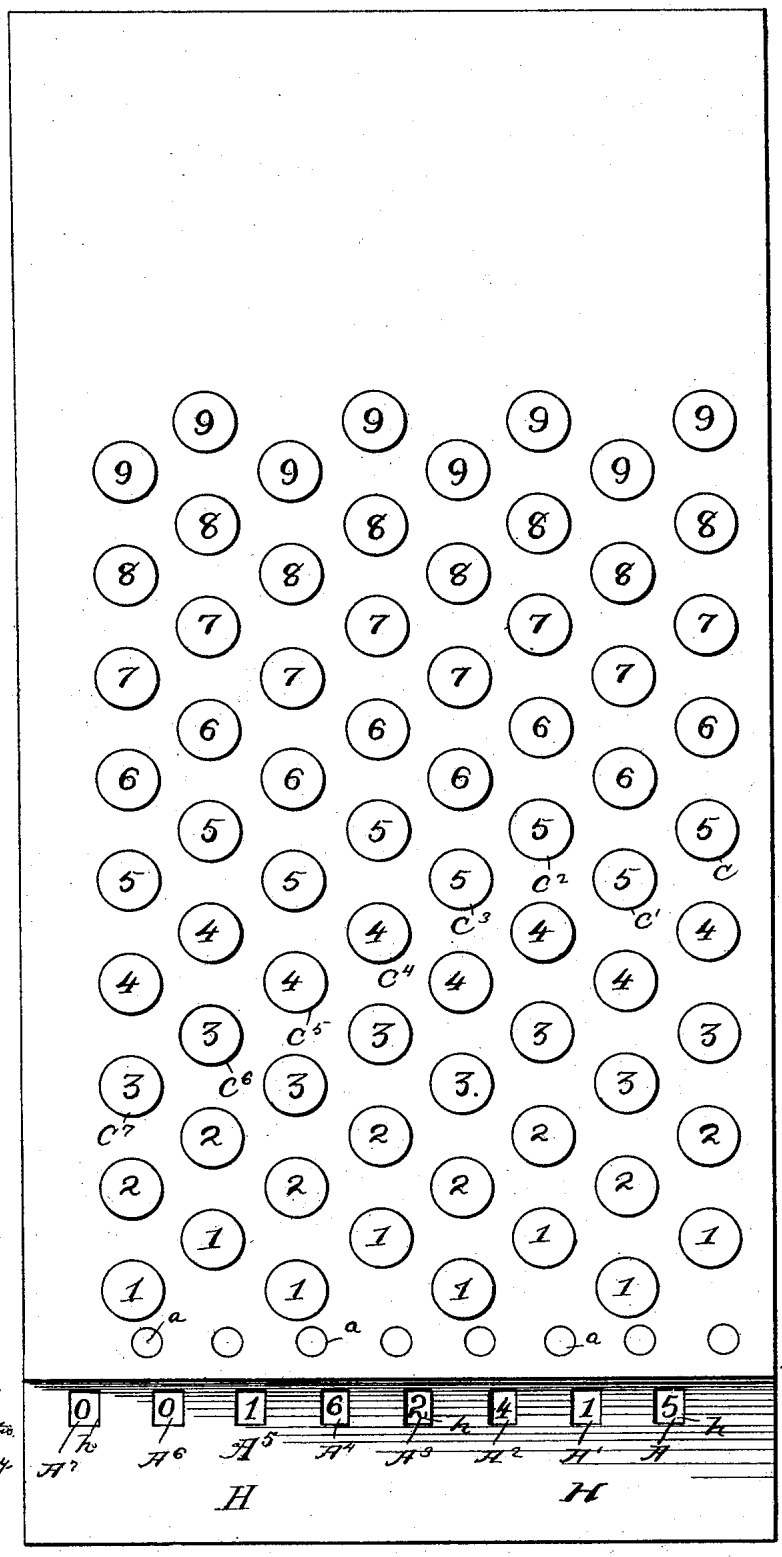
(No Model.) 5 Sheets—Sheet 1.

D. E. FELT.

ADDING MACHINE.

No. 366,945. Patented July 19, 1887.

