(No Model.) 3 Sheets—Sheet 1.

A. STARK.

ADDING MACHINE.

No. 308,528. Patented Nov. 25, 1884.

Fig. 1.

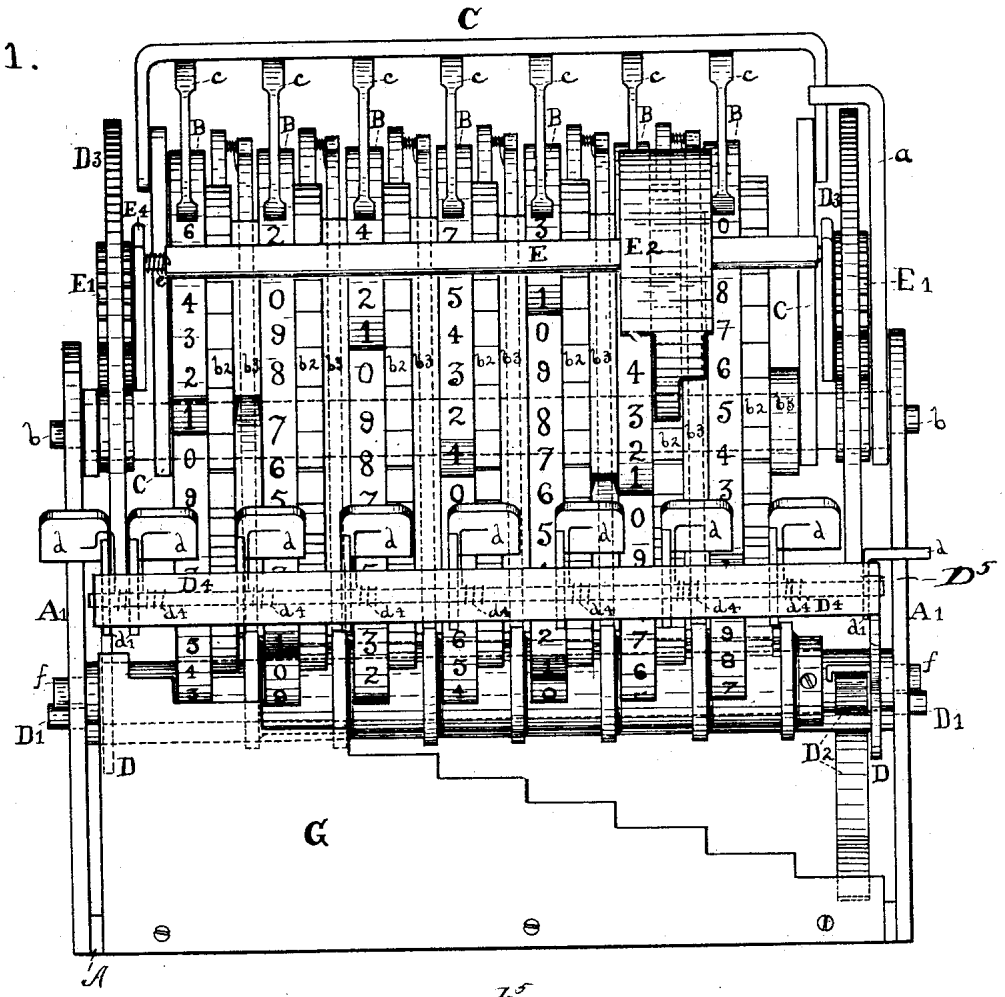
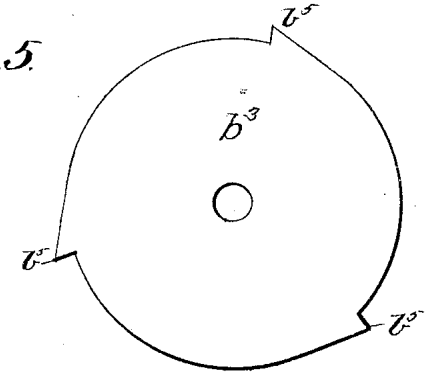


Fig. 5.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 4.

