No. 695,933. Patented Mar. 25, 1902.

H. HOLLERITH.

ELECTRICALLY ACTUATED COUNTER.

(Application filed May 22, 1901.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

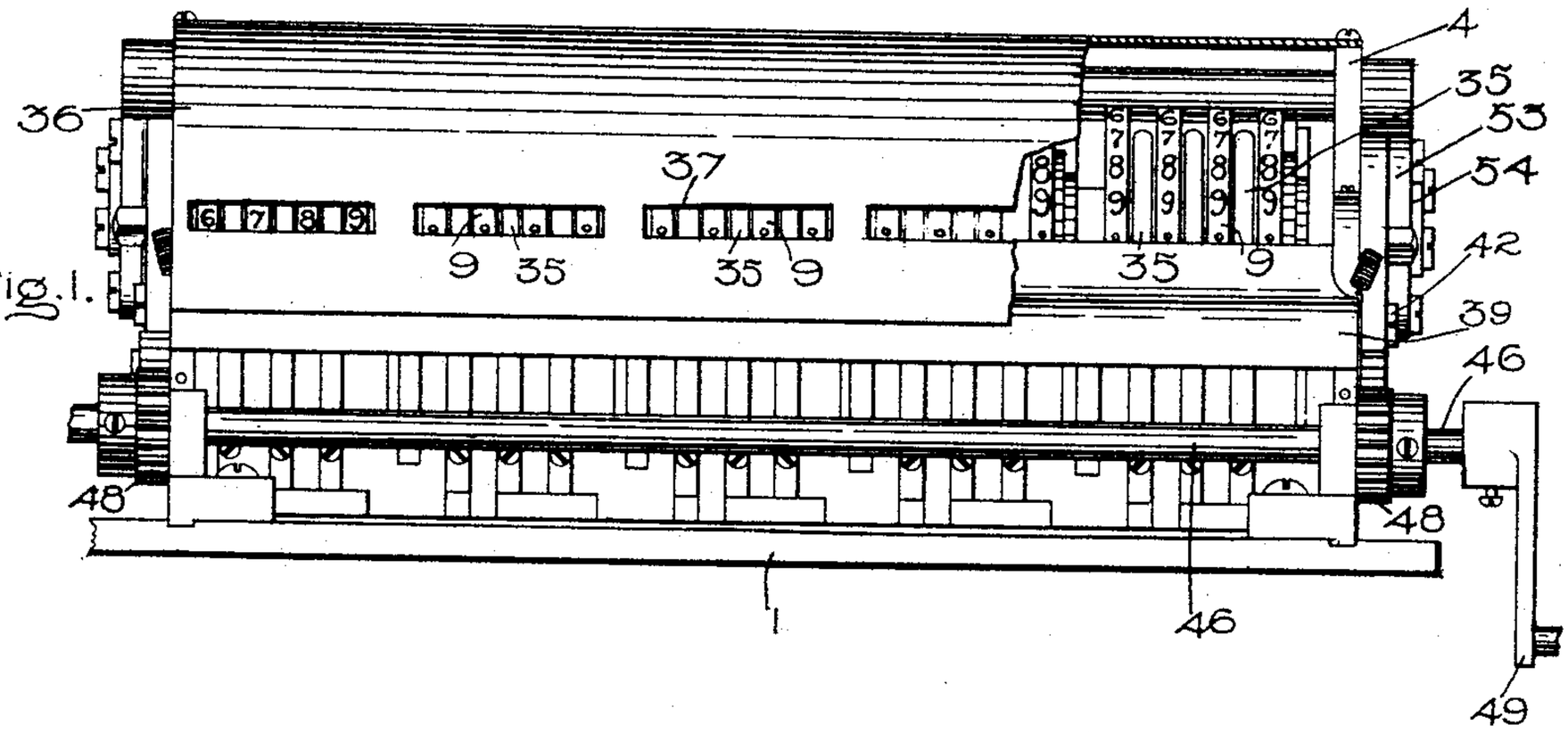
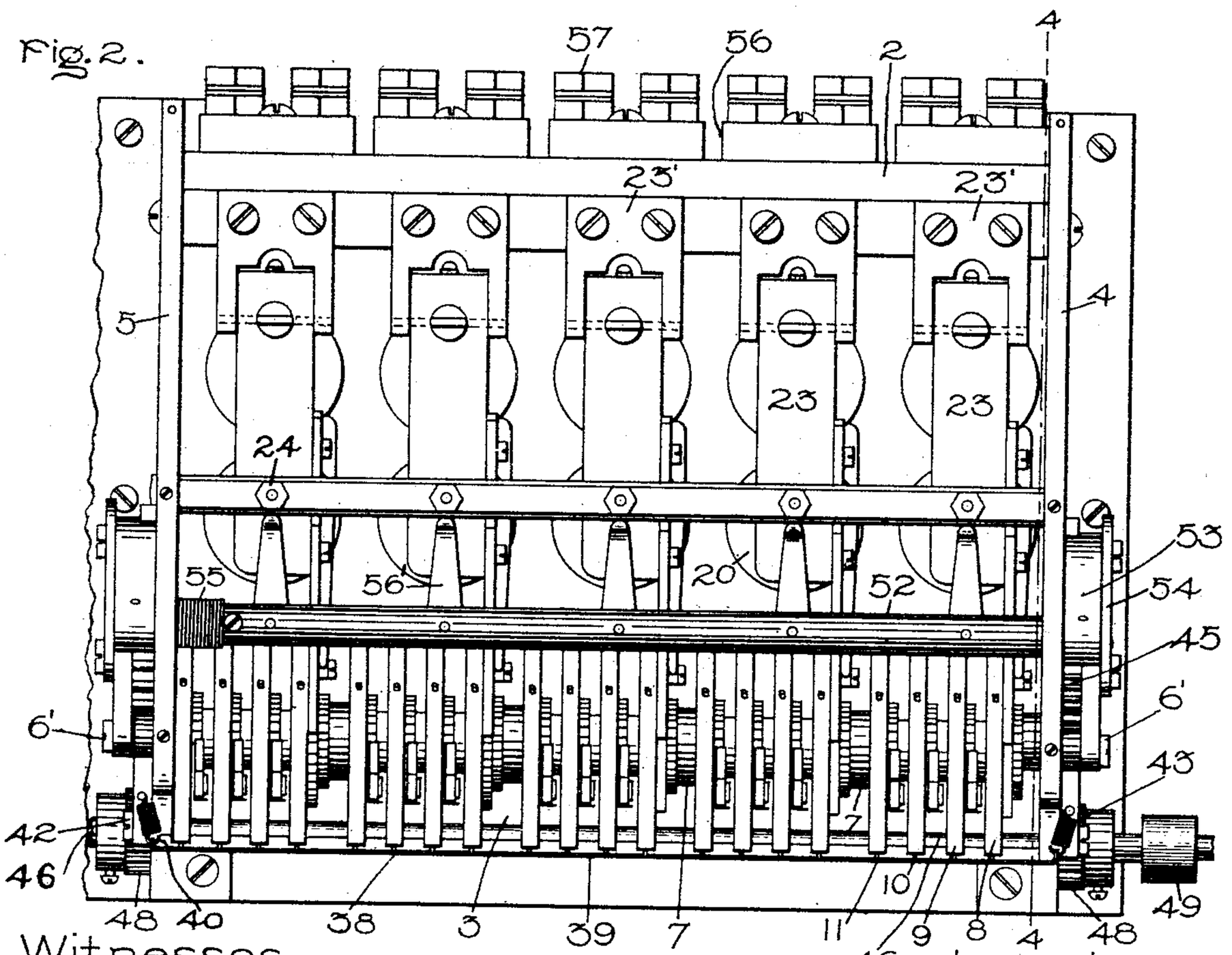