Fig. 1



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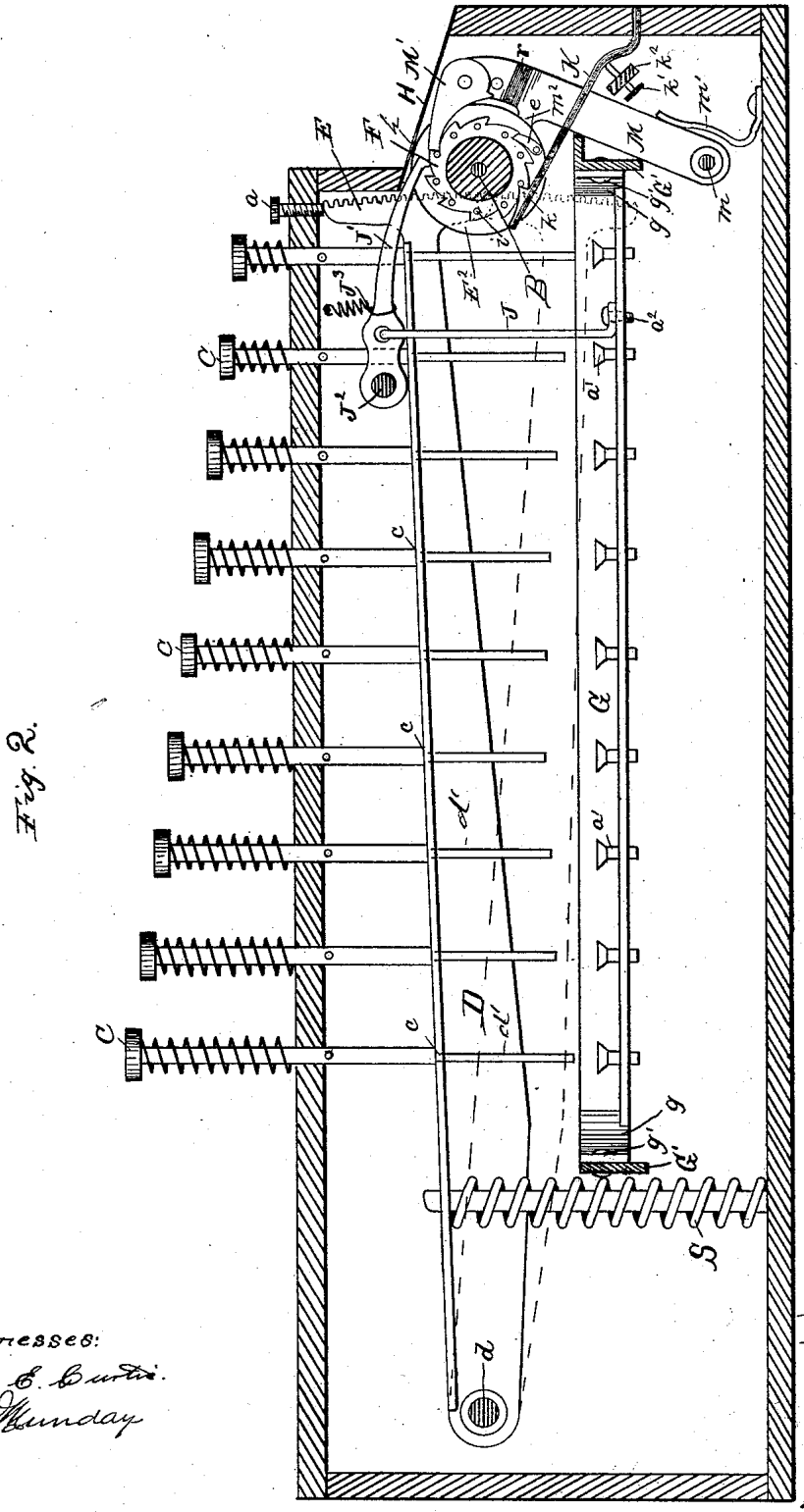

Fig. 2.