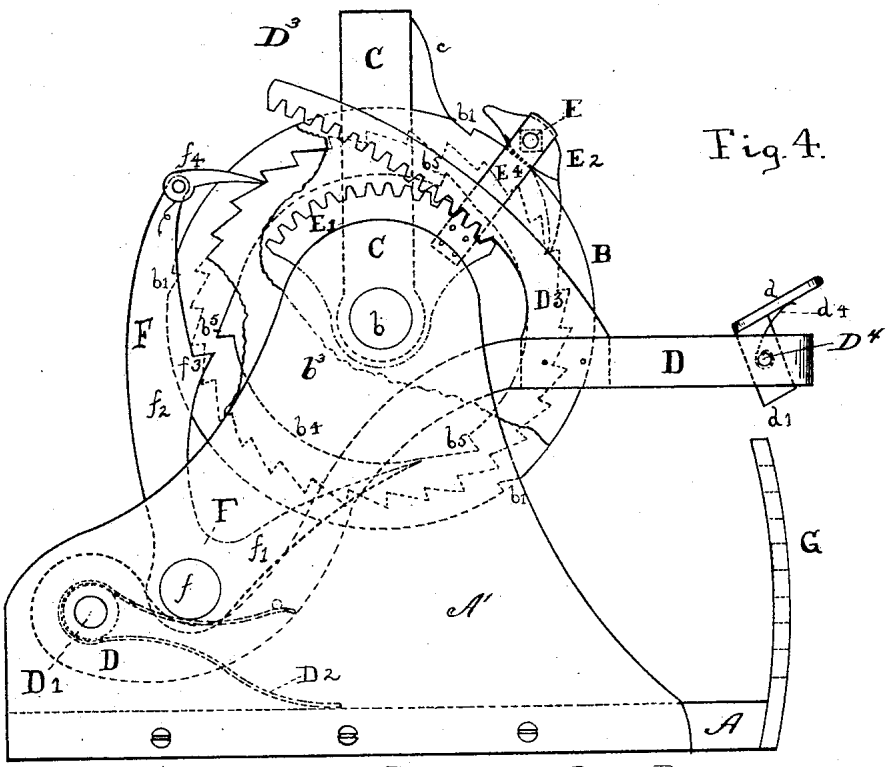
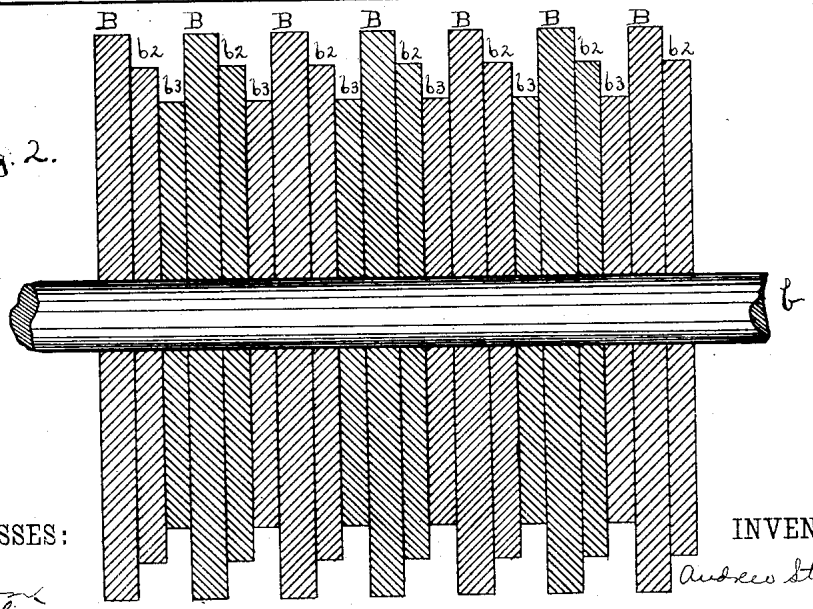


Fig. 2.