Fig. 2.



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(No Model.) 3 Sheets—Sheet 2.

Fig. 3.

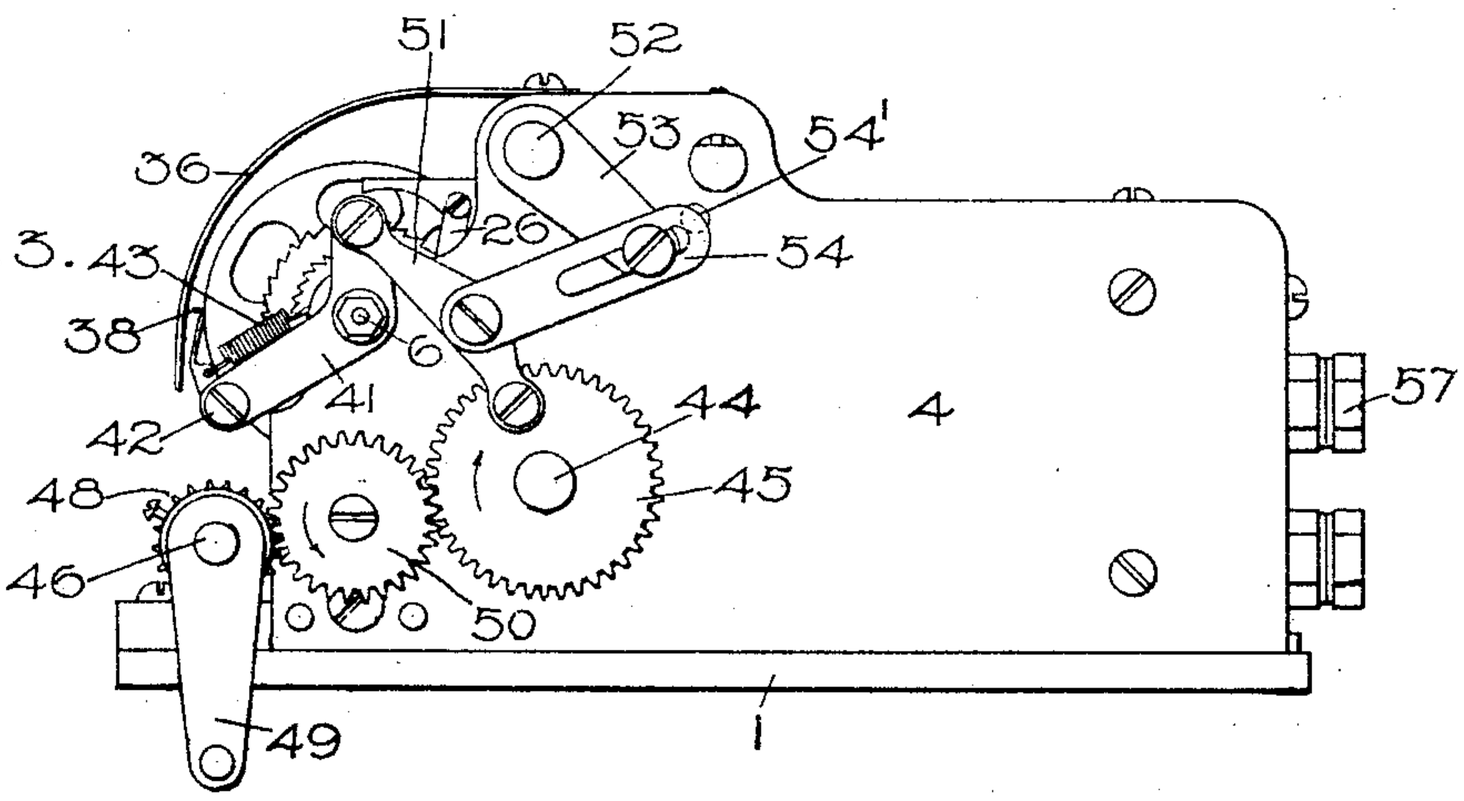

Fig. 4.