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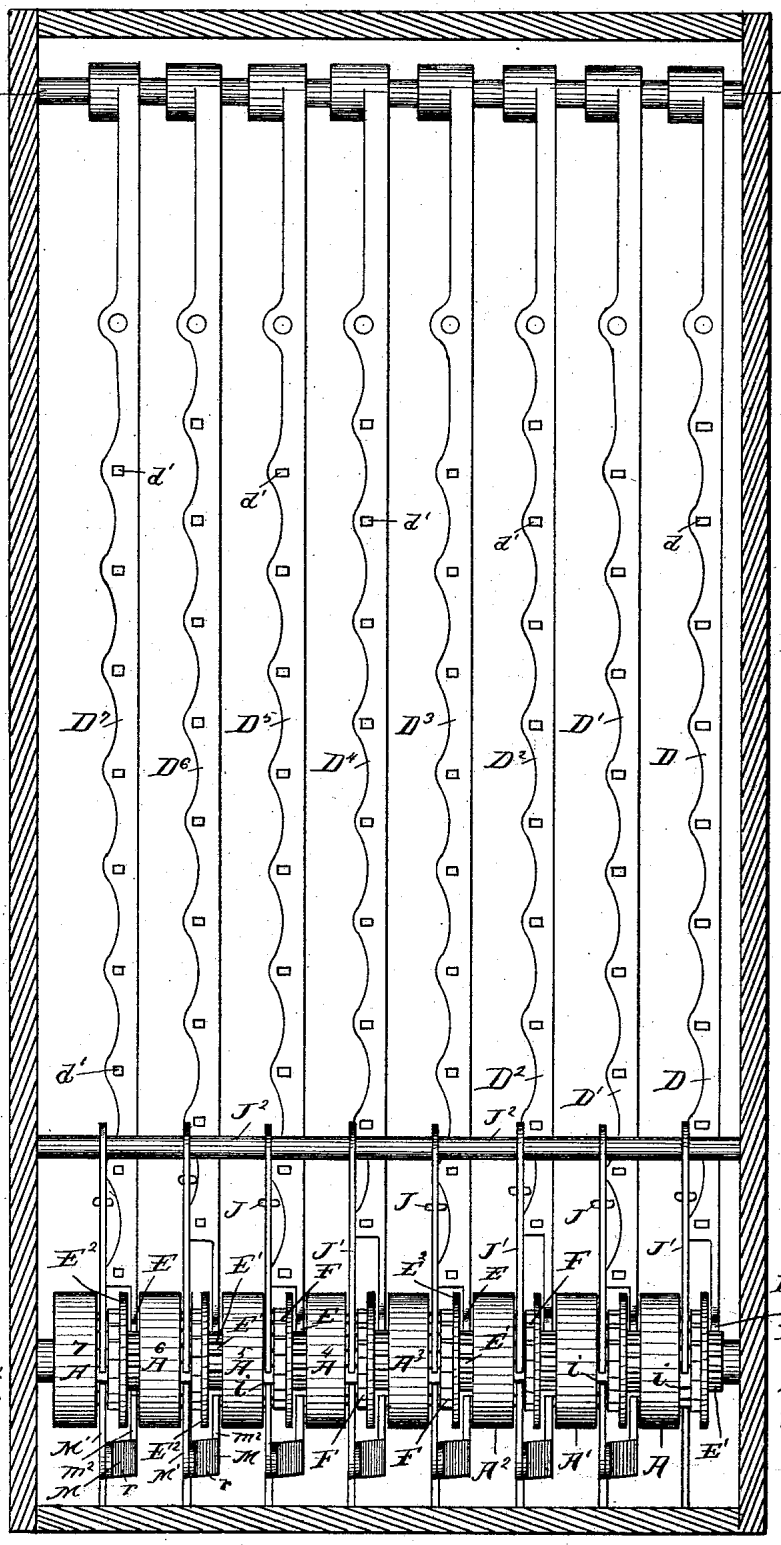
Fig. 3.



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D. E. FELT.

ADDING MACHINE.

No. 366,945. Patented July 19, 1887.

Fig. 4.

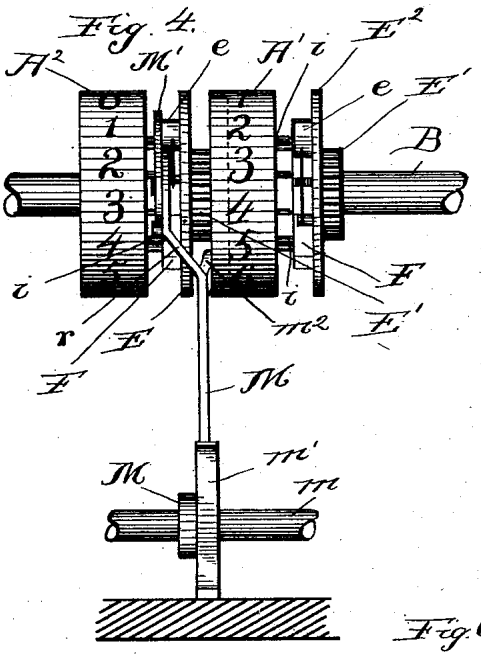


Fig. 5.

