No. 662,899. Patented Nov. 27, 1900.

H. WINN & C. M. SPALDING.

COUNTING REGISTER.

(No Model.) (Application filed Jan. 22, 1890.) 4 Sheets—Sheet 1.

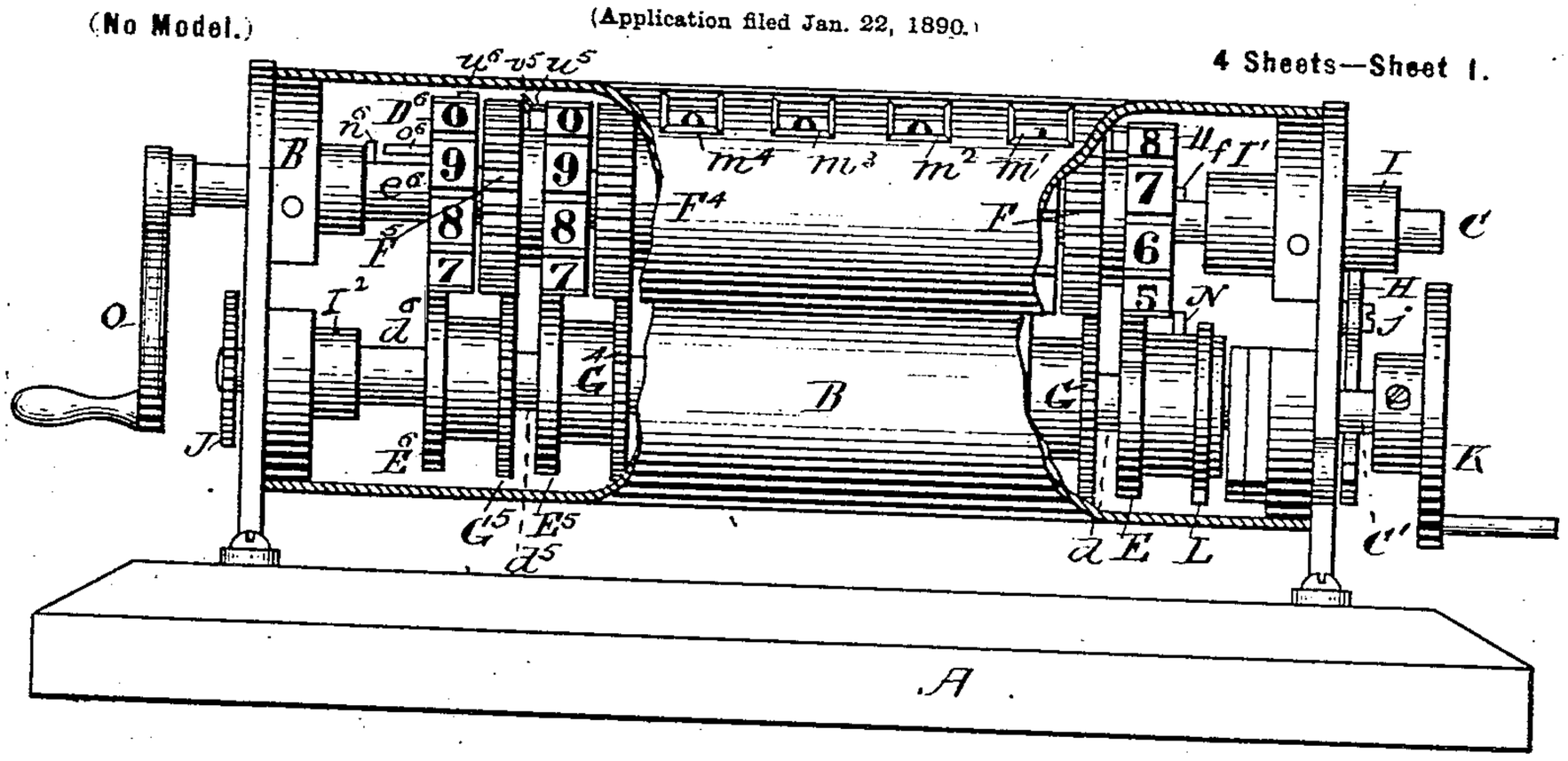

Fig. 1.

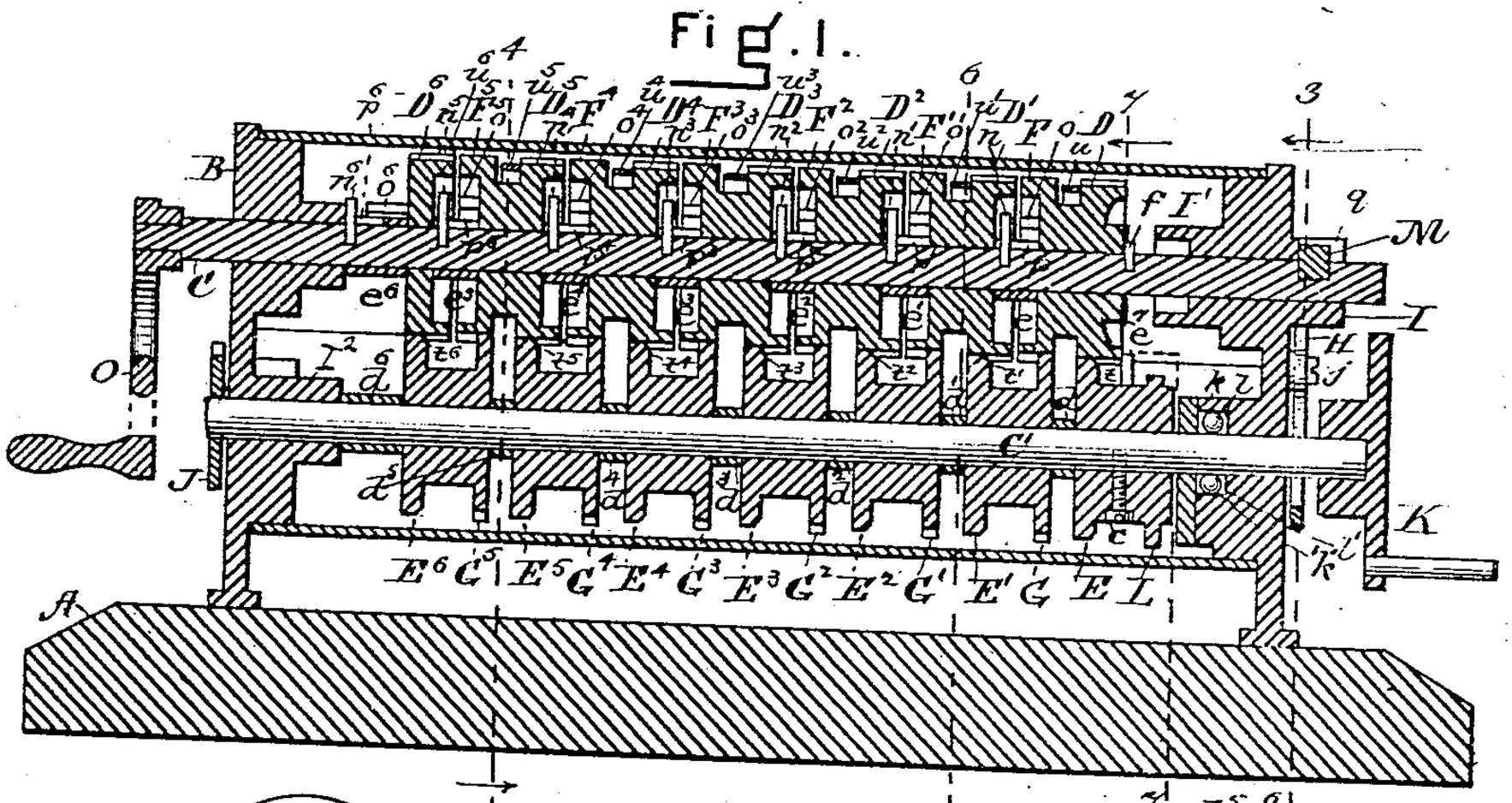

Fig. 2.

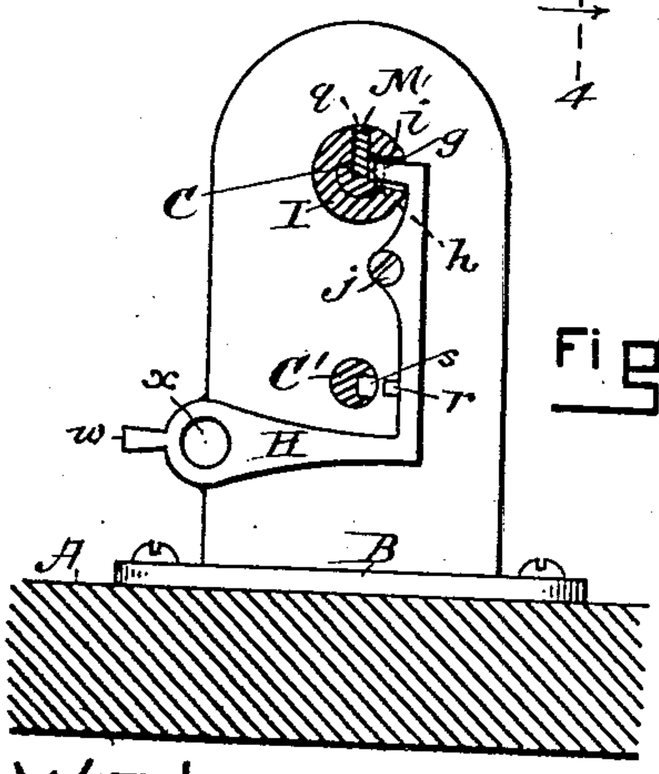

Fig. 3.