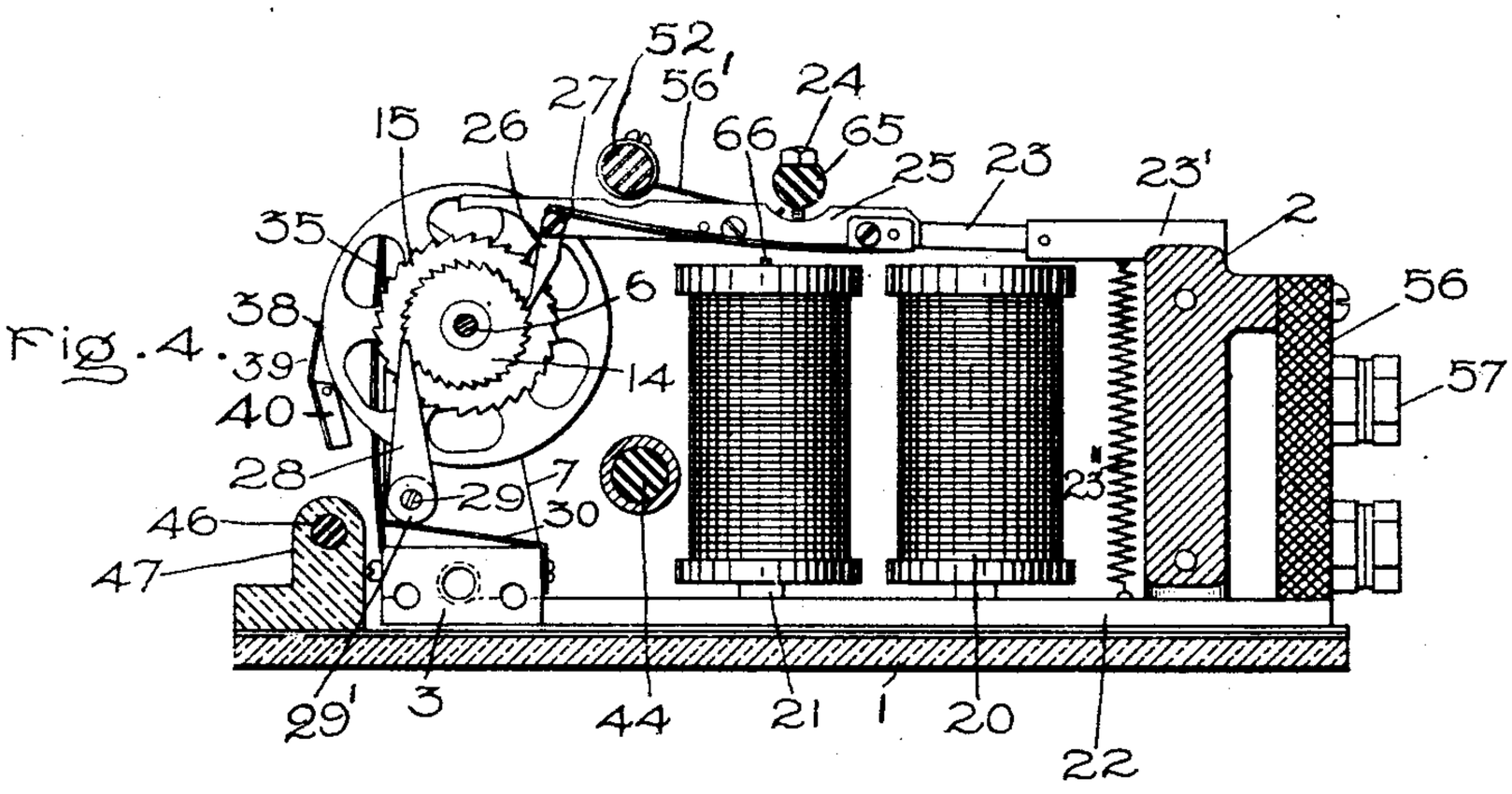

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Fig. 5.