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(No Model.)

3 Sheets—Sheet 3.

A. STARK.

ADDING MACHINE.

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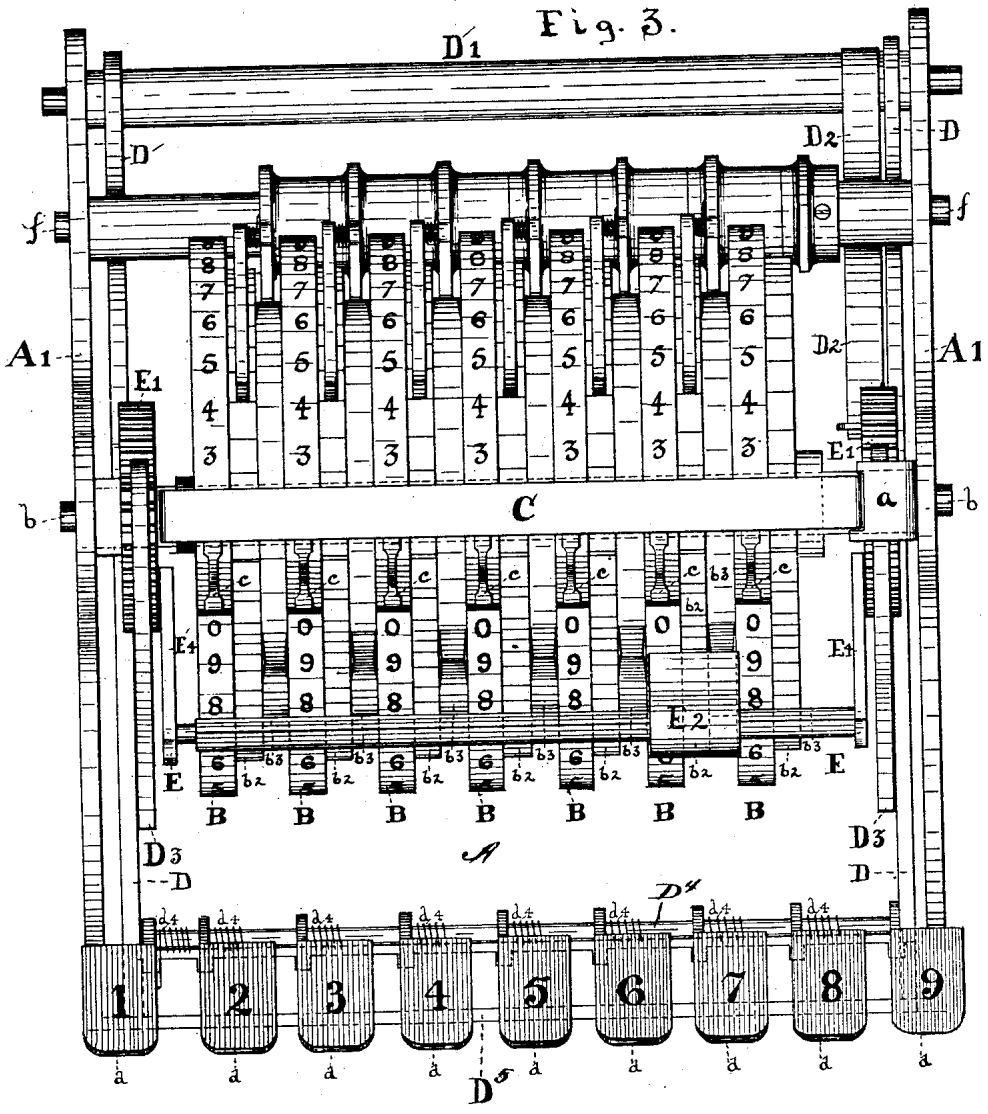
Fig. 3.



