No. 666,919. Patented Jan. 29, 1901.

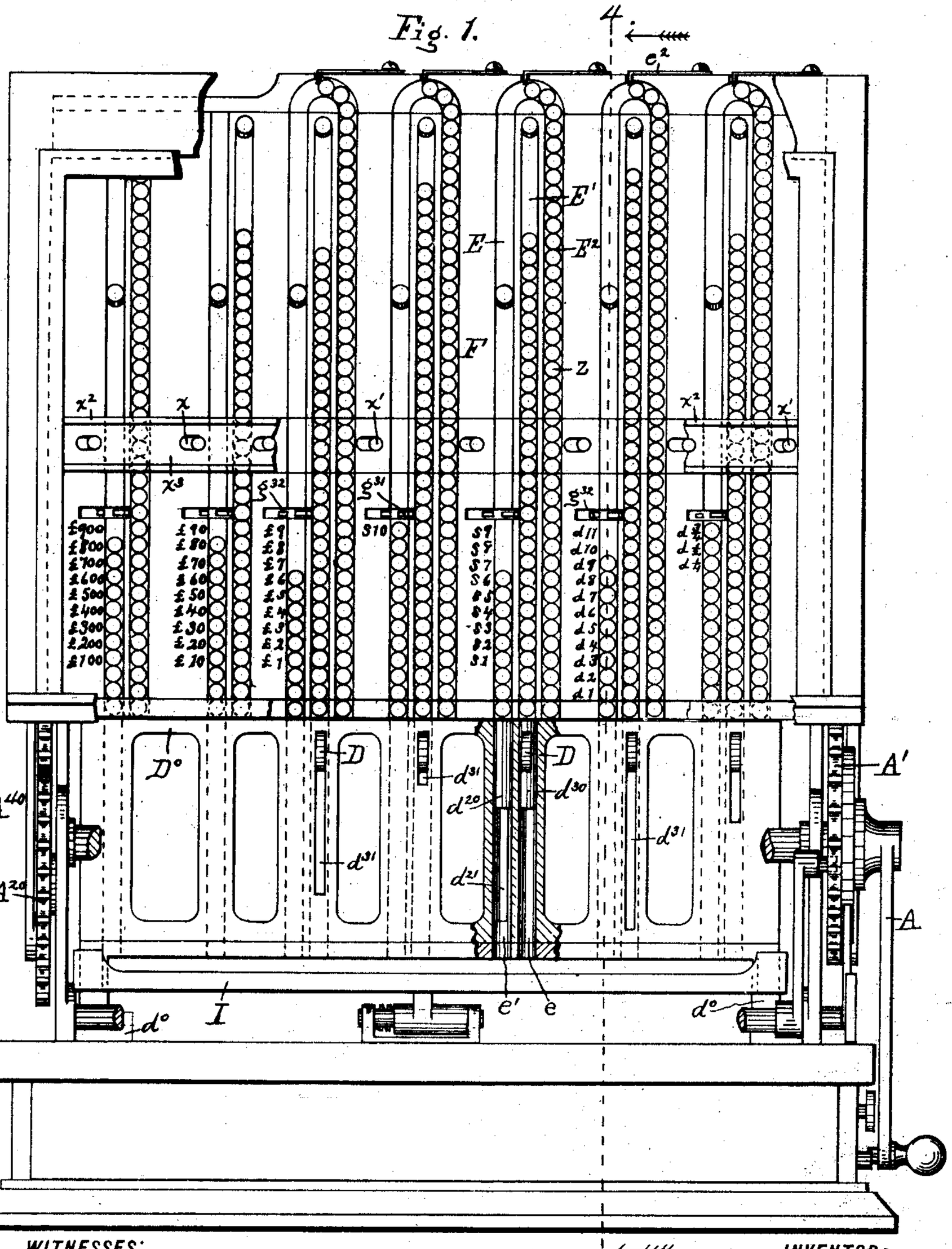
W. H. CLARK.

CALCULATING MACHINE.

(Application filed May 23, 1898.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.