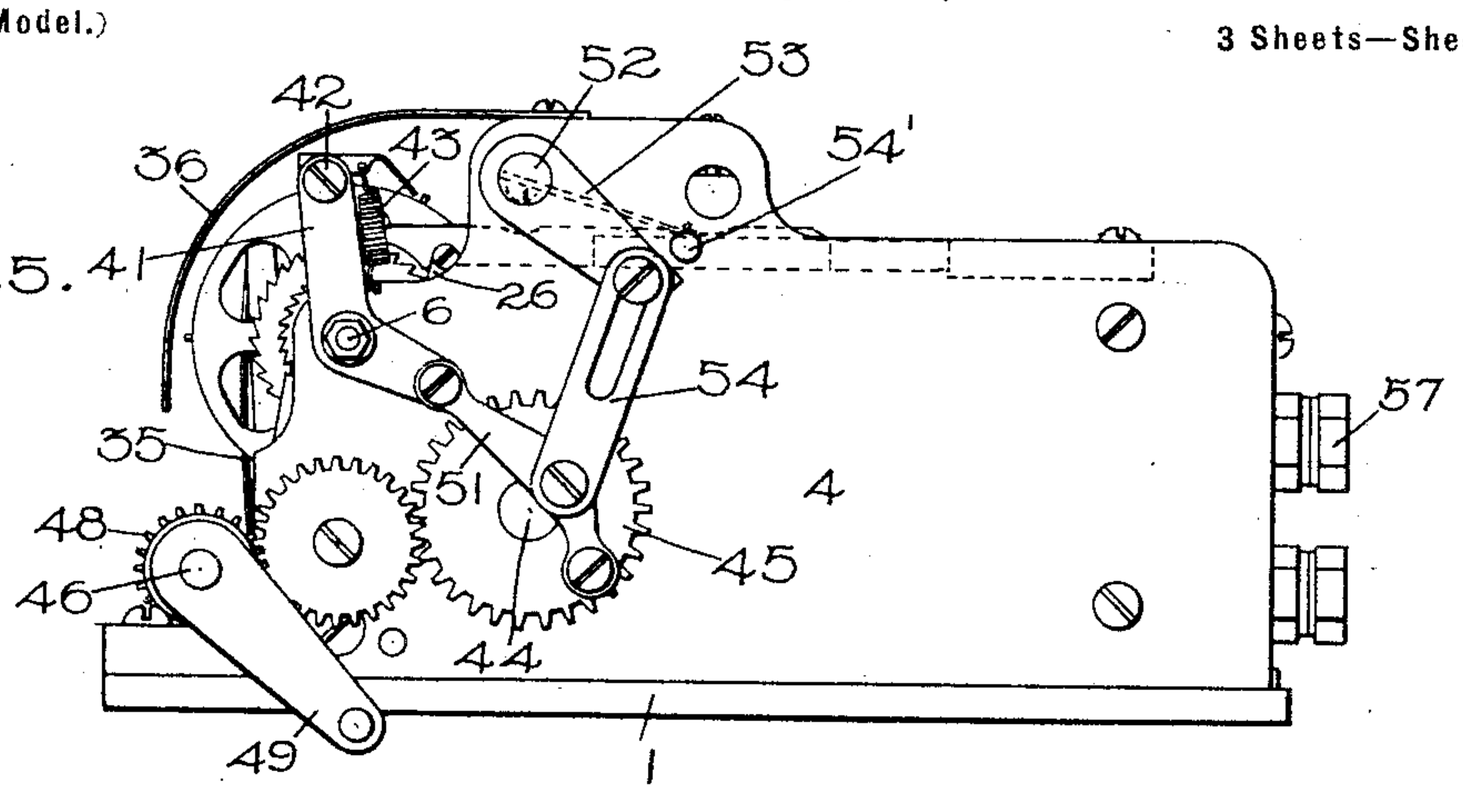


Fig. 6.

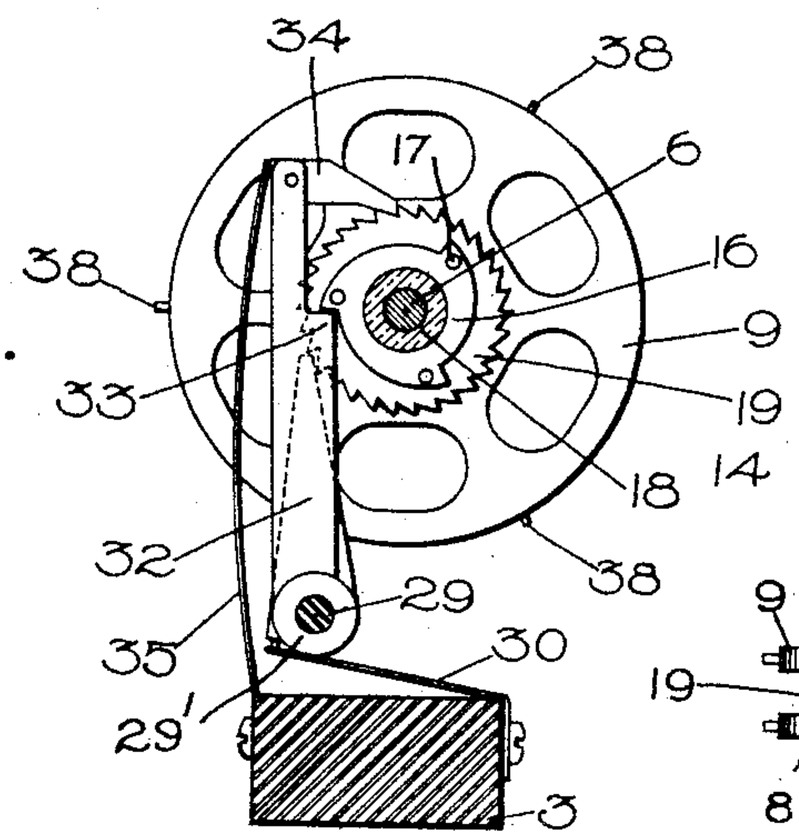


Fig. 8.

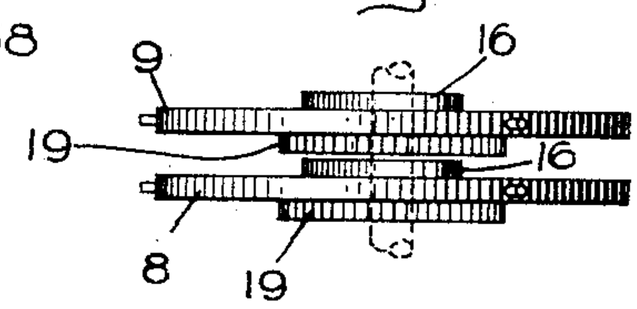
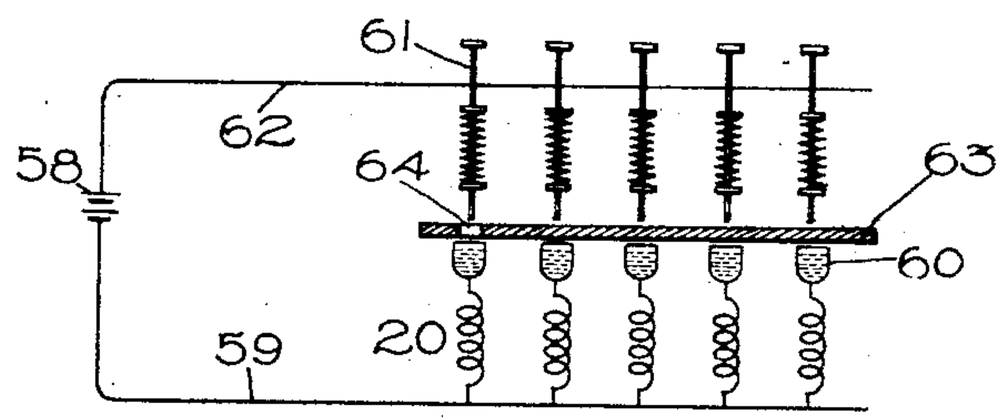


Fig. 7.



