(No Model.) 5 Sheets—Sheet 1.

W. H. CLARK.

CALCULATOR.

No. 527,943. Patented Oct. 23, 1894.

FIG 2

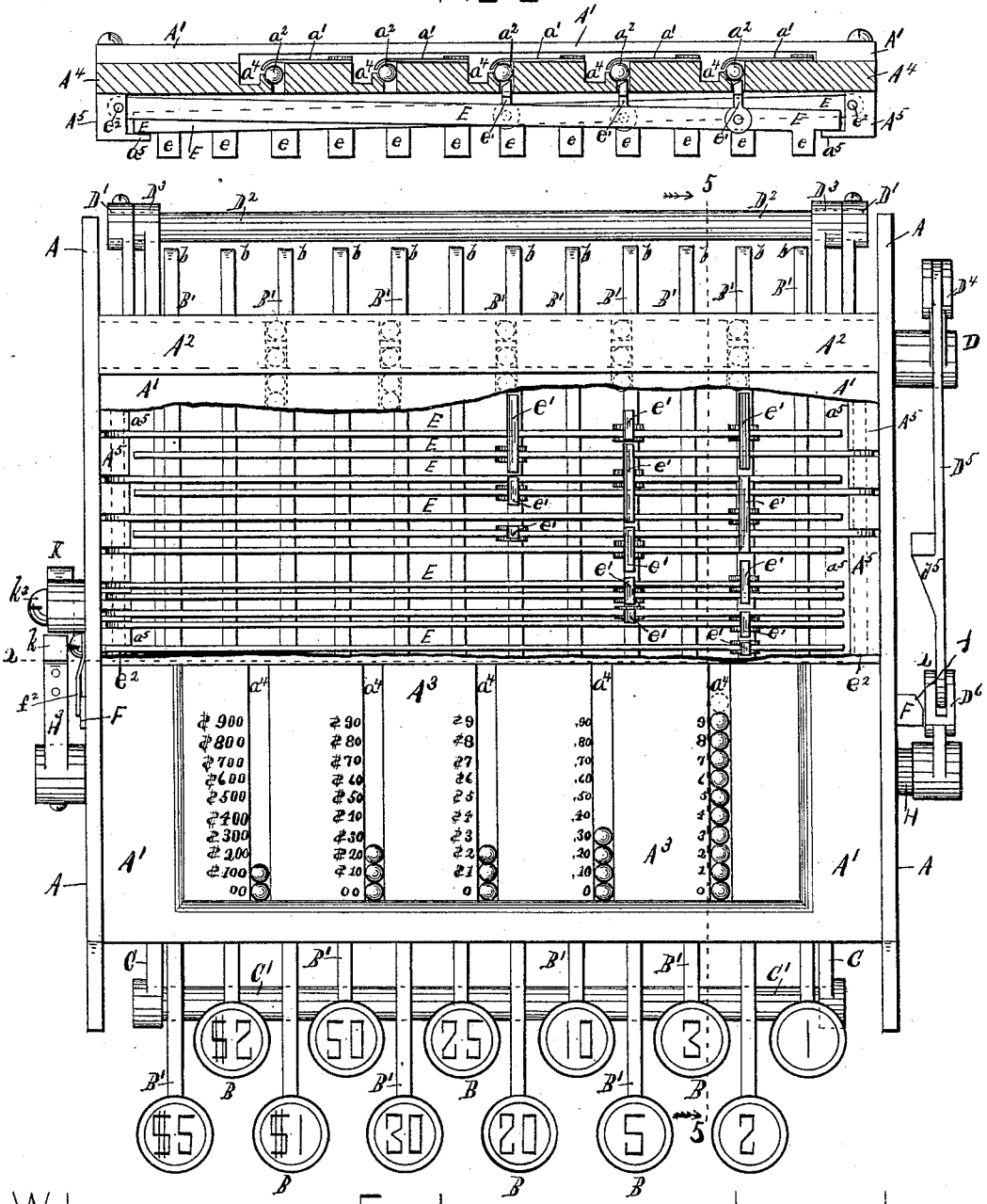

FIG 1

Witnesses

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CALCULATOR.