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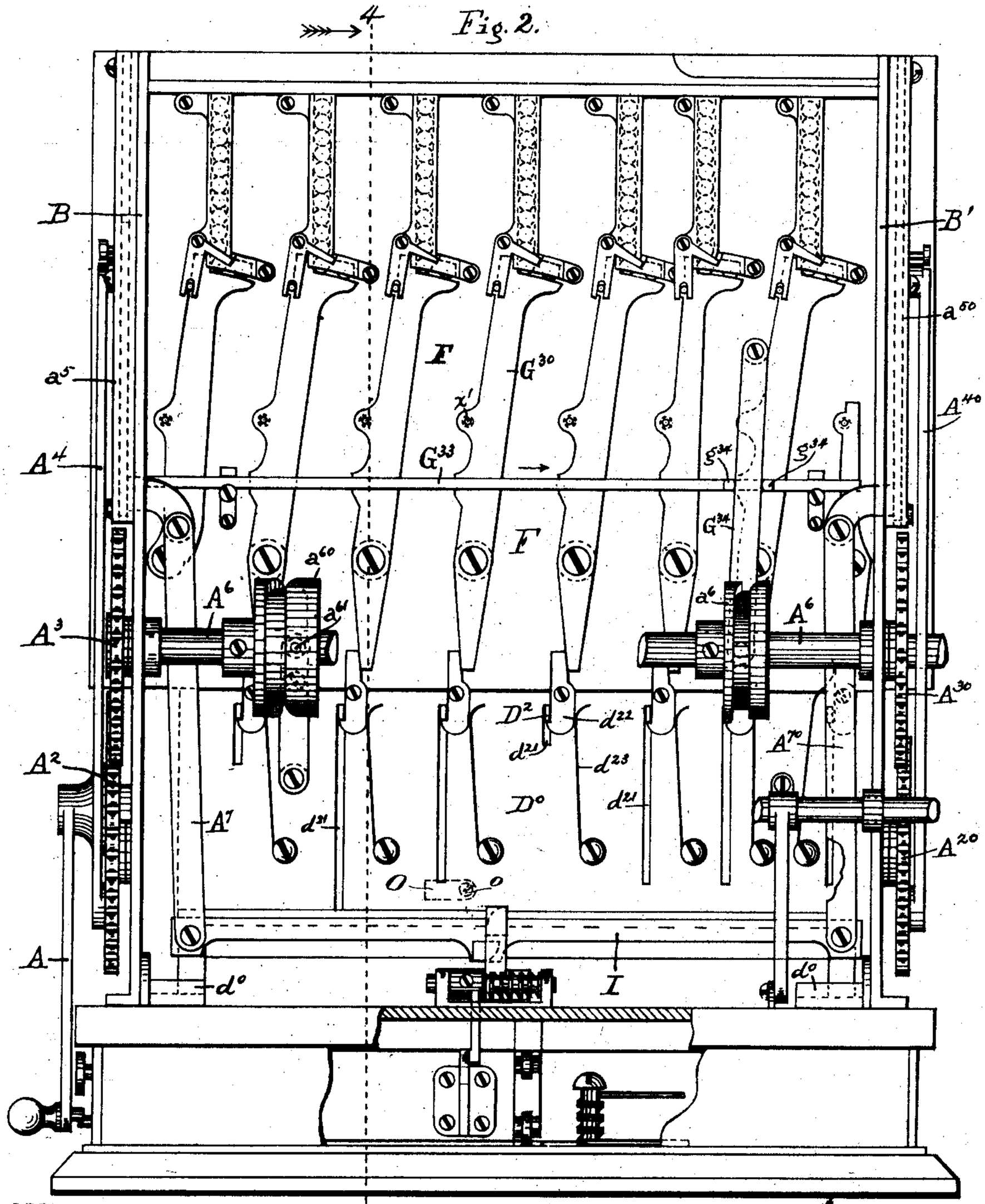
(No Model.) 4 Sheets—Sheet 2.

Fig. 2.