Fig. 10.

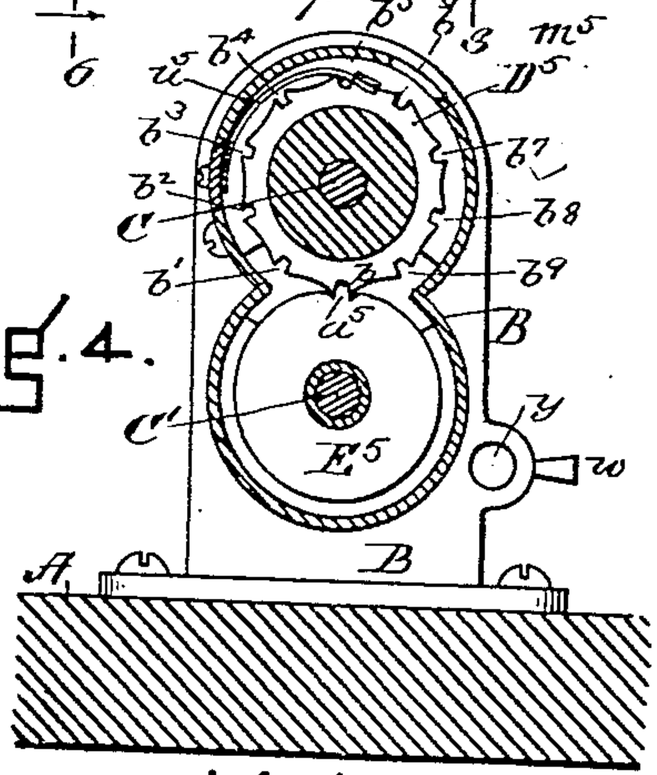

Fig. 4.

WITNESSES.

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4 Sheets—Sheet 2.

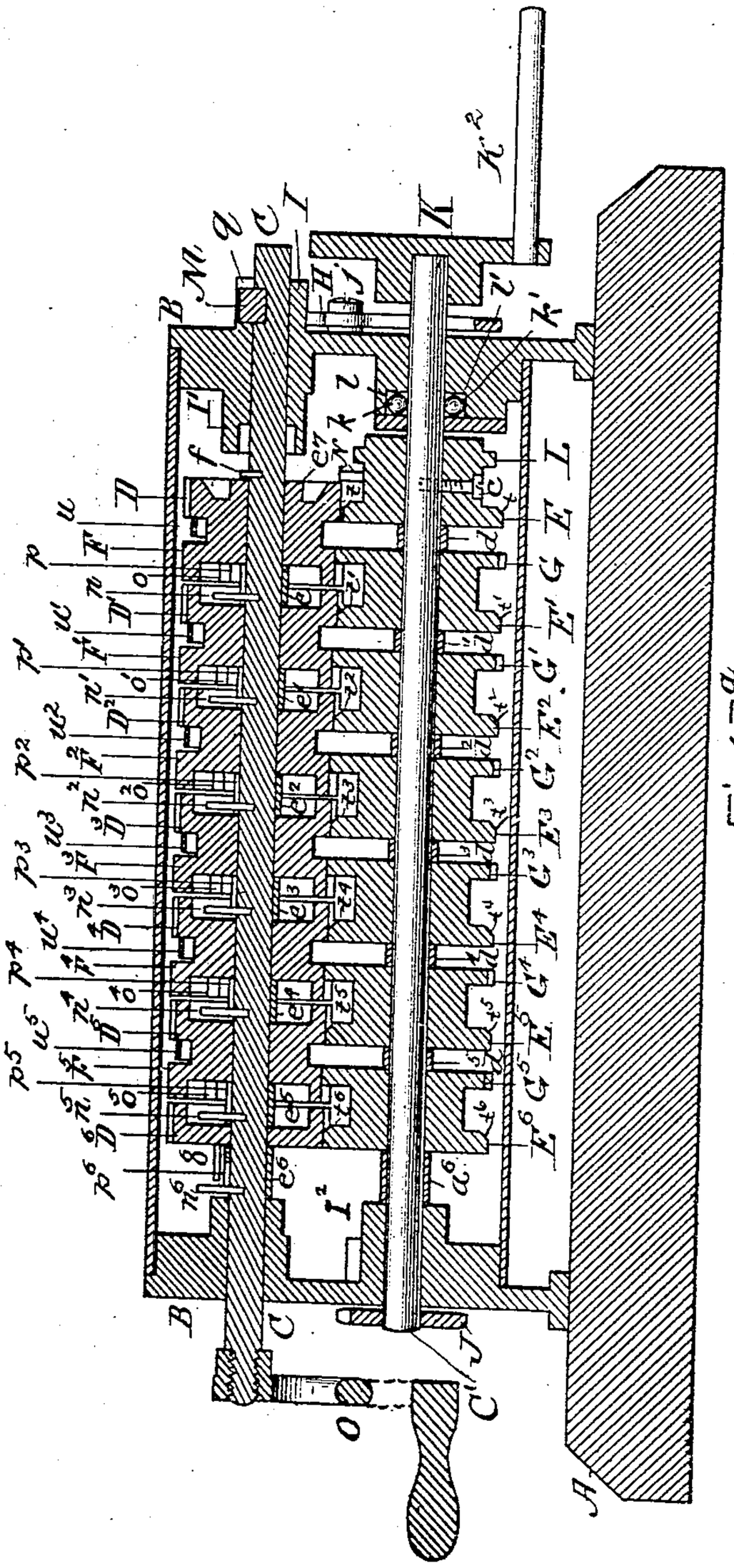

FIG. 2a.

WITNESSES

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(Application filed Jan. 22, 1900.)

(No Model.) 4 Sheets--Sheet 3.

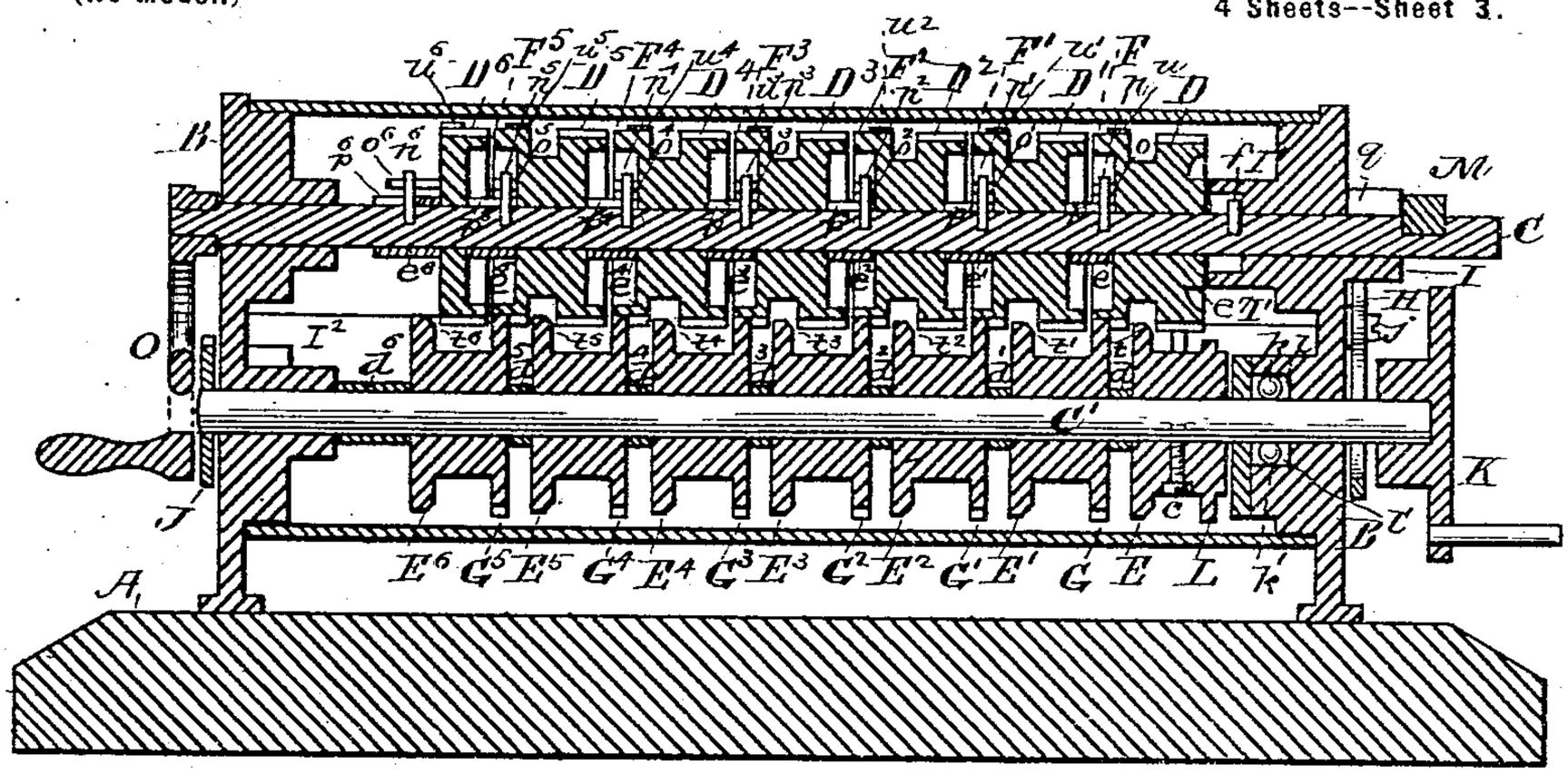

Fig. 5.