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FIG 4

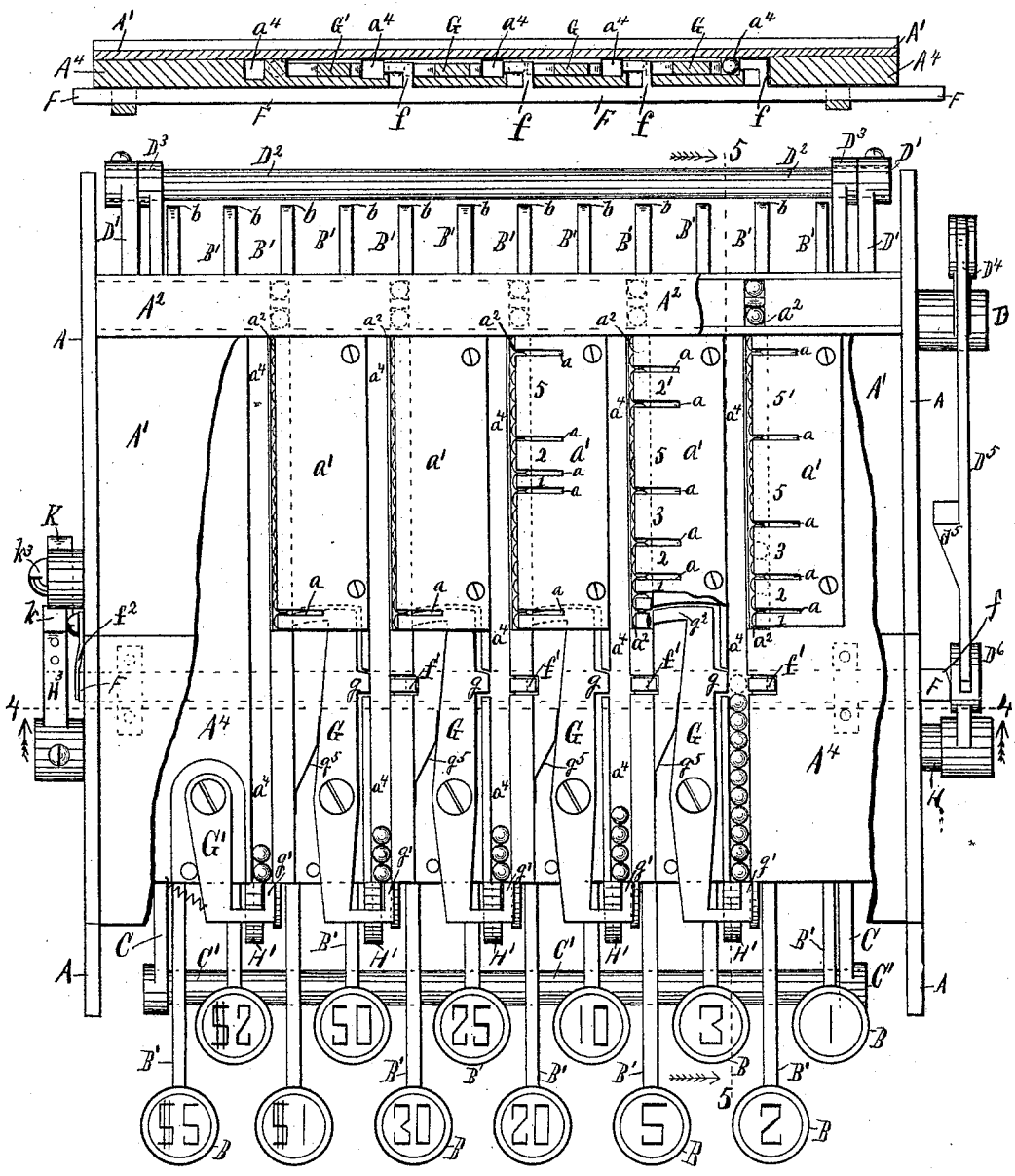

FIG 3

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No. 527,943. Patented Oct. 23, 1894.