Witnesses
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UNITED STATES PATENT OFFICE.

HERMAN HOLLERITH, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO THE TABULATING MACHINE COMPANY, A CORPORATION OF NEW YORK.

ELECTRICALLY-ACTUATED COUNTER.

SPECIFICATION forming part of Letters Patent No. 695,933, dated March 25, 1902.

Application filed May 22, 1901. Serial No. 61,454. (No model.)

To all whom it may concern:

Be it known that I, HERMAN HOLLERITH, a citizen of the United States, residing in the city of Washington, District of Columbia, have invented certain new and useful Improvements in Electrically-Actuated Counters, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

My invention comprises improvements in registering devices by which items of various classes may be counted and which are actuated by the operation of suitable circuit-controlling devices not necessarily located in close proximity to the counters. Counters of this general character are employed by me in the operation of the Hollerith tabulating system; and the object of my invention is the construction of an electrically-actuated counter which shall fulfil certain essential requirements of that and other similar work. The particular field of tabulating-work in which my improved counter is particularly useful is in the compilation of population statistics, where a large number of units of dissimilar character occur, each class or character of units requiring its own individual counter, thus necessitating the employment of a correspondingly large number of counters for each tabulating-machine. It is essential in that and other similar work that these counters should be arranged so that they are within convenient reach of the operator and so that the reading of the counters may be easily, quickly, and accurately made at all times. In this work also a greater or less number of items of dissimilar character are grouped together, and each individual record consists of a number of these groups, so that it is desirable that the counters should be capable of being assembled and reassembled in corresponding groups, each of which contains a greater or less number of separate counters, according to the records being compiled. In accordance with these requirements my invention comprises a registering-counter containing a plurality of rotating counter-wheels having a common axis of rotation and presenting their edges, upon which the numbers are carried, to the front of the machine; transferring and resetting mechanism so arranged as not to interfere with the close spacing of the wheels or the grouping of the counters which must exist to permit readings to be easily made; an electromagnet for each counter arranged directly behind the counter-wheels so as not to project above or beyond the wheels, thus permitting the close grouping of a large number of counters without loss of space, and common supports for the magnets and actuating mechanism of a variable number of counters so that they may be conveniently arranged in groups of any desired number to correspond with the record groups.

Other essential requirements for work of the character above mentioned, where the counters are employed in such large numbers, are a complete interchangeability of parts to permit the reassembling of the counters in new groups and simplicity of construction, by which certainty of operation, freedom from disarrangement, and low cost are secured.

The features of novelty characterizing my invention are hereinafter fully described and claimed.

In the accompanying drawings, which illustrate an embodiment of my invention, Figure 1 is a front elevation of a counter. Fig. 2 is a top plan view thereof. Fig. 3 is an end elevation. Fig. 4 is a cross-section taken on the line 4 4 of Fig. 2. Fig. 5 is an end view, with the resetting-bar in its extreme upper position. Fig. 6 is an enlarged detail view, mostly in elevation, of the means employed for transmitting motion from one wheel in the train to the next. Fig. 7 is a diagram of the circuit connections, and Fig. 8 is an enlarged plan view of a pair of the counter-wheels.

The apparatus which I have illustrated consists of five counters grouped together in one supporting-frame; but it will be understood that a less number may be grouped in this frame and that the frame may be extended to provide for a greater number. Each counter comprises four registering-wheels with carrying or transfer mechanism interposed between them, and as the counter illustrated is designed for the counting of units the first or

units wheel only is actuated by the magnet, the motion of the wheels of higher order being imparted to them only by the transfer devices.

The counters, arranged in groups or sets each of which comprises the desired number of individual counters, are supported upon a shelf 1, which may be of convenient length to support a number of groups end to end. Each group is arranged in a frame consisting of a back piece 2, a front piece 3, and two side plates 4 and 5, which form a support for the various shafts and other moving parts. Grooves are preferably formed in the shelf to receive the lower edges of the side plates 4 and 5; but any convenient method of removably securing the frame to the shelf may be used instead.

Extending across the front of the group of counters and supported at its outer ends by the side plates 4 and 5 is a stationary shaft 6, Figs. 3 to 6, and loosely mounted thereon are the registering or counter wheels. The shaft is supported at intermediate points by bearings 7, Figs. 2 and 4, secured to the front frame-piece 3. The shaft also forms a support for the levers located outside of the side plates, as will be hereinafter described. By removing one of the nuts 6′ and slipping the shaft endwise all of the wheels may be removed. In the present instance four wheels 8, 9, 10, and 11 are shown for each counter, the first being the units, the second the tens, the third the hundreds, and the fourth the thousands wheel.

The construction of the units or driving wheel 8 is best shown in Fig. 4. A ratchet 14, by which the wheel is advanced, and a ratchet 15 for preventing overthrow are secured to the wheel. On the opposite end of the wheel is a three-point cam 16, Figs. 6 and 8, by means of which the transfer mechanism is operated. Three sets of digits from "0" to "9," inclusive, are suitably formed on the edge of each wheel, the cipher in each set of digits being represented by a projecting pin, to be presently described. The ratchets and cam are secured to the wheel by pins 17. The wheels are provided with a central metal bushing, Fig. 6, forming a bearing of substantial length, so that the amount of wear is reduced to a minimum and the life of the apparatus is correspondingly increased.

The intermediate wheels 9 and 10, Figs. 6 and 8, are each provided with a ratchet 19, which engages with a pawl to prevent backward rotation and with a second pawl, from which it receives its forward step-by-step movement. On the left-hand or opposite side from the ratchet is mounted a three-point cam 16, similar to that on the wheel 8.

The end wheels 11 are provided with a ratchet 19, but have no cam, since they do not communicate motion to another wheel. The ratchet and bushing are of the same construction as previously described and are secured in the same manner. When it is desired to record a number greater than nine thousand nine hundred and ninety-nine, additional intermediate wheels are employed of the construction referred to.