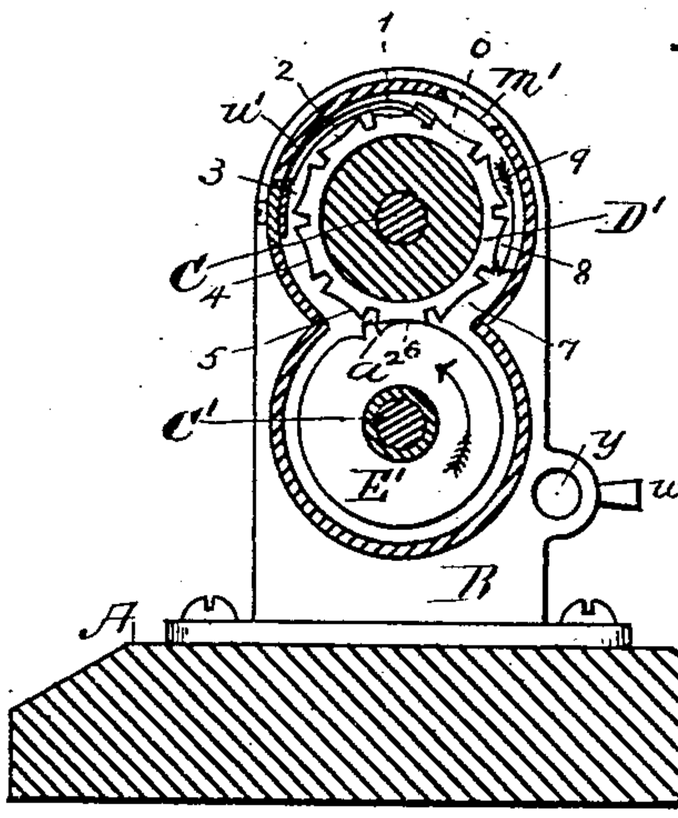

Fig. 6

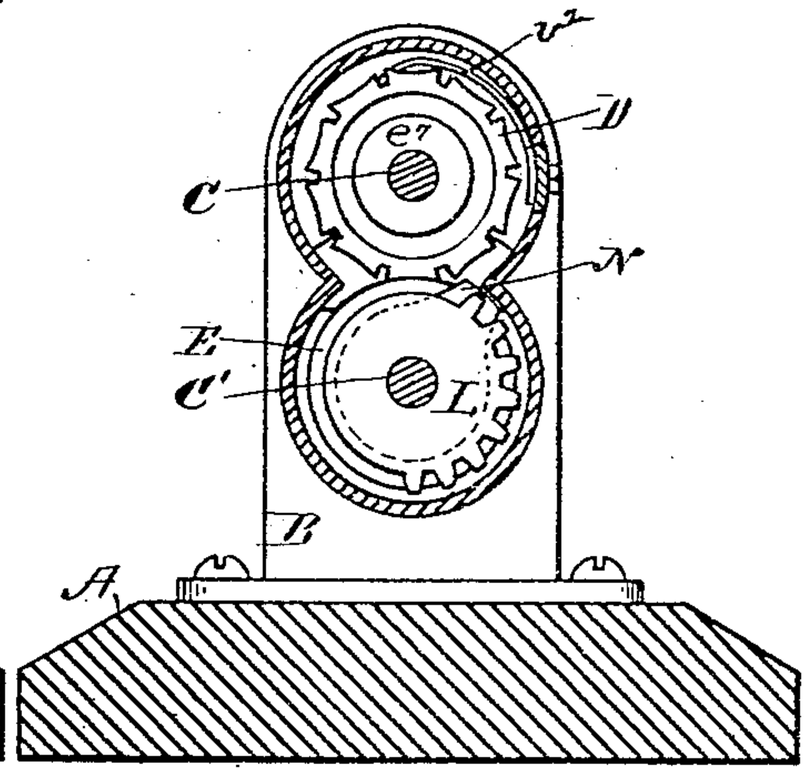

Fig. 7

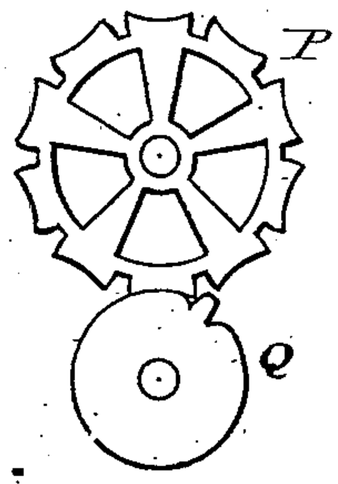

Fig. 8

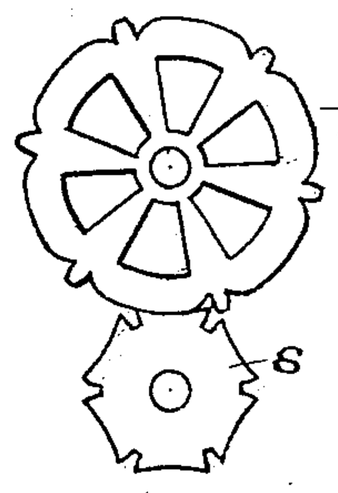

Fig. 9.

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COUNTING REGISTER.

(No Model.) (Application filed Jan. 22, 1900.)

4 Sheets--Sheet 4.

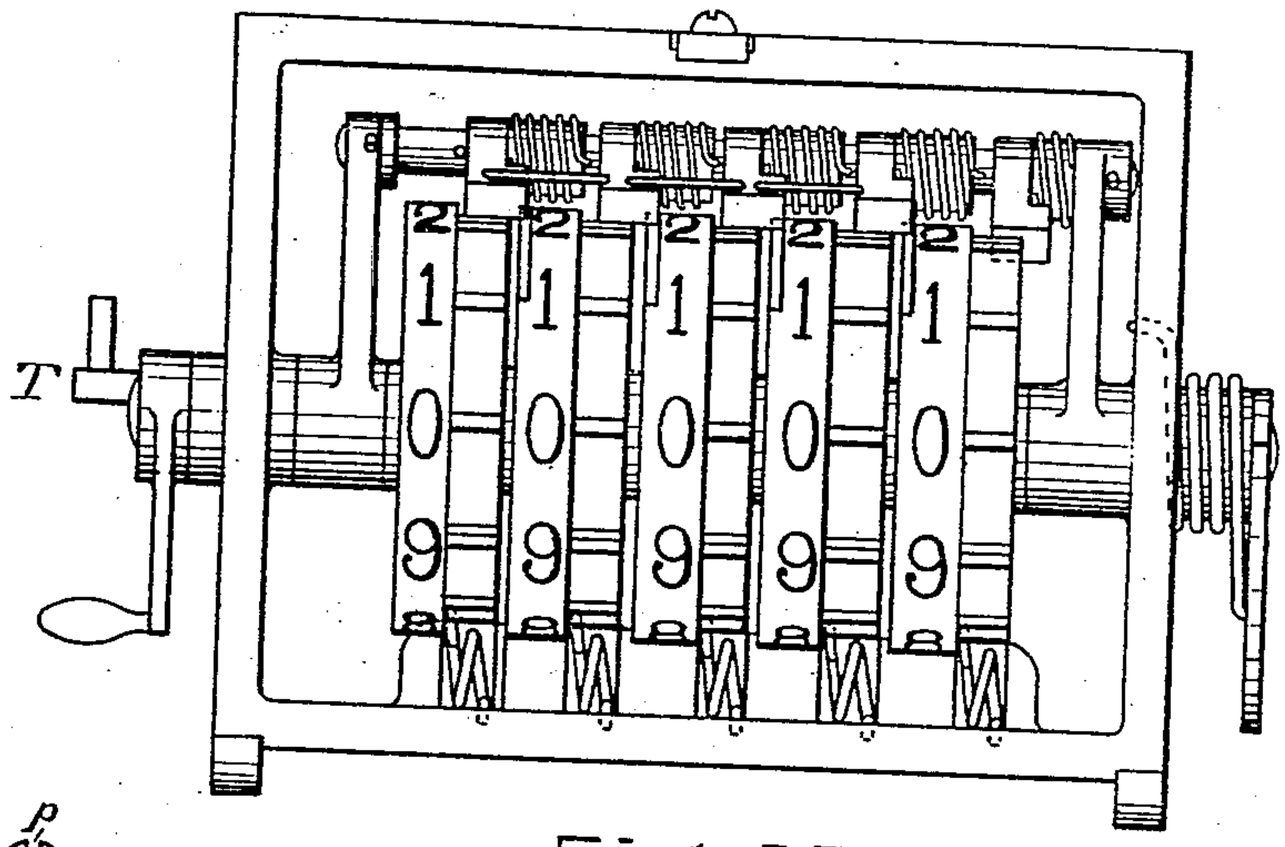

Fig. 12.