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UNITED STATES PATENT OFFICE.

ANDREW STARK, OF CHICAGO, ILLINOIS, ASSIGNOR TO L. W. NOYES, OF SAME PLACE.

ADDING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 308,528, dated November 25, 1884.

Application filed October 18, 1883. (No model.)

To all whom it may concern:

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

My invention relates to machines for producing a visible registration of the sum of any numbers by manipulation of finger-keys corresponding to the digits of which the numbers to be added are composed. Its distinctive features are fully set forth in the claims, reference being had to the accompanying drawings, wherein—

Figure 1 is a front elevation. Fig. 2 is a horizontal section of the number-rollers and their common arbor. Fig. 3 is a plan view. Fig. 4 is a side elevation. Fig. 5 shows the triple cam.

The entire mechanism is attached to and held in place by the base A and the sides A′ A′.

B B are rollers placed on a common axle, *b*, and adapted to revolve independently of each other, and each having its periphery divided into three or more equal spaces by the notches *b′*, and each space subdivided into ten subdivisions, numbered from 0 to 9, inclusive. Each roller has on one side, and rigidly secured to it, a notched disk or ratchet-wheel, b^2, having as many equispaced teeth as there are equal numbered spaces on the periphery of the rollers. On the other side each roller, except the last one to the left, has secured to it a triple cam, b^3, having a face, b^4, and a projection, b^5, corresponding to each of the notches *b′* on the periphery of the roller.

C is a bar passing across the top and bent down at the sides of the system of rollers and fixed upon the shaft *b*, and having a series of light springs attached to it in such manner that one end of each may press on the periphery of one of the rollers and fall into the notches *b′*. The bar is held in place—that is, prevented from revolving around the shaft *b*—while the rollers are being operated by the notched projection *a* of the side frame A′.

D D are parallel lever-arms, attached to the rock-shaft D′, which is pivoted in the frame A′ A′ behind the system of rollers B, and has a spring, D^2, for throwing back the lever-arms D D after being pressed down in the act of adding a number, as hereinafter described. These two lever-arms D D extend past the ends of the system of rollers B, and are connected across the front of the machine by the key-bar D^1, to which are pivoted eight keys, *d*, numbered from 0 to 8, inclusive. A ninth key, *d*, numbered 9 is rigidly secured either to the key-bar D^1 or to one of the side bars D as shown. The side bars D are also connected across the front of the machine by the cross-bar D^5, which serves for a stop for the keys *d*, rocking over their pivots on the key-bar D^1, as hereinafter explained. The pivoted keys *d* are formed and placed so as to stand when at rest with their upper faces inclined downward toward the machine, being thrown into that position by suitable springs, d^1 as soon as the pressure of the finger is removed. The pivoted keys have each a toe, *d′*, which projects considerably below the point at which they are pivoted, so that as the keys are pressed downward, overcoming the spring d^1, the toe is thrown forward sufficiently to cause it to strike upon its proper stop. The ninth or rigid key has a similar toe, *d*, which stands always in position to collide with its proper stop when the key-bar is sufficiently depressed.

From the lever-arms D there are projected upward and backward two pieces, D^3 D^3, one at each end of the machine, and in front of the axis of the rollers, having on their under edges segment-racks, which engage with the segment-pinions E′ to impart motion to the driving-pawl E^2. These segment-pinions are pivoted upon the shaft *b*, one at each end of the system of rollers B. From each of them an arm, E^1, extends up beyond the edge of the rollers B, having a range of motion concentric with the rollers B, and just in front of them, equal to nine numeral-spaces on the periphery of the rollers. The cross-bar E carries a pawl, E^2, which engages with the ratchet-disks b^2, rotating them and the attached rollers B in the direction of the numbers. This bar E and its attached pawl E^2 carried by the sector-pinions E′ E′, to which they are attached by means of the arms E^1 at each end,