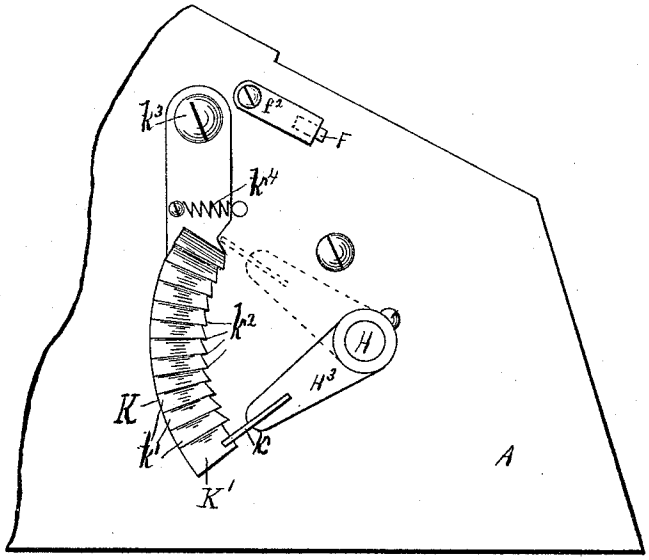

Fig 6

Fig 5

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(No Model.) 5 Sheets—Sheet 4.

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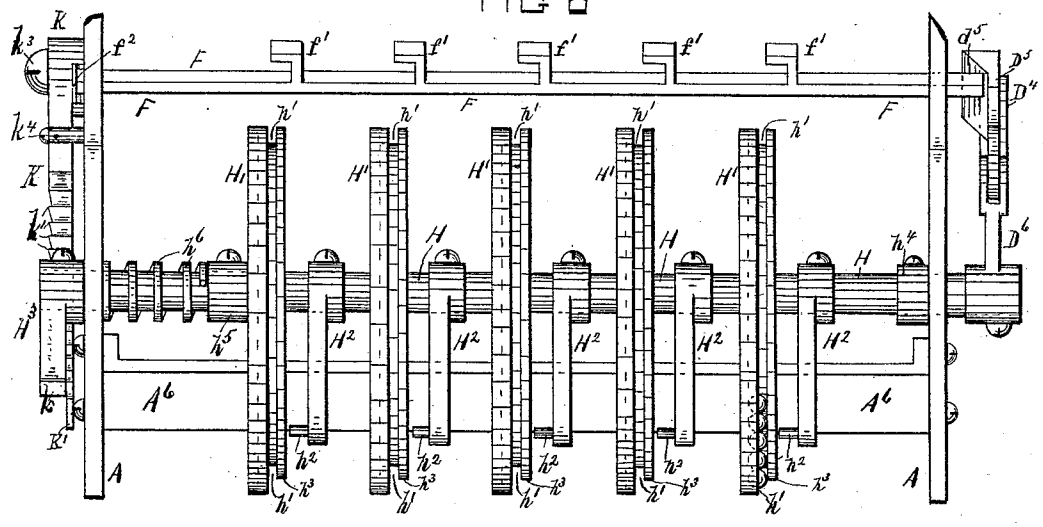
No. 527,943. Patented Oct. 23, 1894.