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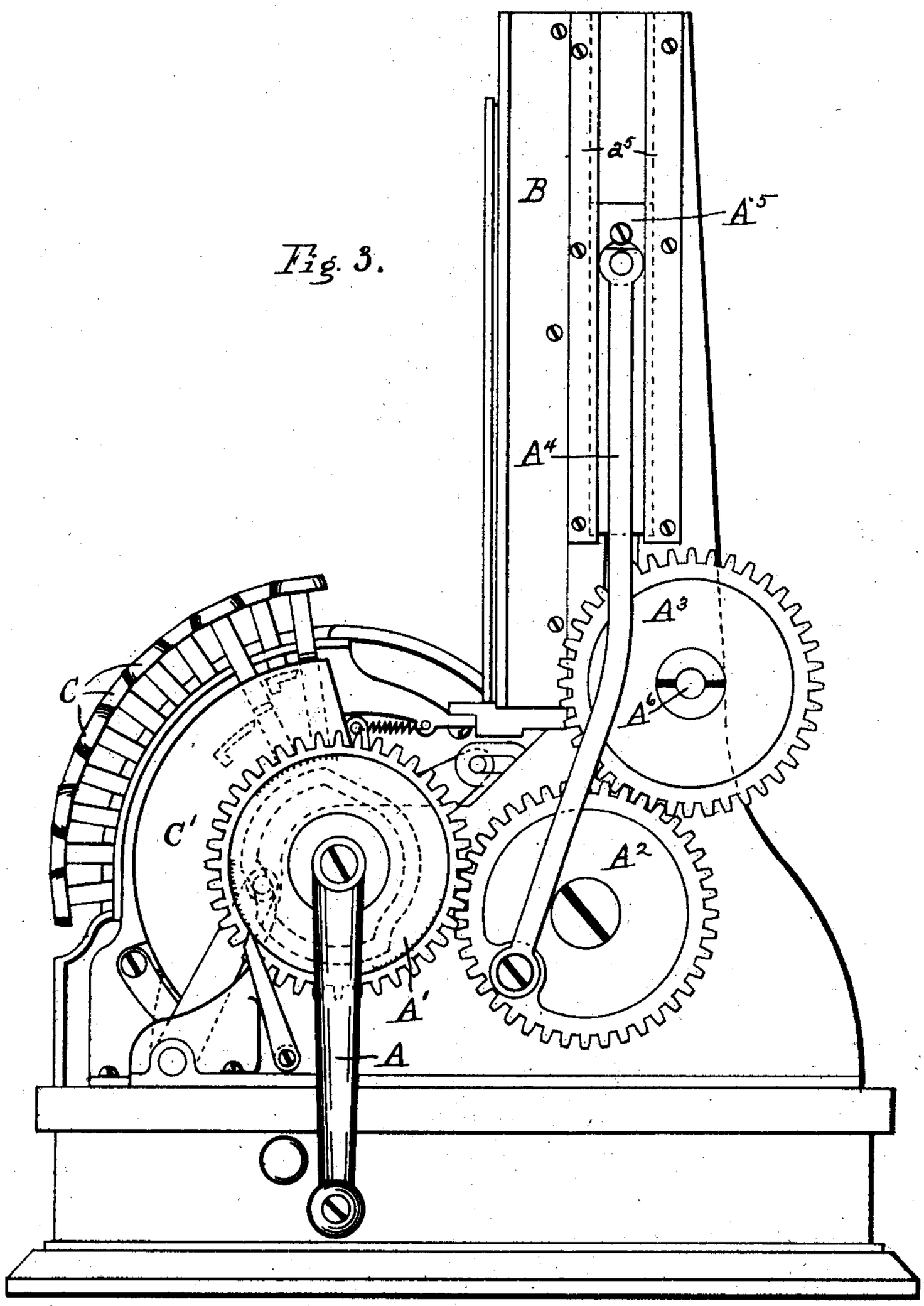
(No Model.) 4 Sheets—Sheet 3.

Fig. 3.



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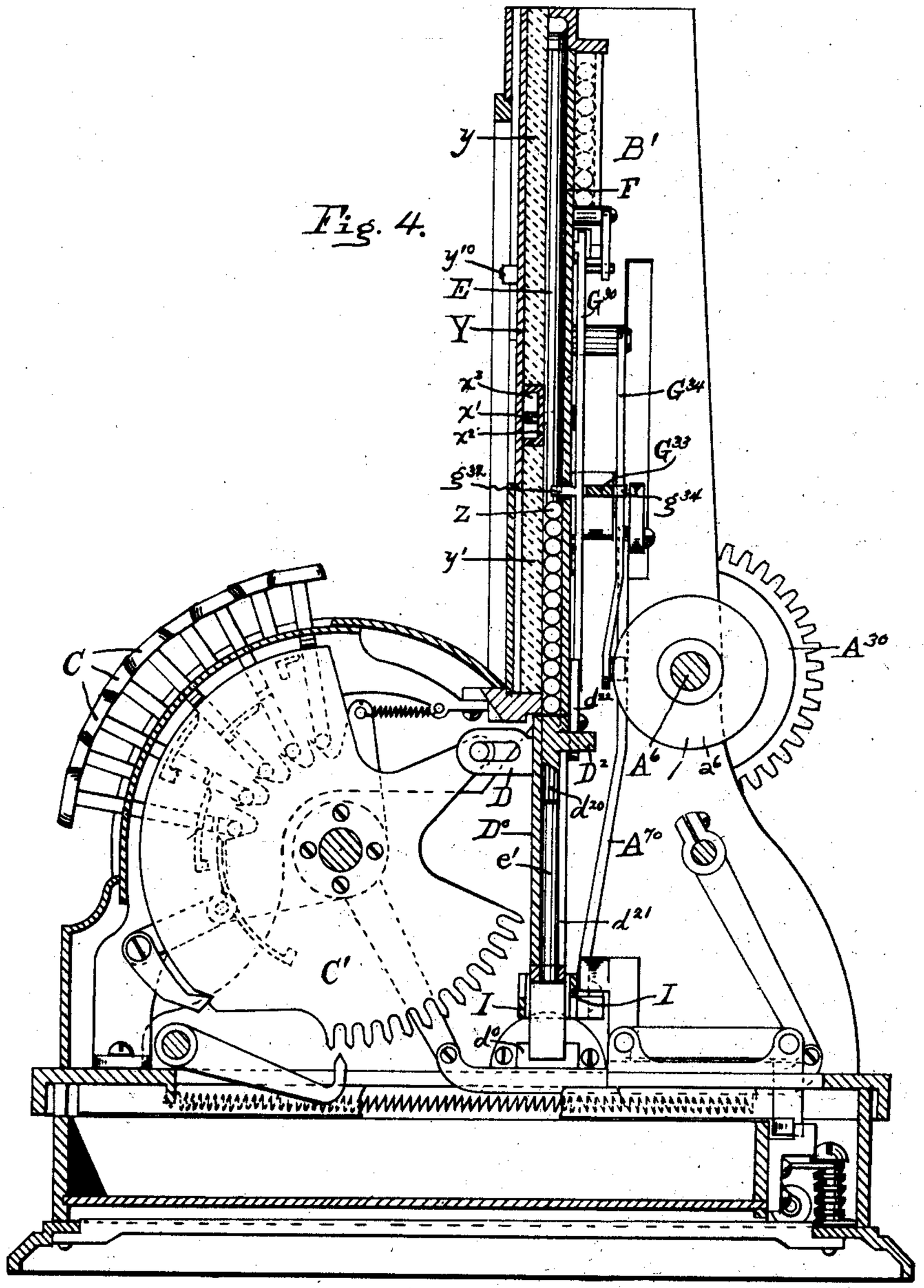
(No Model.) 4 Sheets—Sheet 4.