are actuated by the segment-racks D^3 D^3, engaging with said sector-pinions E′ E′. The cross-bar E is pivoted at each end in the projecting arms E^4 E^4 of the pinions E′ E′, the pinions being pivoted to the shaft, as described. The cross-bar E is of such shape that the pawl E^2 slides upon but cannot revolve about it, and is kept in contact with the ratchet-disk b^2 by the use of a suitable spring, *e*, applied to the cross-bar; or the cross-bar may be rigidly attached to the arms E^4 E^4, and in that case the cross-bar may be made round, and a suitable spring be arranged to directly actuate the pawl E^2.

F F F F are devices for carrying the tens from one roller to the next from left to right. They are bell-crank levers pivoted at their angles, respectively, on the shaft *f* supported in the frame A′ A′. They are operated by the peripheral cams b^3, attached to the rollers B, the lower arm, *f*′, of each having a bearing-surface in contact with one of the cams b^3, and adapted to be acted upon by the latter, so as to be thrown down by each of its projections b^5. The upward-projecting arm f^2 of the bell-crank lever F has on its inward edge a bearing-surface terminating in the projection f^3 midway from its upper end, against which the cam b^3 acts to throw back the bell-crank lever, which has a pawl, f^4, on its upper end engaging in the ratchet b^2, attached to the adjacent side of the next roller to the left. In front, and attached to the base, I have placed a vertical projection, G, arranged to stop the descent of the key-bar D^4 and keys *d*. The upper edge of this projection is of varying height, corresponding to the key which it is intended to stop, stopping 1 on the first level, 2 on the second level, 3 on the third level, &c. Instead the toes *d*′ may be made of similarly varying length, and the stop G may then be of uniform height.

The operation of my invention may be understood from the following description: The cross-bar C, released from the catch *a*, which is made sufficiently elastic to be sprung aside for that purpose, is rocked back toward the shaft D′ a distance of full ten numeral-spaces, the pawls *c* sliding on the periphery of the rollers or number-wheels respectively. The bar C being then rocked forward to its first position, the pawls *c* engage in the notches *b*′, which are only ten numeral-spaces apart, on the periphery of the rollers, so that in the course of the rocking movement of the bar through ten full spaces every wheel will be thus engaged by its corresponding pawl. The pawls being all in line, the notches, and so the zeros, which are at the same distance from the notches on all the wheels, will be brought into line, and will so stand when the forward movement of the rock-bar ceases and the catch again engages it. The operator now places the pawl E^2 so that it will work on the ratchet of the first roller to the right (the units-roller), and depresses the key corresponding to the figure to be added in the units-column. The spring d^4, which sustains the key *d* upon the key-bar, being much weaker than the spring D^2, which sustains the key-bar itself, yields first to the pressure upon the key, permits the key to rock over the key-bar and throw its toe *d*′ forward into range of the stop-bar G. Pressure being continued upon the key, and the rocking motion of the key itself being arrested by the contact with the cross-bar D^5, the spring D^2 yields to the pressure of the operator, and the key-bar is depressed until the toe *d*′, protruded forward as explained, collides with its corresponding stop on the stop-bar G and arrests the descent of the key-bar. The pressure being removed, the springs D^2 and d^4 react and throw the key and key-bar into their initial position. In this motion it will be seen that the segment-rack D^3 has been carried with the key-bar and side bars, D D, and that thereby the sector-pinion E′ has been revolved and has carried with it the pawl E^2 and the number-wheel engaged by the pawl through an arc corresponding to the number of the key depressed, thereby bringing into the position occupied at starting by the zero a figure on the periphery of the number-wheel corresponding to said key. The key corresponding to the next figure in the column is now pressed down, and in like manner all subsequent figures in the units-column, whereupon the rollers will show the sum, reading the figures which appear below the ends of the springs. The operator now presses upon the head of the pawl E^2, to disengage it from the ratchet b^2 of the units-roller, and slides it along upon the bar E until it will work upon the ratchet of the next (tens) roller, and, commencing with the first figure in that column, proceeds as before, and similarly with all succeeding columns until all have been added, when the machine will show the aggregate upon the line where the zeros stood at the beginning.