Fig 8



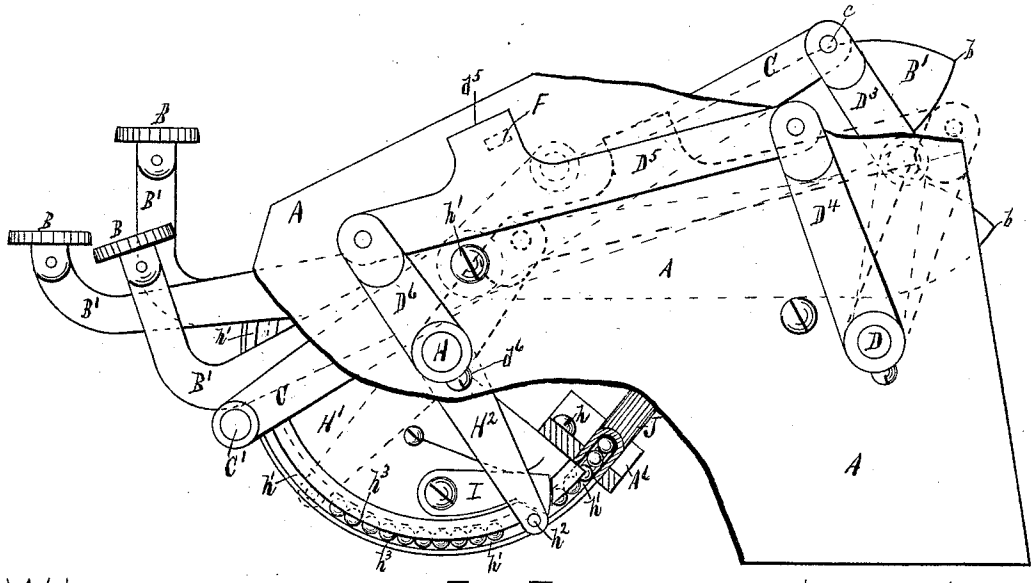


Fig 7

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(No Model.)

5 Sheets—Sheet 5.

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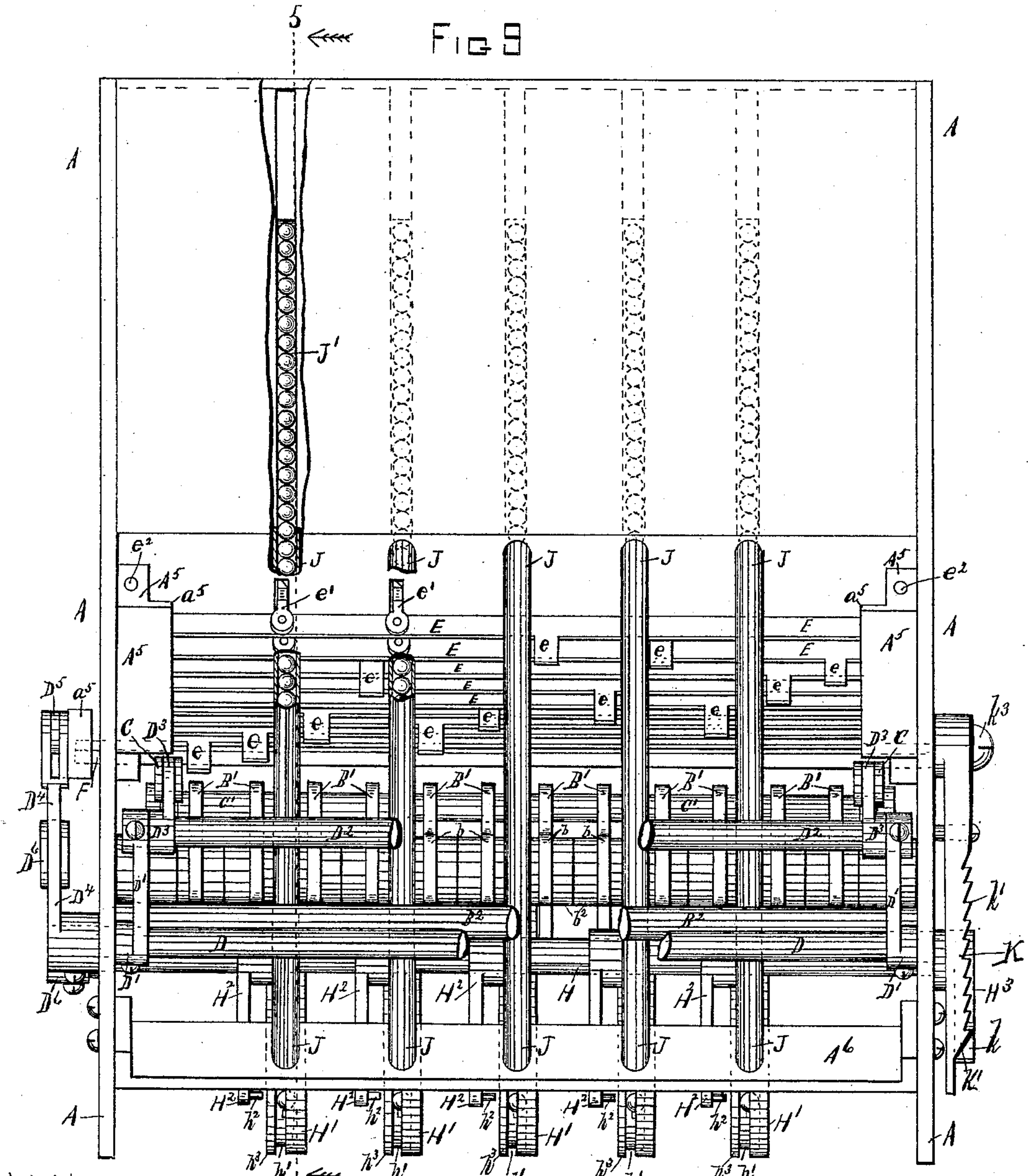
CALCULATOR.