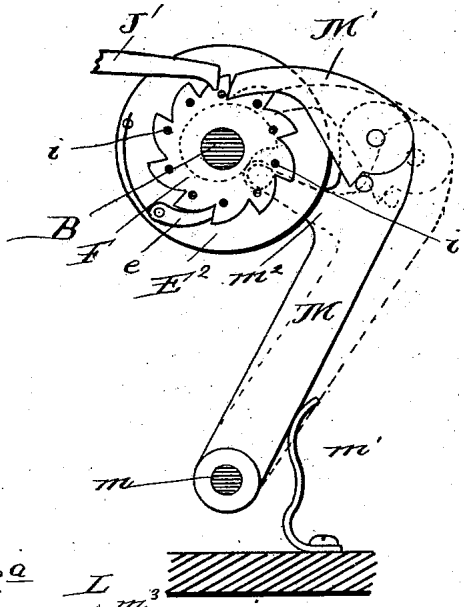


Fig. 6ª

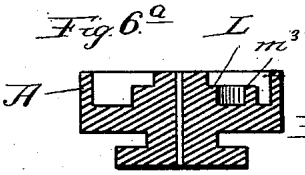


Fig. 6.

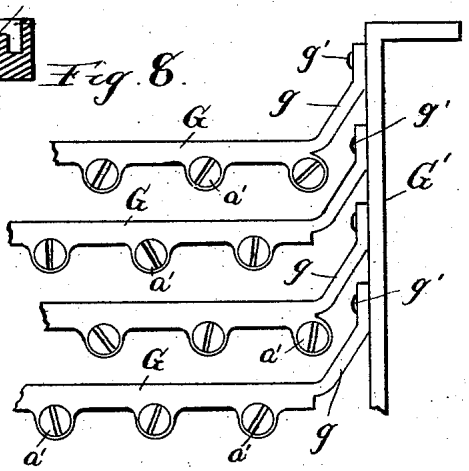


Fig. 6.

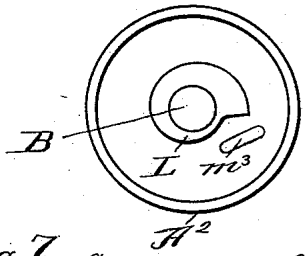
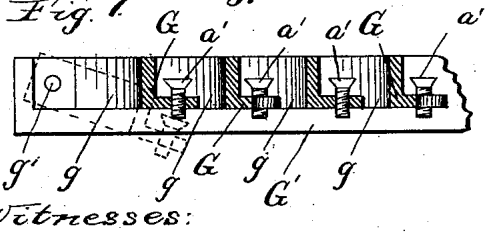


Fig. 7.