Fig. 11.

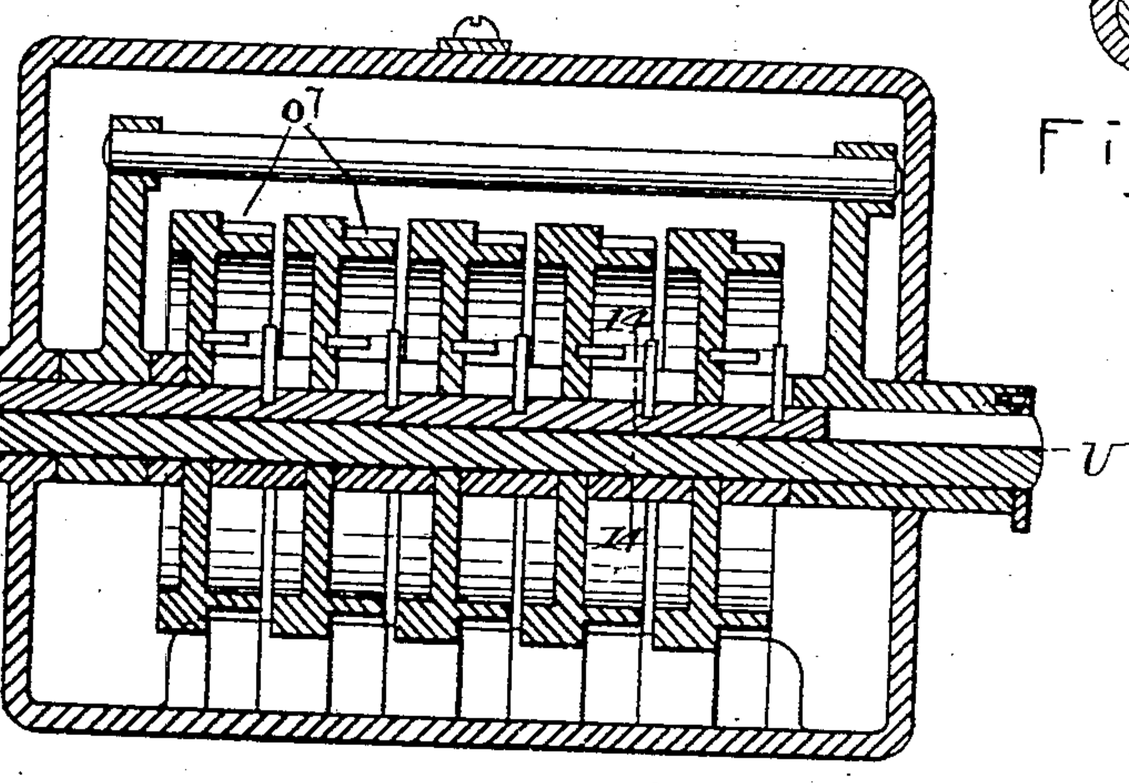

Fig. 13.

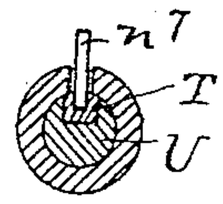

Fig. 14.

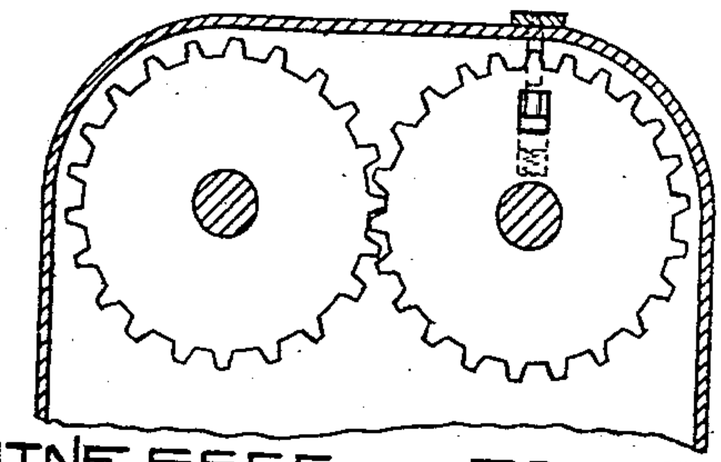

Fig. 15.

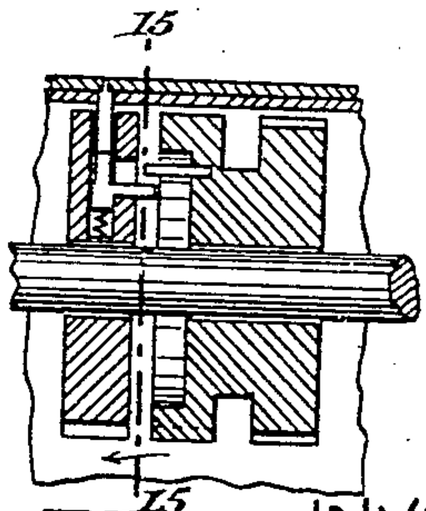

Fig. 16.

WITNESSES.

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UNITED STATES PATENT OFFICE.

HENRY WINN, OF MALDEN, AND CHESTER M. SPALDING, OF BOSTON, MASSACHUSETTS.

COUNTING-REGISTER.

SPECIFICATION forming part of Letters Patent No. 662,899, dated November 27, 1900.

Application filed January 22, 1890. Serial No. 337,763. (No model.)

To all whom it may concern:

Be it known that we, HENRY WINN, of Malden, in the county of Middlesex, and CHESTER M. SPALDING, of Boston, in the county of Suffolk, State of Massachusetts, have invented a new and useful Improvement in Counting-Registers, whereof the following is a specification.

The object of this invention is to secure various advantages in counting-registers, especially to make one easy to work, which cannot make a mistake, in which when locked the count cannot be tampered with, in which when a count is shown the operator can instantly wipe out the count, restoring the operative parts to the position required to begin the count anew, to make a register operative without springs and useful in calculating-machines, and to show results, carry tens, and combine with other mechanism for mechanical calculations. Ease of operation is secured by the use of simple gears, most or all of which are not touched by any spring when operated to count. Accuracy is secured by gearing together the register-wheels in such manner that a mistake cannot occur without breaking the register, while in common registers the wheels are usually turned by spring teeth or pawls which are occasionally thrown over their notches without operating the register, causing mistakes. Instantaneous restoration of the operative parts from any position to the position required to start the count anew is secured by disconnecting the register-wheels from their continuous gearing, connecting a tooth which may be rotated by the operator with a projection on each register-wheel to be restored, and thereby rotating such register-wheel back to its starting position, while the intermediate gears remaining connected with the register-wheels and being allowed to remain meshed with each other are necessarily rotated back to their starting position as the register-wheel is moved back to its own.

In the drawings, Figure 1 is an elevation of the register on a support, with parts of the case broken away to show operative parts. Fig. 2 is a vertical central longitudinal section of the same. Fig. 2^a is an enlargement of the section shown in Fig. 2. Fig. 3 is a vertical cross-section of the same, taken through the line 3 3 of Fig. 2 and showing parts to the left of that line in that figure. Fig. 4 is another vertical cross-section of the same, taken through the line 4 4 of Fig. 2, showing parts to the right with gears partly revolved. Fig. 5 is a longitudinal vertical central section of the same, taken in the same plane as Fig. 2, but showing the operative parts in the position they assume while in process of restoration or resetting them to zero. Fig. 6 is a vertical cross-section of the same, taken through the line 6 6 of Fig. 2, showing parts to the right of that line. Fig. 7 is a vertical cross-section of the same, taken in the zigzag line 7 7 of Fig. 2, showing parts to the left thereof. Figs. 8 and 9 show an outline of an alternative system of register, driving, and intermediate gear wheels used when it is desirable to have the register-wheel large in proportion to its driver. Fig. 10 is an elevation of one of the friction-springs used in restoration or resetting them to zero. Fig. 11 shows in elevation a washer. Fig. 12 is an elevation of another variety of register to which an alternate form of the means of restoration or resetting to zero is applied. Fig. 13 is a longitudinal central vertical section of the register shown in Fig. 12. Fig. 14 is a cross-section taken through the line 14 14, Fig. 13. Figs. 15 and 16 show by sections parts of another variety of register to which another alternative form of the means of restoration is applied, Fig. 15 showing a section through the line 15 15 of Fig. 16.

In Figs. 2 and 5 wheels D F D′ F′ are shown in same positions as other like parts. The lower shaft and screw do not appear as in section in Figs. 2 and 5 and intermediate gears do not appear beyond Geneva gears in the cross-sections.

The same letters in different figures indicate the same parts.

