance as arranged in multiple with the main battery, and is normally open at a key 224. Upon closing the circuit at said key, the magnet draws down the lever 126, and thereby forces contact 133 into bearing with its coöperating contact 132.

The operation of the apparatus as a whole may now be described. The subscriber tallies each call upon the subscriber's instrument in the usual manner, that is, by operating the push button or lever 25, and in so doing effects two results; first, he steps forward the units counter of the train one step; and secondly, as the actuating lever practically reaches its limit of inward movement it engages the lever 72 and closes the buzzer circuit, thus sounding the buzzer and transmitting an audible signal to the exchange operator, indicating that the call has been registered. In this connection it is to be noted that each time the push rod 25 is operated, the contact lever 22 is lifted to close the circuit to ground, as hereinbefore described.

Whenever it is desired to transfer the accumulated calls at the subscriber's station to the exchange recorder, the operation is substantially as follows: the operator having first connected in the exchange recorder, calls the subscriber and requests him to operate his push button 25. At the same time the operator closes the circuit through the starting magnet 128 by depressing the key 224, whereupon the mechanism begins to operate. The thrusting in of the push button by the subscriber raises the lever 22 and releases the disk 20, and at the same time closes the circuit at the subscriber's end to ground. Instantly the main magnet 51 closes, and upon the first interruption caused by the interrupter 214, (which it will be understood is running continuously), the armature of the magent 80 steps forward the group or fractional gears, and with this the disk 20, thus preventing the lever 22 from dropping back into the notch of the disk when the push bar returns. The mechanism will now continue in operation automatically until the circuit is permanently opened by the lever 22, again dropping into the notch 21 of the disk after the latter has made one complete revolution. The magnet 51 responding to the interrupter 214, will continue to step the group of fractional gears around, and inasmuch as the counter ratchets of the subscriber's instrument move tooth for tooth with the ratchet 66, it follows that the contact screw 46 will be lifted free from the lever 22 a number of times equal to the sum of the ratchet teeth of all of the counter ratchets which pass by their several levers during their restoration to zero. It will be remembered that the fractional gears actuate the several ratchets of the different counters successively so that the contact screw 46 will be lifted successively by the different teeth of the different counter ratchets. Each time the contact screw 46 is lifted away from the contact lever 22, it constitutes an absolute interruption of the main circuit which operates the relay 105. The relay does not, however, respond to the impulses of the interrupter 214, because the current continues to flow through a relay at all times, whether the interrupter be in open or closed position, except when the line is interrupted at the subscriber's station by the lifting of the contact screw 46 out of engagement with the lever 22. It follows,

therefore, that the relay armature will respond only to the interruptions of the circuit at the subscriber's counter, and accordingly the relay-controlled circuit extending through the magnets of the counter at the central station will be opened and closed the same number of times that the circuit is interrupted at the subscriber's counter during the taking of the reading. Inasmuch as the repeater and the contact disks thereof are rotating synchronously with the subscriber's counter, it follows that the current will be switched successively through the different magnets included in the several branch circuits of the relay-controlled circuit; each magnet being operated as many times as the main circuit is interrupted at the subscriber's station while the circuit extends through this particular magnet. For example: assuming the counter at the subscriber's instrumnt indicated "324" when the reading is taken, this would mean that the units counter had been stepped forward three steps, the tens counter had been stepped forward two steps, and the hundred counter had been stepped forward four steps, while the thousands counter had not been stepped forward at all, or remained at zero.