Fig. 4.



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UNITED STATES PATENT OFFICE.

WILLIAM H. CLARK, OF ROCHESTER, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE NATIONAL CASH REGISTER COMPANY, OF JERSEY CITY, NEW JERSEY.

CALCULATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 666,919, dated January 29, 1901.

Application filed May 23, 1898. Serial No. 681,534. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. CLARK, a citizen of the United States, and a resident of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Calculating-Machines, of which the following is a specification.

This invention relates to calculating-machines, and is described and illustrated herein as being applied to cash-registers of the kind shown in United States Letters Patent heretofore granted upon application made by me—such, for instance, as in Letters Patent Nos. 544,426, 556,045, and 596,359. The mechanisms shown in said Letters Patent are constructed for calculation by the decimal system or by any other system of regular numeration. The invention herein set forth relates particularly to cash-registers or calculating-machines of this variety, but is such a modification thereof as to be adapted to calculation in an irregular numerical system. The system herein set forth as an illustration of my invention is that of British currency, including farthings, pence, shillings, and pounds. The invention herein set forth is an improvement upon the devices shown and described in said patents and also in the mechanism for resetting the register to zero.

My invention consists in the constructions and arrangements of parts hereinafter described and claimed.

In the drawings, Figure 1 is a front elevation of a cash-register embodying my invention, parts thereof being removed in order to exhibit and illustrate the mechanism and operation thereof. Fig. 2 is a rear elevation of the same machine, certain parts being removed to exhibit its construction the better. Fig. 3 is a side elevation of a machine embodying my invention, the outer case being removed; and Fig. 4 is a section on the line 4 4 of Fig. 2 looking in the direction indicated by the arrow in the last-mentioned figure.

This computing mechanism is of the well-known two-motion variety and is operated by a crank A, which actuates a train of gear-wheels A' A^2 A^3, one of which, as the wheel A^2, operates a pitman A^4, which reciprocates a vertically-sliding block A^5, running in guides a^5 on the side of the frame-plate B of the machine. The last gear-wheel A^3 of the train above mentioned is fixed upon a shaft A^6, which bears certain cams, as a^6 and a^{60}, (see Fig. 2,) for operating certain of the working parts. The shaft extends through the machine and bears a gear-wheel A^{30}, meshing with a gear-wheel A^{20}, which operates a pitman A^{40} and a sliding block running in guides a^{50} on the end plate B' of the machine. The last-mentioned end plate B' is opposite to the end plate B, above mentioned, and the blocks A^5 and A^{50} move in parallel lines.

The machine is provided with a setting mechanism consisting of a series of keys C and a setting-plate C', constructed and having a series of parts coöperating therewith, as set forth in United States Letters Patent No. 596,360, of December 28, 1897, granted upon an application made by me. The mechanisms for operating the balls Z in guideways in the way-plate F are the same as in my said Patent No. 596,359; but great difficulty prior to my present invention was found in making a simple and effective modification of my former mechanism in order to adapt it to computation in an irregular numerical system. In adapting machines made under the patents above mentioned to this purpose by effective and simple means I make no change whatever in the mechanism except in respect to the transfer-bar D^0, and, if necessary, in the length of stroke of the bail.