A is the base, upon which is mounted the case B, inclosing the register-gearing, in which case are supported two shafts C and C′, having bearings in the case and located in position relative to each other to carry two sets of gears, of which those on one shaft take into those on the other. Made to rotate on shaft C are the register-wheels D D′ D^2 D^3 D^4

D^5 D^6, seven in the register shown, occupying the seven relative places in decimal notation from units to millions, the one at the right being called the "units-wheel," D' being the tens-wheel, D^2, the hundreds-wheel, and so on in order to the left till D^6 is called the "millions-wheel." Located on the opposite shaft C', in position to take into the register-wheels, are seven corresponding driving gear-wheels, called "drivers," E E' E^2 E^3 E^4 E^5 E^6, each register-wheel and its driver forming the usual Geneva gearing. (Best shown in outline on the shafts in Figs. 4 and 6.) Each driver has one tooth, like the tooth a^5 of driver E^5, which takes into one of the ten equidistant notches on the periphery of the register-wheel connected, (designated on wheel D^5 as b b' b^2, &c., to b^9,) depressions being made in the driver on each side its tooth to permit the entry and passage of the projections of the register-wheel and other depressions between each pair of notches in the periphery of the register-wheel into which the periphery of the driver enters, locking the register-wheel from rotation till the driver-tooth in its rotation enters a notch to rotate it. In the latter depressions of the periphery of each register-wheel in the register shown are engraved or otherwise shown the nine cardinal numbers with the zero in consecutive order, as indicated in Figs. 1 and 6. The driver-tooth operating in one notch only of the register-wheel at each rotation of the driver rotates the former one-tenth of a rotation by each rotation of the latter. This Geneva gearing is peculiarly adapted to use in a counting-register, since the driver, which may be attached to and rotate with any part of which the rotations are to be counted, rotates the register-wheel only one-tenth of a rotation to each of its own rotations, moving it with its own speed when moving it at all and locking it stationary, so that a count may be observed upon it till another count is due, and since the cardinal numbers with the zero appear in consecutive order in the ten equal parts of the periphery of the register-wheel, if the zero-section be taken as the starting-point or observation-section, the counts of the continuous rotations of the driver in one direction will appear at the observation-section (which does not change its place) until the tenth rotation, when zero will reappear there, and if an adjacent wheel be at the same time made to show the figure "1" in the tens position, corresponding to the units position of the zero, "10" will appear, which is the number of the count of the driver. On the same axial shaft and rigidly attached to by being made integral with each register-wheel, except that in the highest place of decimal notation, is an intermediate gear-wheel, located in position to mesh into a corresponding intermediate gear-wheel on the opposite shaft, which latter gear is rigidly attached to the driver of the register-wheel occupying the next higher place in decimal notation. Thus to the register-wheel D, which is in the units place, is rigidly attached the intermediate gear F, which takes into the intermediate gear G, rigidly attached to the driver E', which operates the register-wheel D' in the tens place, so the intermediate gears F' F^2 F^3 F^4 F^5 are respectively rigidly attached to the register-wheels D' D^2 D^3 D^4 D^5 and respectively take into corresponding intermediate gears G' G^2 G^3 G^4 G^5, which are respectively rigidly attached to the drivers E^2 E^3 E^4 E^5 E^6, each connecting pair of intermediate gears thus serving with a driver to gear together two register-wheels, one of which is in the next higher decimal place above the other, and since the intermediate gears, which mesh together, have equal numbers of teeth, one rotating with its connected register-wheel and the other with the driver of the next higher register-wheel, which by its own full rotation rotates that register-wheel one-tenth of a rotation, it follows that each register-wheel of a lower decimal place is geared to the register-wheel of the next higher decimal place in such manner that one rotation of the lower wheel causes one-tenth of a rotation of the next higher, so if the units and the tens wheels start with their zeros in an observation-line a complete rotation of the units-wheel bringing its zero again to that line will throw up "1" to the line on the tens-wheel, if the direction of the rotation be as indicated by the arrows, Fig. 6, and thus the tens of each wheel of a lower decimal place are carried to the next higher and their counts left there registered.

The intermediate gears may of course be of any variety or number which will accomplish this result, and various means may be suggested to transfer the rotation of the register-wheels to the drivers of the next higher wheels in place; but in this case common spur-gears are used, and when they are used it is better that the number of teeth of each shall be a multiple of ten, so that each notch of each register-wheel shall have the same angular position from shaft C as a center as every other relative to a corresponding tooth or notch on its intermediate gear. This will result in placing the numbers always in a true line from right to left for observation. In this register the driver of the units-wheel is rigidly attached by the screw c to the shaft C', (see Figs. 2, 2^a, and 5,) rotating with it, while all the other drivers, the register-wheels, and intermediate gear-wheels rotate on their respective shafts. So in the operation of counting the shaft C' rotates while the shaft C is stationary. Plainly the operation would be equally well effected if shaft C' were made stationary and driver E were rotated on it by any means of connection with the part of which the motions were to be counted.

The drivers are kept at their proper distances apart on shaft C' by loose washers d d' d^2 d^3 d^4 d^5, while another loose washer d^6, acting in conjunction with the wheel E^6, rigidly attached to shaft C' against the case,

holds the set of drivers and attached intermediate gears, as well as the shaft C', in their proper places in the case, although of course projections on the gear-wheels making each fill a designated space would accomplish the same result, or the washers might be rigidly attached to shaft C' without changing their effect, or the shaft C' might be held in place in many ways, one of which would be to make the external wheels shown attached to it to fit on the exterior of the case. Washers e e' e^2 e^3 e^4 e^5 e^6, similar to the former, but slit, as shown in Fig. 11, to permit pins to pass longitudinally in them, serve a like purpose to hold the register-wheels and their attached intermediate gears in place. They are not essential, since the rims of the gears on shaft C might abut and the case be projected against the wheel D^6 as against projection e^7 of wheel D, as shown in Fig. 5, which projection also might be a washer. These washers, with pin f in shaft C, prevent side motion to the left in the case of the shaft C or the gears which it carries, while the tooth g of the pivoted lever H enters a cross slit or opening h in shaft C, as seen in Fig. 3, and while there holds it from motion to the right, while the tooth g itself is solidly held from such motion by the sides of the slot in the projection I outside of the case, through which it passes while its front end is in the shaft, as well as by the screw j on which it is pivoted to the case.

Rigidly attached by screws or otherwise to the shaft C' is the spur gear-wheel J and the crank K, each of which may be used to connect rotating parts or by simple attachments reciprocating parts of which the motions are to be counted.

It being desirable that shaft C' should rotate only in one direction for counting, the common ball-ratchet is introduced, with the two balls k k', located in chambers l l' of the case, so shaped that the friction on them of the shaft rotating in the direction not desired tends to cramp the balls into a space too narrow for them and stops the rotation; but rotation in the other direction, tending to drive them into a space giving them ample room, is not interfered with. Obviously a common spring-ratchet attached to the case and working on the wheel carrying driver E would accomplish the same purpose, though with more noise. If reverse rotation is desired for subtractions from the count, the balls may be removed.

Through the case is cut adjacent to each of the register-wheels an observation-opening, the openings m' m^2 m^3 m^4 being shown, the series standing longitudinally with shaft C.

Attached to driver E is a segment-gear L, (see Fig. 7,) used in driving the driver by a double rack to count reciprocating motions.

The case B may be made in parts, as desired, which may be rigidly screwed, riveted, or otherwise fastened together.

The operation of the device for counting is as follows: Each register-wheel is arranged at starting with its driver in the position of those parts seen in Fig. 6, the zero being brought to the observation-opening and the driver-tooth having the position there shown which it has when it has just ceased to move its register-wheel and the driver has with its periphery locked the wheel into place. Driver E being so attached to the mechanism of which the motions are to be counted as to be rotated once for each count desired is rotated in the direction indicated by the arrow on the driver seen in Fig. 6, driving its register-wheel in the reverse direction. Plainly the first rotation of the driver E will bring the number "1" on the wheel D to the observation-opening; the second, the figure "2;" the third, "3," and so on, each rotation bringing there the number indicating its count, till at the tenth rotation zero will return there. At the same time the ten rotations of the driver E have caused one rotation of the driver E', at the end of which the figure "1" of the tens-wheel is brought to its observation-point, making the count show correctly "10," so the "1" remains, registering the first ten rotations of driver E, while the additional ones are shown in the units-opening till ten more rotations bring "2" to the tens observation-point and zero to the units, showing the number "20," the correct count of the rotations of the driver E always appearing. In like way "1" will be added to the count of the hundreds-wheel by ten rotations of the tens-driver E' and zero will appear at the tens and units places, the count reaching "100." So the count proceeding the tens will be carried from the register-wheel in each lower decimal place to the one in the next higher and the true count of the rotations of the driver E will always appear in the line of observation-points till "9,999,999," the limit of the register, shall be reached, after which the parts will all assume their starting position. Subtractions from the count may be made, if the bells k k' be removed, by simply reversing the rotations of the driver E, when the counts before shown will reappear in reverse order; but the register will rarely be required to count up to its limit, wherefore some means are required when any count is being shown to restore all the parts to their starting position for beginning anew, at which in this register the figures in the observation-sections show zero. This process is called "restoration," and is thus accomplished:

A series of shaft-pins n n' n^2 n^3 n^4 n^5 n^6 are set into the shaft C in position when the shaft is moved longitudinally to the right from its position shown in Figs. 2 and 2^a and rotated to engage with corresponding wheel-pins o o' o^2 o^3 o^4 o^5 o^6, rigidly fastened into the united register and intermediate wheels and the register-wheel D^6, (provided said wheels are held from moving longitudinally with the shaft and held by friction applied or otherwise from rotating with the shaft, except as they may be rotated by said engaging pins,) and to rotate

by such engagement said united register and intermediate wheels and the register-wheel D^6. Space is made between each register-wheel and the intermediate wheel attached to the next lower register-wheel by chambering out the wheels adjacent to the place where space is required to locate said wheel and shaft pins and permit them to rotate in the ordinary use of the register for counting without interfering with each other. Chambering out of one or both the adjacent wheels in this way permits the observation-points of the register-wheels to be constructed nearer together. The washers $e\ e'\ e^2\ e^3\ e^4\ e^5\ e^6$ have slits $p\ p'\ p^2\ p^3\ p^4\ p^5\ p^6$, permitting the shaft-pins to pass longitudinally in them; but the slit p^6 does not pass through washer e^6, its end affording a stop against which pin n^6 abuts when the shaft-pins have been carried far enough longitudinally with the shaft C to engage with the wheel-pins, after which pin n^6, if the shaft moves further longitudinally, drives the series of register and attached intermediate wheels with it and the shaft in such motion. In the shaft C is a spline consisting of a key M, working in a slot q of the projection I of the case. This key acting against the sides of the slot prevents the shaft C from rotating until it is passed out from said slot q, and as the tooth g prevents this passage when the register is used for counting this shaft does not rotate during that process, though such rotation would not interfere with the counting, nor is the prevention of this rotation essential to restoration to zero; but its advantage consists chiefly in keeping the shaft-pins at a proper starting-point, where they cannot strike the ends of the wheel-pins when moving with the longitudinal motion of the shaft to engage them, said wheel-pins when the tooth of the first driver E is not in its notch having each only ten angular positions, counting from the shaft as a center, in which they can stand, and the starting position of each of the shaft-pins being arranged with reference to these positions, so that the shaft-pins shall not impinge the ends of the wheel-pins when so moving to engage them. To make sure that this tooth of driver E shall not be in the notch of its register-wheel when the parts are moved into position for restoration to zero is one of the purposes of the projection N, which is located on the part integral with the driver E in a line with said tooth longitudinally of shaft C′ and near enough to the register-wheel D when engaged by the tooth of driver E to prevent sidewise disengagement until the tooth has passed out of the register-wheel and the periphery of driver E has locked the register-wheel from rotation.

Another provision secures the same end—namely, the tooth r on lever H rides on the periphery of the shaft C′, and thereby prevents the tooth g from disengaging with shaft C at all times except when the socket s of shaft C′ is in position to admit the former tooth r, which only occurs when the periphery of the driver E, and not its tooth, is in the register-wheel D, and the tooth r locks the shaft C′ in position at all times when the tooth g is not entered in the shaft C, locking that so that during counting the shaft C is locked and the gears it carries held in place for the count by tooth g, and during restoration the shaft C′ is locked by the tooth r, one shaft being always stationary.

The intermediate gears F F′ F^2 F^3 F^4 F^5 are considerably wider than the gears G G′ G^2 G^3 G^4 G^5, with which they engage, the excess of width being on the left of the latter in their positions shown in Figs. 1 and 2, so that the intermediate gears on the shaft C may be moved enough to the right from their positions as shown in those figures to disengage the series of drivers E E′ E^2 E^3 E^4 E^5 E^6 from their respective register-wheels (since those drivers are located on the left-hand edges of their register-wheels) without disengaging the intermediate gears.

Each driver is chamfered a little at its outer corner on the right in the position thereof seen in Figs. 1 and 2, forming the inclines $t\ t'\ t^2\ t^3\ t^4\ t^5\ t^6$ wherever on the periphery of each driver it is intended to draw the register-wheel into gear with it after separation for the process of restoration to zero, but which inclines may without much detriment pass entirely around the driver, and so may be made cheaply by being turned off. These inclines may equally well be made on the register-wheels by chamfering off the outer left-hand corner of each through its periphery on the side where it enters into engagement with its driver in the same manner as the driver is shown to be chamfered or may be made, as described, on both driver and register-wheel. Their purpose is to aid in the adjustment together of the register-wheels and drivers when pushed or drawn sidewise into gear when one is not exactly in the correct position to pass into engagement with the other. The inclines will by impinging against the opposite wheels adjust the position of either wheel slightly, so that the making of the parts does not require that nicety which would be required to prevent the blocking of properly-made gears when being brought into engagement sidewise without the inclines. They are not, of course, indispensable, for that nicety may be used, or if the gears operate very loosely they may be brought together without them; but the latter construction is objectionable and the former costly.

One of the advantages of using Geneva gear in this register is the facility with which the driver and register-wheel may be brought into gear together when the periphery and not the tooth of the driver is presented sidewise to enter engagement with the register-wheel, which position is the only one in which these parts are permitted to engage each other, since the devices described prevent the driver E and the register-wheel D from entering engagement except in that position,

and the gears are so adjusted that when the tooth of the driver E in counting is left out of its notch all the other driver-teeth must be left out of theirs. In this position an accidental partial rotation, which would bring a tooth of an ordinary spur-gear to abut directly sidewise against the tooth of the spur-gear it is to enter, and therefore block against engagement, would only slightly project the register-wheel beyond the position where it would engage the driver sidewise so little that a slight bevel (or incline *t*) would correct the error.

Located in the depressions between the register and attached intermediate gear-wheels on the shaft C are friction-springs *u u' u² u³ u⁴ u⁵*, which have no function in the ordinary use of the register for counting and do not then press upon the gears. These springs are used to counteract any tendency of the united register and intermediate wheels to rotation by friction of the shaft C rotating in them to hold them from accidental misplacement when the register-wheel and its driver are ungeared for restoration to zero and prevent their overrotation. Since the register-wheel D^6 is attached to no intermediate gear, a like spring u^6 is made to bear directly upon it for like purposes, which is unobjectionable in counting owing to the very rare use of that wheel; but if it be desired that the device be springless when used for counting a projection like an intermediate gear might be attached to its left side, as seen in Figs. 1 and 2, as the intermediates are attached to the other register-wheels, when the friction-spring u^6 might be made and operate like the others. Each of these friction-springs is attached to the case, and they may all be fingers of one comb-spring so attached. Each of them (except spring u^6, which does not leave the periphery of register-wheel D^6) is like the spring shown in the enlarged view, Fig. 10, having an inclined projection like the projection *v* thereon and v^5, (seen in Fig. 1,) which inclines serve to raise the springs up to bear on the intermediate gears on the shaft C when those gear-wheels are pushed to the right, as seen in Fig. 5, passing under the inclines.

For convenience of manipulation a crank O is attached to shaft C and a projection *w* to lever H, which lever has a circular opening *x*, which when shaft C is locked in its counting position by tooth *g* coincides with another like opening *y* in a projection of the case, in which position the parts may be locked by a padlock by passing the hasp through these openings *x* and *y*, which, since all the gears interlock, will prevent tampering with the count.

The process of restoration is as follows: The shaft C' is turned till the socket *s* will admit the tooth *r*, in which position the tooth of the driver E has passed out of its notch in the wheel D. Then the lever H is turned on its pivot till the tooth *g* passes out of shaft C, which cannot occur till the tooth *r* enters the socket *s* in shaft C'. Shaft C is then pushed into its position seen in Fig. 5. This motion first drives the shaft-pins far enough to the right from their position seen in Fig. 2 so that if rotated they will engage the wheel-pins, as seen in Fig. 5, when pin n^6, striking washer e^6 in its slot, pushes the whole series of gears on the shaft C, moving them, with the shaft, till the projection e^7 brings up against the case, which has a projection I' to receive it, when the series is confined between the pin n^6 and this projection and the several gear-wheels on the shaft C have been pushed so far to the right from their position seen in Fig. 2 (the gears on the shaft C' remaining stationary) that all the register-wheels are ungeared from their drivers, (and can be rotated independently of them,) but not so far as to ungear the intermediate wheels. The same sidewise motion to the right projects the intermediate wheels on the shaft C against the inclines *v* v^6, &c., of the springs *u* u^6 (which are held from sidewise motion by attachment to the case) and lifts the springs till they bear on the tops of the intermediate wheels, resisting by friction the rotation of these and the register-wheels. Spring u^6 is not so lifted, but always bears on the periphery of wheel D^6. Shaft C is then rotated till its shaft-pins engage the several wheel-pins wherever they may find them left in the process of counting (the key M having been passed out of the slot *q* to permit this rotation) and until the key M has made a complete rotation, reaching again its position to enter the slot *q*. The two series of pins are so adjusted relative to each other that this complete rotation of shaft C, which necessarily engages the wheel-pins with every register-wheel, giving a common rotation to all, brings simultaneously all the zero-figures of those wheels into the line of observation-points at the instant when the key M has reached its position to enter the slot *q*. This key M has a bearing in rotation on the outer face of projection I, which holds the various parts on shaft C in proper position during restoration to zero by its action in conjunction with the pin *f*, which bears on the inside, and pin n^6. Of course the gears could be held in place by hand-pressure without key M during this process, but it is a convenient help; and a slight drawing pressure on shaft C during the process is of advantage, for key M will then drop into slot *q* and mark the completion of the required rotation. Obviously when the register-wheels have been set in the count on different numbers their pins will be at different points of their circle of rotation, but wherever they are the shaft-pins will find them and in the single rotation of shaft C will rotate the register-wheels to their starting-point, which, all rotating together, they will reach simultaneously.