The counters are turned forwardly to restore them to zero in the mechanism constructed as herein described, and it follows that the units counter must be rotated the remainder of a revolution, or seven steps, to bring it to zero, and accordingly its contact lever will be raised, and will, through its connection with the contact screw 45, open the circuit seven times while this units counter is being restored to the zero position. The units counter at the exchange recorder will likewise be stepped forward by its corresponding magnet seven steps, and will show the numeral 3; it being understood that the numerals on the counters at the exchange recorder are arranged to run backwardly considered with reference to the direction of rotation of these counters. In precisely the same way, shortly after the units counter of the subscriber's instrument has been restored to zero, the tens counter or counter will be restored to zero by the engagement of the coöperating fractional gear, and in completing its full revolution it will actuate its contact-actuating lever eight times, which will in turn interrupt the circuit eight times and set up "2" on the corresponding counter of the exchange recorder. The hundreds counter will next be turned to zero, operating its lever six times, and thus turning the corresponding counter of the exchange recorder back to "4". The exchange recorder will therefore at the end of the reading, show "324" while the subscriber's instrument will stand at zero.

In case the central operator wishes to restore the exchange recorder to zero after having noted the reading from a given subscriber, she will simply turn the rock shaft 156 by means of the cross-handle 156', thus rotating the eccentrics into the position shown in Fig. 11, and permitting the contractile springs 182 to draw down the several restoring levers 181, which, acting upon the cams 161, will force the counters back to zero position and arrest them at this point. It will be noted that at the completion of the reading operation, the subscriber's instrument will automatically open the circuit permanently and thus arrest its rotation when the lip of the contact lever 22 drops into the notch 21 of the disk 20.

While I have herein shown and described a preferred embodiment of the invention, yet it will be obvious that both the system of connections and apparatus may be modified without departing from the spirit of the invention.

I claim as my invention:

1. In combination, a tally mechanism comprising a series of tally wheels each provided with a circumferentially disposed series of cams, a corresponding series of levers operatively engaged with the respective cams, a contact actuating device common to all of said levers, a line contact operable by said contact actuating device, a magnet actuated ratchet and gear mechanism for successively returning each of said counters to an initial position, a relay at the receiving station, a repeater at the receiving station adapted to operate synchronously with the main magnet of the subscriber's instrument, an electrically actuated counter at the receiving station, a circuit operably connected with said electrically actuated counter and controlled by said relay.

2. In combination with a circuit extending from station to station, an electrically controlled register at a sending station, a repeater at a receiving station in circuit with the register at the sending station and electrically controlled to operate synchronously with the latter, a transmitting mechanism at the sending station operated by the sending register and adapted to effect current variations differentiated from those which operate said sending register and repeater, a relay at the receiving station responsive to the current variations of the transmitting mechanism, a recording mechanism operable through said relay, and means for intermittently interposing and withdrawing resistance from the circuit whereby the sending register and repeater are operated without operating the relay.

3. In an apparatus for electrically transmitting readings, an electro-magnetically operated register at a sending station, an electro-magnetically operated repeater at a receiving station, a circuit extending through

said register and repeater, means for interposing and withdrawing resistance in said circuit for the purpose of operating said register and repeater without completely interrupting the circuit, a relay at the receiving station connected in said circuit and unresponsive to the reductions of current effected by the introduction of said resistance, a transmitting mechanism operatively connected with the register at the sending station, and adapted to effect current variations to which said relay is responsive, an auxiliary circuit controlled by said relay, and a recording mechanism controlled by said auxiliary circuit.

4. In combination, an electrically controlled register at a sending station, a repeater at a receiving station in circuit with the sending register and electrically controlled to operate synchronously with the latter, a transmitting mechanism connected with the sending register and adapted to effect current variations differentiated from those which operate said sending register and repeater, a relay at the receiving station responsive to the current variations of the transmitting mechanism, and a recording mechanism operable through said relay.

5. In an apparatus for electrically transmitting tactual readings, an electro-magnetically operated register at a sending station, an electro-magnetically operated repeater at a receiving station, a ground-to-ground circuit extending through said register and repeater, a transmitting mechanism operable by the register at the central station, and comprising means for opening and closing the circuit successively and correspondingly to a tactual reading, a relay at the receiving station included in the main circuit and also included in a shunt to the main circuit, an interrupter interposed in one of the circuits extending through said relay, an auxiliary circuit controlled by the armature of said relay, and a register operable by said auxiliary circuit.