To those acquainted with this art, which includes my patents above mentioned, it is known that the balls Z are forced around in the way-plate F by raising the plug-slides, which rise and fall vertically in channels or ways in the transfer-bar D^0, whereby balls are taken from the storage-way E' into a separating-way *e* in the transfer-bar. Then after shifting of the transfer-bar so that the separating-way *e* registers with an elevating-way E^2 in the way-plate F the balls are forced out of the separating-way *e* and cause the ejection of an equal number of balls from the elevating-way E^2 into a connected registering-way E. When a number of balls have accumulated in the registering-way E equal to or

exceeding the maximum of the denomination which they indicate or register, a number of balls equivalent to said maximum are discharged from the registering-way into a transfer-way in the transfer-bar, and at the same time a single ball is by suitable carrying mechanism discharged into the registering-way of the next higher denomination. The operation of the carrying mechanism for discharging the single ball, as just mentioned, is controlled by the ball in the lower registering-way representing the highest unit of said maximum. At the next operation of the machine a shifting of the transfer-bar occurs which causes the transfer-way e' to register with the storage-way E' and the balls are forced out of the transfer-way and into the storage-way.

The transfer-bar D^0 moves laterally in guides d^0 in order to produce the change of registry above mentioned as between the transfer and separating ways e' e in the transfer-bar with the three parallel ways E E' E^2 in the way-plate F. In my former mechanisms the ways in the transfer-bar contained plug-slides each of which had the same stroke. The reason for this lay in the fact that in my said former mechanisms the decimal system was employed, and ten was the maximum of each denomination. In the present embodiment of my invention as applied to computation in British currency the strokes of the plug-slides vary on account of the lack of uniformity in the maxima of the different denominations—farthings, pence, shillings, and pounds. As applied to British currency the first series of three ballways on the right in Fig. 1 are devoted to farthings and must be capable of operating to the extent of four farthings before a carrying operation of the addition of a unit into the pence column or system of ways can begin. Hence the register is capable of indicating only three farthings, because the indication of the fourth farthing is equivalent to one penny. The pence-column is capable of indicating eleven pence, because twelve pence make one shilling. Since twenty shillings make one pound, it is found convenient to divide the shillings column or register into two parts in a decimal manner. The first series or column relating to shillings is capable of indicating and registering nine shillings and the second is capable of indicating a unit equivalent to ten shillings. Consequently the first of the two shillings systems indicates nine shillings only, because a tenth shilling is equal to one-half a pound and is conveniently carried into the next shillings system of ways. The second system indicates only a single unit of ten shillings or one-half a pound, because the indication of the second unit of the same value would indicate one pound and should therefore be carried into the pounds-column or next series of ways. The only purpose of dividing the shillings-column as thus described is for the purpose of making the apparatus more compact and obviating the necessity of having a transfer bar and ways therein wide enough to take in nineteen balls representing the nineteen units, which plus one make up the equivalent of a pound.

In the normal position of rest the separating-ways e in the transfer-bar D^0 register with the storage-ways E' in the way-plate, and in each separating-way there is a plug-slide d^{30}, having an arm D passing through a slot d^{31} in the front of the transfer-bar and which is part of a setting mechanism, such as is set forth in my invention shown in the United States Letters Patent No. 596,360. By dropping the setting-arm D to different degrees a number of balls equivalent to the units which it is desired to register may be taken from the storage-way E' into the separating-way e, and then upon shifting the transfer-bar the same number of balls may be forced in the registering-way E of the system or denomination then employed. In the normal position of rest the setting-arm D is held up by the setting mechanism in a manner well known, so as to cause the plug-slide d^{30} to be level with the top of the transfer-bar and to exclude balls in the way-plate from passing into the separating-way. The transfer-way e' is normally under the registering-way E and contains a plug-slide d^{20}. An arm D^2 extends from said plug-slide through a slot d^{21} in the rear side of the transfer-bar D^0. The bail I extends around the transfer-bar and rises and falls with each operation of the machine and has such a normal position of rest that any plug-slide may drop freely to its lowest position; but the bail has such a stroke upward that it comes in contact with each arm D and D^2 and lifts every arm which may have been dropped to its highest position—namely, to such a position that the plug-slide closes the top of the tranfer or separating way in which it moves. If the slots through which the arms D and D^2 project were of uniform length, the plug-slides might drop to the bottoms of the ways; but, as above explained, it is necessary, particularly in the case of the plug-slides d^{20}, which move in the transfer-ways e', that said plug-slides should not drop in the ways a distance greater than would permit the passage into any transfer-way of a number of balls exceeding the maximum, less one, of the denomination to which that transfer-way relates. Consequently it is necessary in the case of computing in an irregular numerical system that the plug-slides should be stopped at points corresponding to the positions which would permit only the proper number of balls to pass into the transfer-ways. As an example of a means whereby this result may be accomplished I have produced the present mechanism, in which the slots d^{21}, in which the arms D^2 move, are long enough to permit movement of the plug-slide only to an extent proper to the denomination to which it pertains, and when the plug-slide has dropped to the desired extent the arm D^2 rests