The drivers must of course be restored during the process to their starting positions, as seen in Fig. 6. This is effected by leaving the

attached intermediate gears always in engagement during restoration as well as during the count. The ungearing of the register-wheels and drivers (shown in Fig. 5) breaks up the gearing into independent sets, consisting each of a register-wheel, its attached intermediate gear, the connecting intermediate gear, and the driver attached to that. The wheels of each set rotate together—that is, the register-wheel propels the others to rotate the same number of times that it does—wherefore when the register-wheel is turned to its starting position, showing the zero at its observation-point, the driver will be rotated to its starting position (seen in Fig. 6)—that is, it will be restored. The driver of the units-wheel is an exception, being, with the highest register-wheel, outside of these sets. This driver E is set in its starting position when tooth r is entered into the shaft C', to which it is rigidly attached. It is generally also left in its starting position by the attached part of which the motions are to be counted. When the gears are all restored to their correct angular starting positions on the shafts as centers, key M, having reached slot q, drops in, shaft C is drawn back longitudinally to its starting position, pin f striking projection e^7 and drawing thereby the gears on shaft C back to place to start the count, the register-wheels engaging their drivers sidewise as they pass along impinging on the inclines t t', &c., to correct any error in the positions of themselves or the drivers, as described, the springs fall into their depressions and the parts are restored to normal position to begin again the count, and the lever H is turned on its axis, withdrawing the tooth r from shaft C' and entering tooth g into shaft C to hold the latter in place.

The register-wheels might be restored without the longitudinal motion of shaft C by constructing the shaft-pins as projections of a key fitted into shaft C as in a spline, all parts of the key except the pin projections being constructed within the cross-sections of shaft C or a projection thereof, the key being movable in the shaft, as required, to move its pin projections into or out of engagement with the wheel-pins and held in place by the washers or other parts about the shaft C, while it might extend outside the case for manipulation longitudinally to connect or disconnect the wheel-pins. The friction-springs in this case should be bent to bear at all times on their wheels. With this construction engagement of the pins and a simple rotation of the shaft would restore the register-wheels. This modification, which is not herein specifically claimed, is illustrated by Figs. 12, 13, and 14, of which Fig. 12 shows a register having a set of common pawl-actuated register-wheels A^2 A^3 A^4 A^5 A^6, the pawl-bearing arm B^2 being pivoted by sleeves f^2 f^3 on the shaft U and kept by means of the spring g^2 (shown attached to it) from improper rotation by friction of the shaft, and the wheels are kept in place by slotted washers i^2 i^3 i^4 i^5 i^6 like those on shaft C (shown in Fig. 11) with the collars and from overrotation by the springs y^2 y^3 y^4 y^5 y^6, shown bearing on them; but the means of operating the register-wheels for counting are here immaterial. Fig. 13 is a central vertical longitudinal section of the register shown in Fig. 12, with certain parts removed, and Fig. 14 is a cross-section of the washer, the shaft U, and the key T, taken through the line 14 14 of Fig. 13. The wheels are chambered out to admit wheel pins o^7, and shaft-pins n^7 are arranged on the key T, embedded and moving longitudinally in a slot in shaft U in position to be moved by the longitudinal motion of the key in the slot into and out of the circles of rotation of the wheel-pins, which being arranged relatively to the shaft-pins to bring the zeros into line in the rotation, as shown in Fig. 12, it is obvious that when the shaft-pins are in said circle a rotation of the shaft by the crank H^2, preferably in the direction in which the wheels are moved by the pawls, will restore the wheels to their zero position, the springs bearing on them preventing them from being affected by the friction of the shaft, after which the shaft-pins are to be withdrawn from said circles by moving the key lengthwise in the slot. Figs. 15 and 16 show an alternative device illustrating that this means of restoration may be used with a rotation of the wheel-pins effected without rotation of the shaft on which the register-wheels rotate. Thus if V be a united intermediate and register wheel like D F on shaft C, arranged to rotate on shaft W, and X be an independent gear-wheel mounted loosely on the same shaft beside wheel V and geared into a corresponding gear-wheel X', attached to an independent shaft Y, a movable pin 7, attached to a guide working in a way constructed in wheel X and having a limited motion as driven up by a spring 8 or down against the spring by another pin 9, arranged to enter the way for the purpose, and a wheel-pin 10 be attached to wheel V in such position relative to the motion of pin 7 that when pin 9 is withdrawn pin 7 will be forced by the spring up into its circle of rotation, it is obvious that if pin 9 be withdrawn and shaft Y be rotated wheel V may be restored, if out of its starting position, by the means already described. Also a series of wheels like X, having, like that, pins, openings, and springs therein, might be introduced between the gears on shaft C, means of rotating wheels X, as shown, being provided, the wheel-pins being located, relatively to the pins 7, &c., as described, the uniting portions of the driver and attached gears being properly elongated to compensate for the extra space required between the gears on shaft C, when, if projection I^2 on case B be shortened, a pin being inserted in shaft C' next to washer d^6 to prevent its motion on the shaft toward said projection, the shaft C' may be moved

to the left of its position shown in the drawings to ungear the register-wheels and drivers in the same way they are ungeared by motion of the other shaft C, as described, after which wheels X, &c., if rotated, will restore the register parts as required. In this case a cross-piece Z, holding a series of pins like pin 9, entering through holes in the case the ways in the wheels X, &c., simultaneously, might be used to depress the pins in said wheels and fastened as desired onto the case to hold them there except during restoration. Fig. 15 is a cross-section through the line 15 15 of Fig. 16.

Obviously the wheel D might be operated with a pawl to advantage, dispensing with driver E if it is desired to connect it directly to a part having the requisite reciprocal motion.

The register-wheels D D', &c., after ungearing the drivers are restored in a similar manner to the restoration of those actuated by pawls, as described, the restoration of the connecting-gears not interfering. The numbers on the register-wheels may be shown by words or symbols if preferred. Obviously a greater or less number of register-wheels may be used by slightly changing the means of fastening the parts in place.

The abbreviation "&c." is used with designating letters or figures to indicate the remainder of the like parts designated by higher figures or the same letters with higher indices.

For many purposes the intermediate gear F may be considered a simple projection of wheel D. Thus in application of the spring *u* or of means to actuate the wheel D—as, for example, wheel-pin *o*—they may be referred to as applied to wheel D or a projection thereof when actually applied to wheel F.

If it be desired to show the digits and zero more prominently than in the depressions of the register-wheels, projections may be made beside them in the places of the springs, and they may be marked on the full-rounded peripheries of the projections in proper order, the springs being left to rest on them if desired. The location of the figures on the periphery of the Geneva-gear register-wheels instead of on the side enables a closer arrangment of the observation-sections and is effected by putting these gears on one shaft.

It is supposed, unless otherwise indicated, that a "register-wheel," when the term is used, has shown on its "surface," including by this term projections actuated by it and rotating with it, a series of the representations required for representing numbers arranged with reference to the display at a given observation-section of particular examples of the same at particular portions of the rotation of the register-wheel, counting from a predetermined starting position thereof.

A Geneva-gear register-wheel when referred to in general terms is a register-wheel which is actuated to bring its display-figures to the observation-section or held, when displaying a particular example thereof, either directly or through intermediate gearing by a Geneva driver. Thus D is such a wheel directly actuated and held; but if drivers E' E^2 E^3 had the series of figures shown arranged on their peripheries similarly but in reverse order to those on register-wheels D D' D^2 and a line of observation-openings be located across their faces on the front of the lower half of case B parallel to the line shown, each driver being arranged to show "0" at the line when "0" appears at the upper line on the register-wheel immediately actuating it, it is obvious that the count on wheels L D' D^2 would appear on those drivers as well, for each rotates just like its actuating register-wheel, though in reverse direction. Drivers E', E^2, and E^3 would then become Geneva-gear register-wheels, being actuated and held by the Geneva driver E through intermediate gearing.

The operation of ungearing the Geneva-gear wheels D and E and D' and E' and leaving the intermediate gears F and G engaged obviously does not depend more upon the greater width of the moving gear F relative to the gear G than of the moving gears D and D' relative to their respective engaging gears E and E', but with the mode of separation shown upon the gear width on the gear moving toward the point of disengagement arranged in the direction from which it is moved, counting from the point of disengagement—namely, the point on the stationary gear where in the sidewise motion the moving gear leaves engagement with it. This, which may be called "disengagement width," is greater in the intermediate gears F and G than in the Geneva gears D and E or D' and E'. "Disengagement width," as the term is herein used, is the distance one of a couplet of connecting-gears must be moved relatively to the other to disconnect the couplet, not in any direction indefinitely, but in the direction which has been prearranged and in which means of producing such relative motion has been provided for. It obviously depends upon three elements—first, the projections of the gears themselves; second, the location of the gears, and, third, the direction of the relative motion.