It will be understood from the foregoing description that when any roller has been rotated nine numeral-spaces the apex f^3 of the bearing-surface on the upper arm, f^2, of the bell-crank lever F has just passed the apex b^5 of the cam-disk b^3 on the left side of the roller B, and the pawl f^4 has thereby been retracted over the ratchet b^2 pertaining to the next roller to the left, and the point of the lower arm, *f*′, of the bell-crank lever F is resting just at the root of the next cam projection, b^5, of the first roller, so that upon the rotation of the first roller one space farther the cam b^3, acting against the bearing-surface of the lower arm, *f*′, of the bell-crank lever F, drives forward the upper arm and the pawl f^4, and thereby advances the next roller one numeral-space. The rock-shaft D′, being behind the axis of the number-wheels, and the rack D^3, being in front of that axis and the sector E′, having that axis as its center, the radius of the segment-rack D^3 being thereby greater than that of the sector E′, causes the angular motion of the key-bar and of the rack rocking with it to be

proportionately less than the angular motion which the rack thereby gives to the sector and to the number-wheels revolving with it. As illustrated, the radius of the rack is about three times that of the sector, and the angular motion of the rack is therefore only about one-third that of the sector, and thereby the motion of the key-bar, and so of the hand of the operator in depressing it, is reduced approximately to a straight line, which renders the action easier and more rapid than if the operator were obliged at every stroke to follow the curve of the number-wheel through nearly one-third of its circumference, or such portion of its circumference as the number to be added should be of thirty, the whole number of spaces on the wheel.

Having thus described my invention, I claim and desire to secure by Letters Patent—

1. In an adding-machine, in combination with the number-rollers mounted side by side on a single arbor, a gear-sector on the same arbor, a segment-rack meshing therewith whose center of motion and curvature is on the side of said arbor opposite said rack, a driving-pawl mounted on a rigid radial extension of said gear-sector, and the key-bar rigid with said segment-rack, all co-operating to make the angular motion of the key-bar less than the resultant angular motion of the number-wheels, substantially as set forth.

2. In an adding-machine, in combination with the number-wheels, their actuating lever-arm and the mechanism whereby the arm actuates the wheels, a spring to retract the arm, the finger-keys mounted on the arm or some fixed adjunct thereof, and having a limited range of motion with relation to the arm, a spring to sustain each such keys on the arm out of range of the stop-bar, said keys adapted to yield in the direction of the motion of the arm, but to pressure less than sufficient to actuate the arm against its retracting-spring, substantially as and for the purpose set forth.

3. In an adding-machine, in combination with the number-wheels and their ratchet-disks, disks secured to one side of each having two or more equispaced radial or projecting teeth adapted to act as cams, bell-crank levers embracing the disks in their angles, respectively, and having their two arms provided with bearing-surfaces adapted to be acted upon alternately by the cam-teeth of the disks, and pawls pivoted one to each of the bell-crank levers and adapted to engage the ratchet-wheel of the next higher denomination above the one which actuates it, substantially as set forth.

4. In an adding-machine, in combination, a supporting-frame, a shaft fixed therein, a series of independently-revolving number-wheels arranged side by side upon such shaft, and having upon their peripheries notches at each tenth numeral-space only, a rock-bar rocking over the circumference of the wheels, and as many independent spring-pawls thereon as there are number-wheels, said pawls arranged separately to engage the notches on the periphery of said wheels, respectively, whereby all the wheels are simultaneously set to zero-point at starting, substantially as set forth.

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Attest:
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