upon the bottom of the slot and the plug-slide is stopped at this point. In the farthings system the plug-slide can drop only so far as to permit three balls to enter the transfer-way. In the pence system the plug-slide can drop only so far as to permit eleven balls to pass into the transfer-way of that system. In the first of the shillings systems only nine balls can pass into the transfer-way. In the second of the shillings systems only one ball can pass into the transfer-way; but in the pounds system nine balls may pass into the transfer-way, and in any of the remaining pounds systems for higher denominations, as shown in the present embodiment of my invention, the decimal system is employed, wherein nine balls may drop into the transfer-way of each of the pounds denominations. I thus provide for stopping the plug-slides when moved in one direction to permit balls to pass into the ways in the transfer-bar, which obviously correspond in each case to the sum of the diameters of the balls or tally-pieces representing the maximum, less one, of the denomination to which they relate. Each transfer-way e in said transfer-bar D^0 has a plug-slide d^{30}, adapted to move vertically in said transfer-way. An arm D extends from said plug-slide d^{30} through a slot d^{31} in the front of the transfer-bar, and said arm D is connected with the setting mechanism of the cash-register in the manner well known and shown in my Letters Patent No. 596,360.

The operation of these mechanisms is set forth in my said patents, but is here repeated in a condensed form.

On the operation of the setting mechanism the plug-slide d^{30} is lowered to an extent corresponding to the number of units desired to be expressed by the operation of the setting mechanism. This lowers a number of balls—say three—from the storage-way E′ into the separating-way e by suitable mechanism. The transfer-bar is now shifted toward the right in Fig. 1 until the separating-way e comes under the elevating-way E^2 and the transfer-way e' comes under the storage-way E′. The bail I now rises, strikes the arm D, and raises the plug-slides d^{30} up to such a height as will discharge all the balls from the separating-way e by lifting them into the elevating-way E^2 and forcing an equal number of balls past the spring-holder e^2 into the registering-way E. The balls fall in said registering-way upon the balls, if any, already accumulated therein. If the number of balls thus discharged into the registering-way when accumulated upon the balls previously therein are equal to or exceed the maximum of the denomination to which said registering-way is adapted, the ball representing the last or highest unit of said denomination will be pinched between the pin g^{31} and the pin g^{32}, the former of which moves into and out of the path of the balls in said way. The pin g^{31} is moved at each operation of the machine, and when the ball representing the maximum unit of a denomination is in the path of said pin the pin pressing against the ball will push it against the pin g^{32}, which is upon one of the carrying-levers G^{30} on the back of the way-plate F, thus causing the discharge of a single ball into the registering-way of the next higher denomination and at the same time unlatching the plug-slide d^{30} in the transfer-way of the denomination in which the ball has been pinched, as just described. This allows the plug-slide d^{30} to drop as far as its movement is permitted in the transfer-way e' and permits the balls representing the units of the denomination above it to drop into said transfer-way, whereby the balls representing the unit of the next higher denomination are discharged from the register of the lower denomination.

On the back of the transfer-bar are fastened a series of latches d^{22}, adapted to catch and hold the plug-slides d^{20} in their highest positions. The latches are pressed into engaging position by springs d^{23}. When any latch is released, the plug-slide d^{20} drops to the lower limit of its possible movement, permitting the balls sustained by the latch in the registering-way E to drop into the transfer-way e' in the transfer-bar. Balls are discharged from the registering-way only in case of a carrying operation, as between two denominations or in case of resetting the register to zero. The transfer-bar D′ must be made of sufficient depth to permit the employment of a separating-way E long enough for the denomination having the greatest number of integers in the system of numeration employed, and the stroke of the bail I is produced in the usual way by means of the pitmen A^4 A^{40}, which reciprocate the blocks A^5 A^{50}, which are connected to the links A^7A^{70}, connected to the bail. The transverse reciprocation of the transfer-bar E is accomplished by means of the cam a^{60} and the cam-pin a^{61}, attached to the transfer-bar.

The carrying-levers G^{30} are operated both to produce the movement of the ball, which represents the carried integer, and to trip the latch d^{22} (exactly as described in my patent numbered 596,359) by means of a carrying-bar G^{33}, which is reciprocated by a lever G^{34}, engaging between lugs g^{34} upon the carrying-bar and reciprocated by the cam a^6. At each operation of the machine the shaft A^6 makes a complete revolution and causes a single to-and-fro movement of the carrying-bar G^{33}, from the front of which project pins g^{31} through the way-plate F and into such a position as to press against the ball in the registering-way representing the highest integer of the denomination corresponding to that way. If no ball is in the path of the pins g^{31}, the carrying-lever G^{30} is not moved; but if a ball is in the path of movement of a pin g^{31} it is pressed against a pin g^{32}, (see Fig. 1,) which is attached to the carrying-lever G^{30} of the next higher denomination, and causes a movement of said lever sufficient to discharge