A part is said to be "restored" when after a count has been made it is restored to its predetermined starting position and arrangement for beginning the count anew.

A "supported" shaft is a shaft having means of support in the position or positions in which it is required to perform its functions.

Gears P Q R S may replace gears D E F G, respectively, which gears P Q R S are outlined in Figs. 8 and 9.

What we claim as our invention, and for which we pray Letters Patent, is—

1. Two register-wheels arranged for rotation on the same supported shaft, the first having its number representations located for

display in the place of decimal notation next lower than that in which the second has its number representations so located, combined with intermediate gearing constructed and arranged to connect said register-wheels and actuate the second from the first through a driving gear-wheel engaging with it and on another supported shaft, the disengagement width of the gearing connecting the driving gear-wheel to the first register-wheel being greater, as the gears on one shaft are moved sidewise in one direction, than that of its own connection to the second register-wheel, and combined with said driving gear-wheel and said shafts and with means to give the gear-wheels on one shaft a limited sidewise motion in said direction relative to those upon the other, said excess of disengagement width being such as to permit the disengagement thereby of the driving gear-wheel from the second register-wheel but not from the first, combined also with means of rotating the register-wheels when so disconnected and the gearing connected with the first register-wheel, and means of reëngaging the second register-wheel with the gearing connecting it to the first, the various parts being constructed and arranged substantially as described.

2. A Geneva-gear register-wheel mounted on a supported shaft and connected for rotation with a Geneva driver on another supported shaft, said parts being combined with another register-wheel mounted on the same shaft as the first, and with intermediate gearing connecting the latter register-wheel to the driver to rotate it, and with means of giving a limited sidewise movement to the gears on one shaft relative to those on the other, the disengagement width, in said movement of the register-wheel first named in its connection with the driver being such, relative to that of the parts of the gearing connecting the other register-wheel with the driver which change their relative positions in said movement, as to leave for the purposes described, the driver after said movement connected with the latter register-wheel but disconnected from the other, all said parts being constructed and arranged substantially as described.

3. Two or more register-wheels arranged to show when rotated each its number representations at one of two or more observation-sections located in different consecutive places of decimal notation, each register-wheel showing number representations in a lower decimal place being connected to the register-wheel showing number representations in the next higher decimal place by gearing adapted to be actuated by the former register-wheel and thereby to actuate the latter register-wheel intermittent partial rotations, and lock it in place from rotation as described in the intervals between the same, one partial rotation at each rotation of said former register-wheel, but adapted not to be rotated by the register-wheel actuated by it when so locked, combined with mechanism adapted to disengage, for the purposes described, the register-wheels from the gearing which actuates them but not from the gearing they actuate, the several wheels and gears being provided with suitable supporting-shafts and means of holding them in place subject to the action of such mechanism, substantially as described.

4. A series of register-wheels D, D′, &c., on shaft C, each constructed and arranged to engage one of the drivers E, E′, &c., on shaft C′ to each of which register-wheels, except the one in the highest place of decimal notation, is attached one of the intermediate gears F, F′, &c., each arranged on shaft C to rotate one of the intermediate gears G, G′, &c., each attached to one of the drivers, each of which register-wheels has attached to it, and its attached intermediate gear, one of the wheel-pins *o*, *o*′, &c., combined with the case B having bearings for shafts C and C′ constructed to allow the shaft C to be moved longitudinally, as described, on which shaft are shaft-pins *n*, *n*′, &c., each in position to enter the circle of rotation of one of the wheel-pins in the longitudinal motion of shaft C, all combined with projection *f* on shaft C and with a series of springs *u*, *u*′, &c., arranged and attached as described to apply friction to each disengaged register-wheel, all said parts being constructed and arranged substantially as described.

5. The register-wheel D on shaft C and driver E on shaft C′, case B, means of ungearing wheel D from driver E by sidewise motion of the one relative to the position of the other, and of rotating wheel D for restoration, combined with the spring *u* having a support independent of wheel D holding it in position not to bear substantially on wheel D when engaged with driver E, when, of the spring and wheel D, an incline on the one is located in position to be presented to a projection of the other in the relative motion of the wheel to the position of the spring in the direction required for ungearing, in manner to raise the spring onto said projection to bear upon wheel D in its ungeared position as described.

6. Two Geneva-gear register-wheels combined with and arranged for rotation on the same supported shaft, and combined with and connected by intermediate gearing toothed to rotate, through a driver as part of it on another supported shaft, one register-wheel from actuation of the other one-tenth of a rotation to each complete rotation of the actuating register-wheel, said driver and shaft being included in the combination, the gearing connecting the driver and the actuating register-wheel having a greater disengagement width, as the gears on one shaft are moved sidewise in one direction relatively to those on the other, than the gearing has which connects the driver and said actuated register-wheel, combined with means of giving such sidewise motion to the gears on one shaft relative to the gears on the other limited to cease when the driver and actuated register-wheel are

disconnected but before the disconnection of the driver and actuating register-wheel, and with means to rotate said register-wheels and the gear-wheels left connected with the actuating register-wheel, and with means of reengaging said actuated wheel and driver, all said parts being constructed and arranged substantially as described.

7. In a counting-register a Geneva-gear register-wheel arranged on a supported shaft to engage with and be rotated by a Geneva driver on another supported shaft, means of ungearing the register-wheel from the driver and restoring said wheel while ungeared, all combined with a friction-spring, attached to a support independent of the register-wheel, and located and arranged to bear upon said wheel when ungeared, substantially as described.

8. Lever H pivoted to and combined with case B and having the teeth *g* and *r*, shaft C having the depression *h* and shaft C′ having a socket *s*, driver E attached to shaft C′ and register-wheel D all said parts being combined, and constructed and arranged substantially as described.

9. The combination of the lever H having the tooth *g*, case B, shaft C having depression *h*, and one or more of the register-wheels D, D′, &c., with means of keeping the same in place on shaft C.

10. The case B, shafts C and C′, register-wheel D, driver E, and the projection N on driver E located opposite the tooth of the driver in position to prevent wheel D and driver E from disengagement toward the side on which the projection is located when said driver is engaged by said tooth with wheel D.

11. In a counting-register a register-wheel and a driving gear-wheel which are adapted for engagement as gears and mounted on two supported shafts located relatively to each other in position to permit the engagement of said wheels as gears when brought in line together thereon, combined with said shafts, and with means of moving one of said wheels sidewise relatively to the other into gear engagement, combined also with an incline *t* arranged for the purposes described at the edge of the gear periphery of one of said gears which edge the other passes when the gears are moved sidewise relatively to each other into gear engagement.

12. The shaft C having one or more of the shaft-pins *n*, *n*′, &c., thereon, each arranged in position to be projected into the circle of rotation of one of the wheel-pins *o*, *o*′, &c., each on one of the register-wheels D, D′, &c., by longitudinal motion of the shaft relatively to the register wheel or wheels thereon substantially as described, combined with the key M and case B having the slot *q*, in which the key is adapted to move, for the purposes described.

13. Slotted washer *e* combined with shaft C having bearings in case B and arranged for longitudinal motion therein and having the shaft-pin *n*, and with the register-wheels D, D′, and intermediate gear F and pin *o*.

14. Two register-wheels each adapted to bring to view at an observation-section, by its own rotation on a supported shaft, a series of number representations consecutively in a predetermined order, one wheel showing its series in one place of decimal notation, and the other its series in the next higher place, the wheel showing its series in the higher place being connected to and actuated by the other wheel through gearing adapted to communicate to the actuated wheel at each rotation of the actuating-wheel required to show its series at its observation-section, a partial rotation required to change the number representation brought to view by the actuated wheel, and adapted also to lock in place from rotation as described the actuated wheel showing such number representation until its next partial rotation to change the same, combined with means to disengage the actuated wheel from the connecting-gearing while the other wheel remains connected therewith, and, in the period of such disconnection, to rotate the two register-wheels, independently of each other, together with the connecting gear-wheels into the predetermined angular position required for the beginning of their rotation, and with means to reëngage in this position the actuated wheel with the gearing connecting it with the actuating register-wheel.

15. A series of register-wheels combined with and arranged on a shaft in consecutive places of decimal notation, and combined with gearing, connecting each register-wheel in a lower decimal place with one in the next higher decimal place, and adapted as described to transmit intermittent partial rotations to the register-wheel in the higher place from the register-wheel in the lower place, and to lock from rotation the said register-wheel in the higher place between such partial rotations by one of the wheels of said connecting-gearing mounted on another shaft, combined with said shaft and with means to disengage each register-wheel from its locking gear-wheel without disengaging it from the gearing used to connect it with the register-wheel in the next higher decimal place, and to rotate each register-wheel, while so disengaged, and its connected gearing for the purposes described, and reëngage it with the locking gear-wheel, all said parts being constructed and arranged substantially as described.

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