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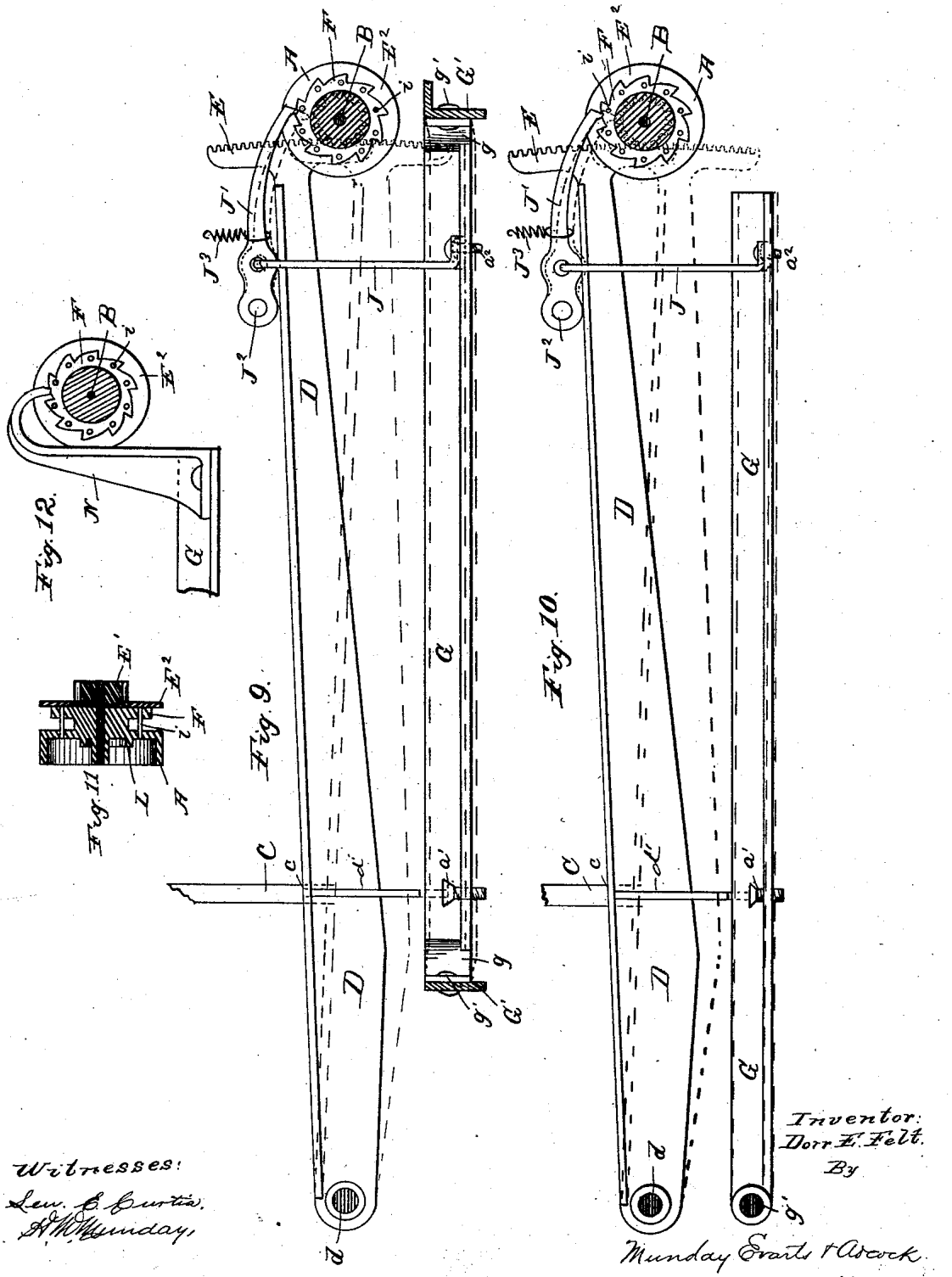
(No Model.) 5 Sheets—Sheet 5.

D. E. FELT.

ADDING MACHINE.

No. 366,945. Patented July 19, 1887.



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UNITED STATES PATENT OFFICE.

DORR E. FELT, OF CHICAGO, ILLINOIS, ASSIGNOR TO HIMSELF AND CHAUNCEY W. FOSTER, OF SAME PLACE.

ADDING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 366,945, dated July 19, 1887.

Application filed July 6, 1886. Serial No. 207,174. (No model.)

To all whom it may concern:

Be it known that I, DORR E. FELT, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Adding-Machines, of which the following is a specification.

This invention is designed to obviate the difficulties heretofore met with in the practical operation of adding-machines. I employ in my improved machine a series of indicator-wheels, the peripheries of which bear the figures from 0 to 9, inclusive, at equal distances apart, in combination with suitable cover, so that but one figure of any wheel is exposed at a time. Said wheels are arranged side by side upon a common shaft, and each of them stands for an order of numbers. Each is also provided with its own series of actuating-keys, representing the numbers 1 to 9, inclusive, and serving, when struck, in connection with suitable connecting mechanism, to rotate the wheel to the point required to indicate that the number represented by the key has been added. Thus if one of the wheels is positioned to indicate 0 and the 5 key of that wheel is struck, the wheel will be turned until it indicates 5. I also employ, in connection with the indicator-wheels and their operating-keys, an automatic carrying mechanism, whereby, when the number added to any wheel of the series produces a sum beyond the highest number represented by such wheel, the wheel standing for the next higher order of number will be actuated to the extent of adding one thereto. This carrying mechanism is entirely independent of the keys struck, and consequently the operator is obliged to give no thought to it, and as the power required is obtained by means of springs he is not obliged to exert any more pressure upon the keys when a number is carried than when such is not the case. I also employ in the machine, and in the combination with the numeral-wheels, an automatic positive stop, for preventing them from being rotated too far by momentum. These and other features of the invention will be fully understood from the accompanying drawings and the subsequent description.