one ball of the next higher numerical order into the registering-way E of that order. The carrying-lever G^{30} rests against the latch d^{22} and trips the latch of the system whose highest integer has been indicated and causes the discharge of the balls in the registering-way of the last-named system into the transfer-way e' below it by allowing the plug-slide to drop freely in said separating-way. These movements occur early in the rotation of the crank A, and on the continued rotation of the crank the bail I rises, strikes all the arms D and D^2 which have dropped, and raises them after the transfer-bar has moved so far as to make the separating-way e to register with the elevating-way E^2 and the transfer-way e' to register with the storage way E' and forces all the balls in the ways in the transfer-bar into said elevating and storage ways and permits the latches to engage the arms D^2 to hold them and their plug-slides in the highest position. These operations are the same as those shown in my said Patent No. 596,359. As an equivalent for the slots d^{21} of different lengths I may employ a series of slots, all of equal lengths; but I may provide stops for the descent of the arms d^{20} of any form to suit any selected denominations. These stops may, for instance, consist of plates fastened to the way-plate E and set in the paths of the arms d^{20}. Such a stop O is shown in dotted lines in Fig. 2 fastened to the transfer-bar D^0 by means of the screw o. In the form of device shown the stops are the bottoms of the slots d^{21}, which are thus integral with the bar, although, as just described, the stops need not be integral therewith.

As an improved form of resetting device for computing-machines, such as shown in my former patents relating to ball-counting mechanisms, I provide the following modification: The way-plate F is slotted through with a series of slots x, Fig. 1, and through these slots extend pins x', which are attached to the carrying-levers G^{30}. When said pins x' are accessible and are moved to rock the carrying-levers G^{30}, the latches d^{22} will be disengaged and the plug-slides d^{20} will drop, discharging all the balls from the registering-ways which they control. On turning the handle A, when the transfer-ways e' are brought under the storage-ways E' in the way-plate, said registering-ways are emptied. If, however, in any registering-way a ball is pinched, as above described, that ball and those above it will be held up, and a second operation of the crank becomes necessary to permit the balls pinched and upheld to drop in the registering-way and pass downward into the transfer-way in order to be carried on into the storage-way; but upon two operations of the crank and moving the pins x' the machine may be reset to zero with all the operating indicating-ways empty. As a convenient arrangement for these purposes I divide the usual front plate of glass into two parts y y' (see Fig. 4) and between them set a metallic plate x^2, having a channel x^3 therein, into which the points of the pins x' may project. This channel is covered by a sliding plate Y, provided with a lock y^{10}; but when the plate is unlocked it may be raised in order to expose the pins x' for operation.

My invention is obviously adaptable to irregular denominations of all kinds.

What I claim is—

1. In a cash-register or calculating-machine for calculating in an irregular numerical system, guideways for tally-pieces, arranged to represent different denominations, tally-pieces in said guideways, a transfer-bar having ways therein and adapted to move laterally from registry with certain of the guideways to registry with certain other of the guideways, a bail having a uniform vertical movement, plug-slides movable in the ways in the transfer-bar for admitting and ejecting tally-pieces from and to said guideways, each slide having an arm projecting into the path of the bail, and means for stopping the plug-slides when moved in one direction, at different points, and corresponding in each case to the sum of the diameters of the tally-pieces, representing the maximum, less one, of the denomination to which they relate, said vertical movement of said bail being as long as the longest plug-slide movement, substantially as set forth.

2. In a cash-register or calculating-machine for calculating in an irregular numerical system, guideways for tally-pieces arranged to represent different denominations, tally-pieces in said guideways, a transfer-bar having ways therein, and adapted to move laterally from registry with certain of the guideways to registry with certain other of the guideways, a bail having a uniform vertical movement, plug-slides movable in the ways of the transfer-bar, for admitting and ejecting tally-pieces from and to said guideways, each slide having an arm projecting into the path of the bail, means for stopping the plug-slides when moved in one direction, at different points corresponding in each denomination to the sum of the diameters of the tally-pieces, representing the maximum, less one, of the denomination to which they relate, carrying mechanism for causing a unit indication in a guideway representing a higher denomination when the maximum in the next lower denomination is reached or exceeded, and means for discharging from the guideway of said lower denomination tally-pieces representing said maximum, less one, said vertical movement of said bail being as long as the longest plug-slide movement, substantially as set forth.