From the drawings and description it will be seen that the wheels are simple in construction and that, being made in duplicate, automatic machinery may be employed in their manufacture, thereby reducing the cost of production and providing for the interchangeability of parts. Between the counter-wheels and the back frame-piece 2 is an electromagnet 20, composed of two spools wound with wire, each spool being provided with a core 21. The magnet is relatively tall, but is small in diameter, and the magnet-cores are alined at right angles to the axis of the wheels, so that it can be located directly back of and not extend beyond them. This relative arrangement is very advantageous, since it enables me to make a compact structure and to reduce the size of the apparatus as a whole to a minimum, an essential requirement for the work for which the apparatus is employed. This construction is also advantageous in that it brings the numbers on the wheels into such close proximity that they may be read easily and without liability of error.

The iron or steel cores 21 of the magnet-spools are secured to an iron strip 22, which extends between the back frame-piece 2 and the front frame-piece 3, and as a strip is provided for each magnet the parts of the frame are held in rigid alinement. The back piece 2 of the frame is preferably made of some non-magnetic material, so that the lines of force from the magnet will not be shunted through it and weaken the effect of the magnet, but will pass through the armature. This arrangement gives a very strong pull with a small expenditure of energy. On the back of the frame-piece 2 are mounted insulating-plates 56, which support the binding-posts 57 of the electromagnets.

Situated directly over each magnet and in a position where it can be readily inspected is an armature 23, which is pivotally supported in a non-magnetic piece 23′. To the rear of the armature is secured a tension-spring 23″, which normally holds the armature away from the pole-pieces of the magnet. Extending between the side plates 4 and 5 and acting as a support for the stops 24, employed to limit the upward movement of the armature, is a rod 65. Each stop is individually adjustable and is located at a point where it is readily accessible. The downward movement of the armature is limited by a stop-pin 66, which is made of a non-magnetic material to prevent the armature from sticking to the ends of the magnet-cores.

Placed edgewise on the side of the armature and rigidly secured thereto is a thin plate 25, having a pawl-shaped outer end, which is arranged to engage with the teeth of ratchet-wheel 15 and limit its forward rotative move-

ment to the distance of one tooth whenever the armature is attracted, thus preventing any overthrow.

Pivotally mounted on the plate 25 for advancing the units-wheel in a step-by-step manner is a pawl 26, which is pressed into engagement with the ratchet 14 by the flat spring 27.

The ratchets 15 of the driving-wheels and the ratchets 19 of the intermediate and far-end wheels are arranged to engage with pawls 28, loosely mounted on a shaft 29, which extends between and is supported by the side plates 4 and 5. Located between these pawls are tubular spacers 29′ and also the transfer-levers 32, to be referred to later. The spacers and levers serve to separate the pawls properly and at the same time permit freedom of movement independent of each other. A flat spring 30 bears against the lower squared end of each pawl or against a pin or projection thereon, Fig. 6, and holds it in engagement with its ratchet.

The springs 30 are secured to the back side of the frame-piece 3 by screws, and all are directly back of and in line with the springs 35, which actuate the transfer-levers 32. By this arrangement the springs are protected from injury and are out of the way.

Motion between the units and tens wheel or between one wheel and the next succeeding one of higher denomination is communicated by transfer-levers 32. (Best shown in Fig. 6.) These levers extend between the wheels and are loosely strung on the shaft 29, which also supports the pawls 28. On the inner edge of each lever 32 is a projection or shoulder 33, which engages with the surfaces of the cams 16. To the upper end of each lever is pivotally secured a pawl 34, which engages with the teeth of ratchet 19. These springs are each mounted in a small groove cut in the front frame-piece 3 and are held by a single screw, thus permitting the ready removal of the spring when it is desired to inspect or adjust the transfer-levers, pawls, and ratchets. The heels of the pawls 34 are extended to form a projection above their pivotal points, against which the springs 35 bear. Each spring therefore performs a double function, one being to hold its lever 32 in engagement with the cam-surfaces, so that as the cam is revolved to carry the cam-point past the shoulder 33 the lever will swing inwardly, while the other function is to hold each pawl 34 in operative engagement with the ratchet, so that such movement of the lever 32 will rotate the ratchet and the counter-wheel to which it is secured a distance of one tooth. This arrangement distributes the load on the magnet evenly throughout the movement of the counter-wheels, and by mounting the wheels directly on the shaft independently of each other the friction is reduced to a minimum and I am enabled to arrange the transfer, retarding, and overthrow-preventing devices between the counter-wheels without requiring a wide separation of the counters and without occupying any space at the ends of the wheels, thus permitting the close grouping of the counters and enabling them to be placed closely adjacent to each other end to end. A curtain 36, of metal or other suitable material, provided with a sight-opening 37, through which the figures on the wheels may be conveniently read, may, if desired, be arranged in front of the wheels. Usually in registering-machines separate devices are employed to lock the transferring mechanism or render it inoperative during the resetting of the wheels to zero after the completion of a counting operation. This necessitates an additional number of parts and adds to the complexity of the apparatus and the space required for its operative mechanism either between the wheels or at their ends. To avoid this, I utilize the movement imparted to the wheels by the transfer devices to complete the resetting of the wheels. On each of the wheels in the apparatus, as illustrated, I employ three series of digits from "9" to "0," and each cipher or the position of each cipher is indicated by a pin 38, projecting radially from the edge of the wheel. The resetting-bar 39 extends across the front of all the wheels in each group of counters, and its ends are turned inwardly at 40 to form supports, by which it is pivotally connected to the bell-crank lever 41 by the screws 42. Springs 43 hold the upper edge of the bar 39 yieldingly against the edges of the wheels and permit it to rock slightly on its pivots and pass over the pins 38 on its return movement. The levers and gears employed to oscillate the bar are the same on each end of the counters and a description of those on one end will therefore be sufficient. The bell-crank levers 41 are journaled outside the counter-frame on an extension of the counter-wheel shaft 6. Extending parallel with the shaft 6 and between it and the magnets is a revolving shaft 44, which carries a gear 45. The shaft is supported in bearings in the side plates 4 and 5.