In the accompanying drawings, Figure 1 is a plan of my machine. Fig. 2 is a longitudinal vertical section. Fig. 3 is a horizontal section. Figs. 4 and 5 are respectively enlarged front and side elevations of the numeral-wheels and their controlling devices. Fig. 6 is a detail view of one of the numeral-wheels, showing the cam for storing up the power, and Fig. 6^a is a partial section of the same wheel. Fig. 7 is a cross-section of the levers for actuating the wheel-stops, and Fig. 8 is a partial plan of the same, both being enlarged. Fig. 9 is a longitudinal vertical section showing the position assumed by the wheel lever and stop-lever. Fig. 10 is a section similar to Fig. 9, showing a suitable substitute for the stop-lever shown in previous figures. Fig. 11 is a section of the numeral-wheel and the companion ratchet and disk, and Fig. 12 shows a modified form of the wheel-stop.

In the drawings, A A′ A^2, &c., represent numeral or indicator wheels—that is to say, wheels provided upon their peripheries with the figures 0 to 9, inclusive. Each of these wheels stands for an order of numbers, the wheel A representing units, the wheel A′ tens, the wheel A^2 hundreds, and so on. Said wheels are loosely mounted upon a common shaft, B, and are actuated by devices now to be described.

C C, C′ C′, C^2 C^2, &c., represent the several series of depressible keys, there being one series for each of the indicator-wheels above mentioned. These series consist of nine keys each, numbered from 1 to 9. Below these keys are located the vibrating segment-levers D D′ D^2, &c., each provided with a retracting-spring, S, pivoted upon bar *d*, there being one such lever for each series of keys and indicator-wheel. The keys are provided with shoulders *c*, which engage with the levers and act to depress the latter against the springs S whenever any one of the keys is struck. At their free ends the levers are provided with toothed segments E, which mesh with and rotate pinions E′ upon the shaft B. Adjoining pinions E′, and either integral with or fast thereto, are disks E^2, carrying spring-depressed pawls *e*. These pawls, when the pinions and disks are rotated by the downward movement of the levers, engage with and rotate the ratchet-disks F, but do not move the latter during the contrary rotation caused by the

return-stroke of the levers. The disks F are joined firmly to the indicator-wheels in some suitable manner, so that the latter are compelled to move with them. The extent of the rotation thus communicated to the indicator-wheels is regulated by the amount of throw given to the segment-levers D D′, &c., which varies with the key struck. Thus the keys numbered 1 are calculated to rotate the wheels one-tenth of a revolution, keys 2 to rotate them two-tenths, and so on through the series of nine keys. For this purpose the keys are graduated in length, as shown, having in view the different distances from the pivots of the levers, and are combined with a stop, so that they reach the limit of their stroke at the proper point in the movement of the segment-lever. That portion of the keys passing through the openings *d′* in the segment levers may be reduced in size from the upper portions. It is intended that the machine shall contain such number of indicator-wheels as may be necessary to indicate the sum of the numbers added, and that such sum can be read by the figures exposed at the openings *h* in the top plate, H, covering the indicator-wheels.

I will next describe the device for preventing over rotation by the indicator-wheels.

G G are levers, which I call "stop-levers." There is one for each series of keys, and they are placed under the same, so as to be actuated thereby. They are made to yield slightly when struck by the keys, and such yield is obtained by providing them with laterally-extending arms *g* at each end and pivoting such arms at *g′* to stationary cross-bars G′. From these stop-bars links or connecting-rods J extend upwardly and are joined to vibrating detents J′, pivotally hung upon a cross-wire, J^2, and adapted to engage with the equispaced wires or teeth *i*, secured in the indicator-wheels and companion disks F, to form ratchets. Springs J^3 lift the detents to their normal position after each operation, and with them the stop-lever also. This construction results in the absolute stopping of the rotation of the indicator-wheel whenever any key has depressed its stop-bar sufficiently to bring the detent into operation with the ratchet *i* of the wheel. It also results in limiting the down-stroke of the keys, so that no special device for this purpose is necessary.