6. In an apparatus for electrically transmitting tactual readings, an electro-magnetically operated register at a sending station, an electro-magnetically operated repeater at a receiving station, a ground-to-ground circuit extending through said register and repeater, a transmitting mechanism operable by the register at the central station, and comprising means for opening and closing the circuit successively and correspondingly to a tactual reading, a relay at the receiving station included in the main circuit and also included in a shunt to the main circuit, an interrupter interposed in one of the circuits extending through said relay, an auxiliary circuit controlled by the armature of said relay, a register connected in, and operable by said auxiliary circuit and provided with a plurality of magnets included in different branches of said auxiliary circuit, and circuit-changing devices operable by said repeater for switching the circuit through the several branches of the auxiliary circuit successively, substantially as described.

7. In an apparatus of the character described, an electrically-actuated transmitting mechanism at a sending station, an electrically actuated repeater at a receiving station, a circuit extending through the transmitting and repeating instruments and mechanism for stepping said instruments forwardly synchronously and step-for-step, a set of counters connected to move with the transmitting instrument successively during the restoring operation, a corresponding set of circuit-changing devices connected to move with the repeater and operating to change circuit connections synchronously with the successive restorations of said counters, a receiving register provided with a series of magnets and counters corresponding to the counters of the transmitting instrument and circuit connections controlled by said circuit-changing devices of the repeater, whereby the counters of the receiving register reproduce the record transmitted by the transmitting instrument.

8. In a counter, the combination of a series of counter tumblers, each provided with a mutilated gear and with a circumferentially disposed series of cam surfaces, a corresponding series of segmental gears having their segments arranged in offset angular relation to each other and connected to move together, the untoothed peripheries of said segmental gears being arranged to coöperate with the mutilated portions of the counter gears to arrest the latter in zero positions, means for manually actuating the units tumbler, train connections between the units and succeeding counter tumblers, a series of contact-actuating levers arranged to coöperate with the several cam surfaces of the counting tumblers, and electrical connections for transmitting impulses effected by said contact-actuating levers.

9. In a counter, the combination of a series of counter tumblers, each provided with a mutilated gear and with a circumferentially disposed series of cam surfaces, a corresponding series of segmental gears having their segments arranged in offset angular relation to each other and connected to move together, the untrothed peripheries of said segmental gears being arranged to coöperate with the mutilated portions of the counter gears to arrest the latter in zero positions, means for manually actuating the units tumbler, train connections between the units and succeeding counter tumblers, a series of contact-actuating levers arranged to coöperate with the several cam surfaces of the counting tumblers, and electrical connections for transmitting impulses effected by said contact-actuating

levers. said several contact-actuating levers being arranged to actuate a common contact device.

10. An apparatus for recording and electrically transmitting accumulated calls of a subscriber's telephone instrument comprising a subscriber's tally mechanism having a train of counter wheels each provided with a circumferentially disposed series of cams, a corresponding series of levers operatively engaged with the respective counters, a contact actuating device common to all of said levers, a line contact operable by said contact actuating device, a main magnet, ratchet and gear mechanism operated by said magnet for successively returning each of said counters to an initial position, a repeater at a remote receiving station provided with a series of contact wheels corresponding to the several counters of the subscriber's instrument and each controlling a branch circuit, a main magnet and magnet-actuated ratchet mechanism for operating said repeater synchronously with the main magnet of the subscriber's instrument and whereby said contact wheels of the repeater are caused to close said branch circuits successively, a series of independently operable counter wheels at the receiving station, a corresponding series of magnets each included in a corresponding branch circuit controlled by the contact wheels of the repeater, ratchet mechanisms operable by said last mentioned magnets, a relay having two windings one of which is of relatively high, and the other of relatively low resistance and both of which are connected with the main line extending from the subscriber's station to the receiving station, an interrupter arranged to alternately open and close the circuit as to one of the windings of said relay, an armature coöperating with said relay armature to open and close the branch circuit extending through the several magnets of the receiving station counter, substantially as described.

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