Across the front of the apparatus extends a revolving shaft 46, journaled in suitable bearings 47 and carrying pinions 48 and a crank-handle 49. Mounted between each pinion and the gear 45 is an idler 50, so that the movement of the shaft 46 is imparted to the gear 45 and between the latter and the bell-crank lever 41 by a link 51. By turning the crank 49 to produce one revolution of the shaft 46 the resetting-bar will be carried upward to the end of its movement, engaging with the pins 38 on the different wheels and rotating them until the figure "9" appears through the sight-opening on each wheel. At this point the projections 33 on the transfer-levers are just about to ride off the point of the cam 16 on the wheels, and if the wheels were moved farther by the resetting-bar until the ciphers appeared through the sight-opening the levers would be released and the wheels would be carried past the zero posi-

tion and the figures "1110" would appear on the wheels of the counter. To prevent this without the interposition of locking mechanism for the transfer-levers, I cause the units-wheel to be first moved into the zero position, while the others remain at "9." In the particular form of apparatus herein illustrated I utilize the means normally employed to actuate the counter to produce this movement of the units or driving wheel. The transfer devices will then move the remaining wheels exactly as they would in the normal operation of the counters. In this manner I achieve the beneficial results above mentioned and also cause the wheels to be set to zero position with absolute precision in every instance. The means which I preferably employ to accomplish this result comprise an oscillating shaft 52, which is supported at the ends by bearings formed in the side plates. On the ends of the shaft are levers 53, which receive motion from the gears 45 by means of the levers 51 and slotted links 54. During the major portion of the movement of the gear and link the lever 53 is stationary and is held against the stops 54′ by the coiled spring 55, located on the left-hand end of the shaft 52, Fig. 2. It is only when the connecting-lever 51 continues to move after the end of the slot in link 54 strikes the stud in lever 53 that the lever 53 moves. The shaft 52 is provided with a plurality of flat springs 56′, one for each counter. During the regular operation of the counter these springs are held out of engagement with the armatures; but when the resetting-bar has been moved, as before described, to the limit of its upward movement, as shown in Fig. 5, thus bringing all the "9's" opposite the sight-opening, the further rotation of the crank 49 will oscillate the bar 52 and depress the springs 56′, which will engage the armatures 23 and depress them exactly as they are moved by the magnets in the normal operation of the machine. This movement of the armatures will cause the pawls 26 to advance all the units-wheels from "9" to "0," and the transfer devices for the higher wheels will then be actuated successively, and all the wheels will thus be reset to zero. The rotation of the shaft 46, which moves the springs 56′ to actuate the armatures 23, will also move the resetting-bar back to its normal position below the pins 38 of the next series of numbers on the wheels.

As I have stated, my invention is particularly adapted for use in the Hollerith tabulating system. In such use the electromagnets are actuated by suitable circuit-closing devices, such as mercury-cups 60, Fig. 7, and spring-pressed pins 61, the action of which is controlled by a perforated card 63. In the particular arrangement shown in Fig. 7 the coils 20 of each magnet are connected with one of the mercury-cups, and when the pins 61 are advanced those pins which are opposite perforations in the card will enter their mercury-cups and close a circuit through their respective magnets. The armature of each of such magnets will then be attracted, carrying with it the plate 25 and pawl 26, which will advance the units-wheel one point. This movement of the units-wheel will rotate the cam 16 thereon, forcing back the transfer-lever 32 slightly against the tension of the spring 35, and when, as before described, a sufficient number of impulses have been made to carry the wheel to zero the shoulder 33 on the lever will ride off the cam-point and the lever will be released and advance the next wheel one point. This transferring is continued to the wheels of higher denomination in the same manner.

Although I have described the operation of my improved counter in connection with a tabulating system, I do not wish to be understood as stating that its utility is confined to such use. On the contrary, it is particularly adapted for telephone-exchange and other similar work where the counting of units of varying classes or character requires a large number of closely-grouped easily-read counters.

It will of course be understood that any desired or convenient number of horizontal rows of the connters may be employed and that the resetting-shaft 46 may be extended to operate all the counter-wheels in each row. If desired, also a common operating means for all the resetting-shafts may be provided.

What I claim, and desire to secure by Letters Patent, is—

1. In combination, a rotating element, a motor for actuating said element, a resetting means which moves said element toward an initial position, actuating devices for said resetting means, and means controlled by said actuating devices for completing said movement independently of the resetting means.

2. In combination, a rotating member, a motor for driving the member in a step-by-step manner, a resetting means which moves the member in the same direction as the motor toward an initial position, and a means for causing the motor to complete the act of resetting.

3. In combination, a counter-wheel, a motor device for moving the wheel, a resetting-bar for moving the wheel to a point approximating an initial position, and means acting directly on the motor device for completing the act of resetting.

4. In combination, a wheel, a motor device for moving the wheel, a resetting-bar for moving the wheel to a point approximating an initial position, means comprising a spring, for acting on the motor device to complete the act of resetting.

5. In combination, a plurality of rotary counting members, a resetting-bar for moving the members toward an initial position, means for producing corresponding move-

ments at opposite ends of the bar, and other means for completing the act of resetting.

6. In combination, a plurality of rotary wheels, motors for moving certain of the wheels, means for imparting motion between the motor-driven wheels and the others, a resetting-bar which acts on all of the wheels and moves them toward an initial position, and means acting through the motors for completing the act of resetting.

7. In combination, a plurality of rotary counter-wheels, motors for moving certain of the wheels, a resetting-bar which acts on all of the wheels, and moves them toward an initial position, a cam and pawl for transmitting motion from the driven to the adjacent wheels, and manually operated means which impart movement to the motors and through them complete the act of resetting.