During the backward rotation of the pinions E′ and disks E^2, caused by the upward motion of the segment-levers, there is a tendency upon the part of the wheels and their actuating-ratchets to move with the pinions and disks. To prevent this, I provide spring-stops K, having nibs or teeth *k*, adapted to engage with the ratchets *i*, already mentioned. The nibs *k* are given a gradual slope upon their neutral side, as shown, to enable the ratchet-teeth to lift the stops easily. The tension of springs K is regulated by screws *k′* in cross-bar k^2. The stops K are also useful in bringing the indicator-wheels into line when they move a fraction too far, as they are usually in contact with two pins, *i*, at a time when the wheels are at rest, and exert a lifting power upon the one beyond the center of revolution of the ratchet *i*. By these stops the indicator-wheels are positively held against backward rotation, and are also caused to present their numbers at the openings *h* in true alignment with each other.

The next feature of the machine to be described is the carrying mechanism—that is, the mechanism by which the numbers are carried from the unit-column to the tens, and from the latter to the hundreds, &c. In describing this part of the machine I shall necessarily include a description of the devices by which power is stored to operate the indicator-wheels in thus carrying numbers. Upon one side of the indicator-wheels are cams L, the general outline of which is that of a spiral, except the larger or outer third, or thereabout, which is concentric. Each indicator-wheel, except that employed for the highest column, is provided with this cam. A spring-lever, M, located adjacent to each wheel, is pivoted at *m* and forced toward the wheels by the spring *m′*. Each lever has an outstanding arm, m^2, which rides upon cam L of the wheel, and guards m^3 are preferably employed upon the wheel to draw the arms inward in case the spring should fail to actuate the levers at the moment the arms pass from the outer to the inner part of the cams. The rotation of any wheel with this construction will gradually force the lever away against the spring, thus storing up power in the latter. This power I utilize in turning the indicator-wheel next above in order by any suitable devices—as, for instance, by the push-pawl M′, pivoted upon lever M and meshing with the ratchet-teeth *i* of the said next higher wheel. It will be noticed that the pushing back of lever M to the dotted position, Fig. 5, will allow the pawl M′ to fall back of the next tooth of the ratchet *i*, so that when the lever-arm passes off from the large part of the cam and allows the lever to swing toward the indicator-wheels said pawl will engage with said next tooth, and as the lever is forced by the spring will move the ratchet and said next higher wheel one tenth of a revolution, so the latter will indicate a number one higher than before. In this manner each of the wheels, except the lowest, is operated to the extent of one number at each revolution of the wheel next below it, and this happens sometimes with several adjacent wheels simultaneously—as, for instance, if the first three wheels, (indicated 9 9 9,) a single unit added to the unit-column should result in the partial rotation by the carrying mechanism of the next three higher wheels as well, so as to indicate 1,000. The carrying operations, whether involving the turning of one or two or more wheels, are entirely automatic and independent of the key, and consequently no more force is required to be put upon the key when numbers are to be carried than when they are not to be carried. The storing of power in the springs begins

whenever the wheels start to form a new ten, and is so graduated that the operator need not feel the increased power due to the friction on the cams.

The construction of lever M as illustrated is preferred. The lateral bend *r* brings the pawl M′ into the plane desired for its operation, while the arm m^2 may be integral with the lever. The screws *a* limit the upward throw of the segment-levers, and are very useful, if not indispensable. The screws *a′* in the stop-levers may be employed to receive the impact of the keys, and, being adjustable, may be set at any point required to compensate for levers not exactly the proper length. The rods J should preferably be either adjustable as to length or be adjustably secured at one end, as by a screw, a^2.

At Fig. 10 I have shown a stop-lever, much like the segment-lever—that is to say, it is pivoted at one end only, the other end being free. With this lever the keys will require to be somewhat different in length from those used with the stop-lever previously described; but the modified form is on some accounts to be preferred.

The pivoted detent J′ may also be dispensed with by attaching to the stop-lever a hook, N, as illustrated at Fig. 12. Where this hook is employed, a spring (not shown) should be used to bring the lever back to its normal position after each operation.

In machines of this character, when the power required by the carrying operations is obtained from the key, it becomes very difficult and sometimes impossible to operate the machine, because enough power to operate all the wheels involved in the carrying cannot be put upon any one key. In my machine, an independent power being relied upon, no such objection pertains.