3. In a cash-register or calculating-machine for calculating in an irregular numerical system, a series of systems of guideways for tally-pieces, each system arranged to represent a different denomination and comprising a storage-way, an elevating-way and a registering-way, tally-pieces adapted to move in said

ways, a transfer-bar having for each system of guideways a transfer-way and a separating-way and adapted to move laterally from registry, respectively, with the registering-way and the storage-way to registry with the storage-way and the elevating-way, a bail having a uniform vertical movement, a plug-slide in each of said transfer-ways and said separating-ways and movable therein for admitting and ejecting tally-pieces from and to said guideways, each plug-slide having an arm projecting into the path of the bail, and means for stopping the plug-slides, when moved in one direction, at different points, corresponding in each denomination to the sum of the diameters of the tally-pieces, representing the maximum, less one, of the denomination to which they relate, said vertical movement of said bail being as long as the longest plug-slide movement, substantially as set forth.

4. In a cash-register or calculating-machine for calculating in an irregular numerical system, a series of systems of guideways for tally-pieces, each system arranged to represent a different denomination and comprising a storage-way, an elevating-way and a registering-way, tally-pieces adapted to move in said ways, a transfer-bar having for each system of guideways a transfer-way and a separating-way and adapted to move laterally from registry, respectively, with the registering-way and the storage-way to registry with the storage-way and the elevating-way, a bail having a uniform vertical movement, a plug-slide in each of said transfer-ways and said separating-ways and movable therein for admitting and ejecting tally-pieces from and to said guideways, each plug-slide having an arm projecting into the path of the bail, means for stopping the plug-slides, when moved in one direction, at different points, corresponding in each denomination to the sum of the diameters of the tally-pieces, representing the maximum, less one, of the denomination to which they relate, carrying mechanism for causing a unit indication in a registering-way representing a higher denomination when the maximum indication in the registering-way of the next lower denomination is reached or exceeded, and means for discharging from the registering-way of said lower denomination the tally-pieces representing said maximum, less one, said vertical movement of said bail being as long as the longest plug-slide movement, substantially as set forth.

5. In a cash-register or calculating-machine for calculating in an irregular numerical system, guideways for tally-pieces arranged to represent different denominations, tally-pieces in said guideways, a transfer-bar having ways therein and adapted to move laterally from registry with certain of the guideways to registry with certain other of the guideways, a bail having a uniform vertical movement, plug-slides movable in the ways in the transfer-bar for admitting and ejecting tally-pieces from and to said guideways, each plug-slide having an arm projecting into the path of the bail through a slot in said transfer-bar, the slots relating to the different denominations having different lengths, permitting in each denomination the admission into the transfer-bar of tally-pieces upon its plug-slide, representing the maximum, less one, of the denomination, said vertical movement of said bail being as long as the longest plug-slide movement, substantially as set forth.

6. In a cash-register or calculating-machine for calculating in an irregular numerical system, guideways for tally-pieces arranged to represent different denominations, tally-pieces in said guideways, a transfer-bar having ways therein and adapted to move laterally from registry with certain of the guideways to registry with certain other of the guideways, a bail having a uniform vertical movement, plug-slides movable in the ways in the transfer-bar for admitting and ejecting tally-pieces from and to said guideways, each plug-slide having an arm projecting into the path of the bail through a slot in said transfer-bar, the slots relating to the different denominations having different lengths, permitting in each denomination the admission into the transfer-bar of tally-pieces upon its plug-slide representing the maximum, less one, of the denomination, carrying mechanism for causing a unit indication in a registering-way representing a higher denomination when the maximum indication in the registering-way of the next lower denomination is reached or exceeded, and means for discharging from the registering-way of said lower denomination the tally-pieces representing said maximum, less one, said vertical movement of said bail being as long as the longest plug-slide movement, substantially as set forth.

7. In a cash-register or calculating-machine, a way-plate having therein guideways for tally-pieces and representing different denominations, tally-pieces in said guideways, a transfer-bar having ways therein and adapted to move from registry with certain of the guideways to registry with certain other of the guideways, plug-slides movable in the ways of the transfer-bar for admitting and ejecting tally-pieces from and to said guideways, latching devices for maintaining certain of the plug-slides in position to exclude tally-pieces from the ways in the transfer-bar in which such plug-slides move, each latching device being at the back of the way-plate and transfer-bar, and means projecting through the way-plate for tripping said latches at will and independently of the regular operation of the machine.

8. In a cash-register or calculating-machine, a way-plate having therein guideways for tally-pieces and representing different denominations, tally-pieces in said guideways, a transfer-bar having ways therein and adapted

to move from registry with certain of the guideways to registry with certain other of the guideways, plug-slides movable in the ways of the transfer-bar for admitting and ejecting tally-pieces from and to said guideways, latching devices for maintaining certain of the plug-slides in position to exclude tally-pieces from the ways in the transfer-bar in which such plug-slides move, each latching device being at the back of the way-plate and transfer-bar, a tripping device for each latch having a part projecting through the way-plate for tripping said latches at will and independently of the regular operation of the machine, and a cover provided with a lock for preventing access to said tripping device.

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