8. In combination, a plurality of rotary counter-wheels, motors for actuating the wheels, a resetting-bar which extends parallel with the wheels, levers located on opposite ends of the bar for actuating it, gearing for moving the levers, means acting on the motors for completing the act of resetting, and mechanical connections between the means and the gearing.

9. In combination, a plurality of rotary counter-wheels, motors for moving the wheels, a resetting-bar which moves the wheels toward an initial position, gearing for imparting corresponding movements to the ends of the bar, an oscillating shaft which acts on the motors, for completing the act of resetting, and gearing between the resetting-bar and the shaft whereby the parts are made to move in proper sequence.

10. In combination, a counter-wheel, a magnet, an armature therefor which advances the wheel, a resetting-bar which moves the wheel toward an initial position, an oscillating shaft, a means carried by the shaft for engaging with the armature and causing it to move the wheel to an initial position, and gearing between the resetting-bar and the shaft.

11. In combination, a plurality of rotary counter-wheels, a pin located in the periphery of each wheel, a motor for actuating the wheels, a bar arranged to engage with the pins for the purpose of resetting the wheels, a means pivoted on the wheel-shaft for moving the bar, a driving-shaft, and gearing between said means and the driving-shaft.

12. In combination, a rotary member, a cam carried thereby, a second rotary member having the same axis of rotation, a lever which engages with the cam, a pawl mounted on the lever, and a single spring for holding the lever in engagement with the cam and the pawl in engagement with the second rotary member.

13. In combination, a plurality of rotary counter-wheels having the same axis of rotation, a cam and a ratchet mounted on opposite sides of the wheels, a lever which extends between each pair of wheels and engages with the cam of one wheel and the ratchet of another for transmitting motion from one to the other, and a motor for imparting an initial movement to the wheels.

14. In combination a plurality of counter-wheels of equal diameter bearing a series of numbers on their peripheries, a shaft on which each wheel is directly but rotatively mounted, a ratchet concentrically mounted on each wheel, transfer devices comprising a spring-actuated lever which stands between each pair of wheels and supports a pawl entirely inside the peripheral line of the wheels for engaging said ratchet, a stop-pawl for each wheel arranged to engage said ratchet, a shaft closely adjacent to the periphery of said wheels on which all the levers and all the stop-pawls are pivotally mounted and springs for actuating the levers and pawls, substantially as shown and described.

15. In a counter, the combination of a plurality of wheels mounted on a common shaft, a frame on which the shaft is supported, pawls for holding the wheels in position, levers for transferring motion from one to the other, a support common to the pawls and levers, springs for actuating the levers, other springs for actuating the pawls, a support which is common to the springs, and a motor for imparting an initial movement to the wheels.

16. In a counting mechanism, the combination of a set of counter-wheels, motion-transmitting mechanism interposed between the wheels, an electromagnetically-operated actuating mechanism for the first wheel of each train, projections on the wheels, a resetting-bar for coöperating with the projections, pivoted means for supporting the bar, and a resetting-shaft having pinions coöperating with the pivoted means.

17. In a counting mechanism, the combination of a frame, a plurality of rotary wheels divided into groups, ratchets on the wheels, a shaft for the wheels mounted in the frame, a base connecting the front and back of the frame, electromagnets mounted on the base, each magnet being located directly back of the set of wheels it operates and having its poles arranged in a line at right angles to the wheel-shaft, armatures for the magnets pivotally secured to a common support, retractile springs for the armatures, actuating means carried by the armatures which engage with ratchet-wheels on the sides of the wheels at a point below the periphery, and a resetting-bar which oscillates outside of the path of the actuating means.

18. In a counter the combination of a plurality of revoluble counter-wheels having a common axis, an electromagnet for each counter located behind the wheels and having its poles alined at right angles to the axis of the wheels, an armature for the magnet carrying a pawl which engages with a ratchet on the units-wheel to advance the said wheel one tooth when the armature is actuated, a trans-

fer-lever arranged between each pair of wheels, a cam on the wheel of lower denomination for gradually setting and quickly releasing the transfer-lever, a pawl carried by the transfer-lever and arranged to engage the wheel of higher denomination, a spring for actuating the lever to effect the transfer, and resetting means comprising fixed projections on the wheels, an oscillating bar, and means for oscillating said bar back and forth over the peripheries of all the wheels in the counter, substantially as shown and described.

19. In a counter, the combination of a plurality of revoluble counter-wheels having a common axis, an electromagnet for each counter located behind the wheels and having its poles alined at right angles to the axis of the wheels, an armature for the magnet carrying a projection which engages with a ratchet on the units-wheel to prevent overthrow, and a pawl which engages with another ratchet on the units-wheel to advance said wheel one tooth when the armature is actuated, a transfer-lever arranged between each pair of wheels, a cam on the wheel of lower denomination for gradually setting and quickly releasing the transfer-lever, a pawl carried by the transfer-lever and arranged to engage the wheel of higher denomination, a spring for actuating the lever to effect the transfer and resetting means comprising fixed projections on the wheels, an oscillating bar and means for oscillating said bar back and forth over the peripheries of all the wheels in the counter, substantially as shown and described.

20. In an electrically-actuated counter the combination with a plurality of counter-wheels, comprising a units-wheel and wheels of higher denomination, resetting means for moving all the wheels simultaneously toward an initial position and for moving the units-wheel into its initial position and means actuated by the movement of the units-wheel into its initial position for moving the remaining wheels into their initial positions.

21. In combination, a plurality of counter-wheels, including a driving-wheel and wheels of higher denomination driven thereby, resetting mechanism common to all of the wheels for moving them toward an initial position, and a means coöperating with said mechanism for causing the driving-wheel to complete the act of resetting.

22. In combination, a plurality of rotary counter-wheels, motors for moving certain of the wheels, means for imparting motion between the motor-driven wheels and the others, a resetting member which acts on all the wheels simultaneously and moves them toward an initial position and means for completing the act of resetting.

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