The operation of the machine is as follows: Suppose we are presented with numbers to be added, as follows:

327
946
183

With the wheels all presenting the zero-mark, the operator begins with the units and successively depresses the keys 7, 6, and 3 in the unit-column. At the first of these operations the unit-wheel will rotate and present the figure 7, the cam L of said wheel acting to push back the lever M as the rotation proceeds. The second operation, the depressing of unit-key 6, causes the rotation of the unit-wheel to position indicating 3, and at the same time its cam L completes its first revolution, so that the spring-lever is released from the larger or outermost part of the cam, and is allowed to move toward the wheels under the force of its spring *m′*. This permits the push-pawl M′ to carry the next higher wheel, that of the ten-column, one space or figure, so that said wheel indicates 1, instead of 0. We now have represented by the unit and the ten wheels the sum 13. The next operation, which is the depressing of unit-key 3, rotates the unit-wheel to 6, giving as the total sum of the unit-column 16. We are now ready to commence operation upon the column of tens, and the operator strikes successively the 2, 4, and 8 keys of that column, resulting in rotating the ten-wheel first to 3, then to 7, then to 5, the last operation also causing the turning of the hundred-wheel one point, and the machine now indicates 156 as the sum of the tens and units. The operator then proceeds with the hundreds, depressing in their order keys 3, 9, and 1 of that column, the first depression carrying the wheel to 4, the next to 3, (carrying 1 at the same time to the thousand-wheel,) and the last to 4. The four wheels mentioned now show the total result to be 1,456.

Instead of adding by vertical columns, the numbers may be added by horizontal columns. Thus, in the example supposed, after first setting the machine to represent 327, the next operation may be to add 946, striking first the 9 key in the hundreds, then the 4 key in the tens, and lastly the 6 key in the units; or this order may be reversed and the units added first, then the tens, then the hundreds, as preferred, and after this is done the remaining number, 183, may be added in the same way. In this manner the operator, who is required to add one number or amount at a time to another, or to the sum of the others—as is the case with cashiers at stores, &c., who note the sums of money they receive as the same are paid—will thus be enabled to keep the account as the business progresses and be able to tell at any time the amount of cash received by them.

In sketching the general operation of the machine as I have done, I do not deem it necessary to go into the details of the carrying mechanism or the various devices by which the wheels are rotated, the description of the parts themselves being sufficiently full to enable those skilled in the art to understand their mode of operation.

I claim—

1. In an adding-machine, a series of indicator-wheels having coincident axes, each of said wheels bearing on its periphery figures 0 to 9, inclusive, in numerical order, each of said wheels being provided with a cam and a ratchet, and a pinion provided with a pawl in engagement with said ratchet, combined with a corresponding series of actuating-keys, each provided with a segment-rack in engagement with one of said pinions, and a series, less by one than the number of said wheels, of vibrating levers, each in engagement with the cam of one wheel and with the ratchet of the next adjoining wheel, and a corresponding number of impelling-springs to actuate said vibrating levers, as set forth.

2. The combination, with the indicator-wheels, the actuating segment-levers, and the graduated keys, of a positive stop for preventing over rotation, the same being put in operation by the keys, substantially as set forth.

3. The combination, with the indicator-wheels, the actuating segment-levers, and the graduated keys, of the detents J′, one for each wheel, and mechanism operated by the keys for depressing said detents into engaging position, substantially as set forth.

4. In an adding-machine, the series of indicator-wheels and carrying mechanism connecting such wheels, in combination with the series of segment-levers, the several series of keys, and a series of positive stops put into operation by the keys for stopping the rotation of the several wheels, substantially as specified.

5. The combination, with the keys, the yielding stops G, rods J, detents J′, and the indicator-wheels and their ratchets *i*, substantially as specified.

6. The combination, with the actuating-keys D and number-wheels A, the yielding stops G, rods J, and detents J′, of the springs J^3, substantially as specified.

7. The combination, with the main shaft and indicator-wheels, all mounted thereon, and ratchets *i*, all mounted upon a common shaft, of automatic carrying mechanism consisting of the cams L, the levers M, provided with arm m^2, resting upon and actuated by the cams, the spring *m*′, and the push-pawl M′, substantially as specified.

8. In an adding-machine, a series of indicator-wheels arranged side by side upon a shaft, a series of segmental levers for actuating said wheels, and the several series of keys, in combination with a series of separate carrying devices, each provided with a retracting-spring in which power is stored for actuating said carrying devices, and two stops for preventing over rotation and backward rotation, respectively, substantially as set forth.

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