No. 527,943.

Patented Oct. 23, 1894.



Witnesses
J. P. Slocum
Wm Marks Jr.

Inventor
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by Hallock & Lord
his Attys

UNITED STATES PATENT OFFICE.

WILLIAM H. CLARK, OF ERIE, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO B. B. BROWN, OF SAME PLACE.

CALCULATOR.

SPECIFICATION forming part of Letters Patent No. 527,943, dated October 23, 1894.

Application filed April 13, 1894. Serial No. 507,405. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. CLARK, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented certain new and useful Improvements in Adding-Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to adding machines, and particularly to that type thereof wherein balls are used to represent numerals, and it consists in certain improvements in the construction thereof as will be hereinafter fully set forth and pointed out in the claims.

My invention is illustrated in the accompanying drawings, as follows:

Figure 1 is a top view of the machine with parts removed to show construction below the cover. Fig. 2 is a transverse section on the line 2—2 in Fig. 1. Fig. 3 is also a top view with parts removed, showing features of construction below the cover and above the inner parts shown in Fig. 1. Fig. 4 is a transverse section on the line 4—4 in Fig. 3. Fig. 5 is a longitudinal section on the line 5—5 in Fig. 3. Fig. 6 is a side view of the ratchet device K and pawl H^3 seen on the left of Fig. 3. Fig. 7 is a side view of the key action and other parts with frame broken away, the point of view being from the right of Figs. 1 and 3, and, hence, from the opposite point from the view in Fig. 5. Fig. 8 is an elevational view of means for elevating the balls for re-use and other parts, the point of view being from the front of the machine, the keys being removed. Fig. 9 is an elevational view from the rear of the machine, with parts broken away to show internal construction.

The construction of the machine and its operation will appear from the following general description.

A A mark the side pieces of the frame work; A′, the top or cover; A^2, the ball reservoir; A^3, the dial; A^4, a frame piece below the cover in which are the ways for the balls, and on which parts of the mechanism are secured; A^5, frame strips at each end of the machine along the under side of the piece A^4 which have ledges a^5 and to which the bars E are pivoted; A^6, a cross frame piece or bar, which serves as a support for some of the parts of the machine; B, the finger pieces, and B′, the levers of the keys.

Other letters and figures of reference will be referred to when describing the parts which they designate.

The machine as illustrated is capable of indicating any amount up to ninety-nine thousand nine hundred and ninety-nine units, but it may be made to indicate ten, or one hundred, or one thousand, or more, times that amount by duplicating parts.

The dial displays as many channels for balls as the machine is designed to indicate units and multiples (by ten) of units. Hence, as the machine illustrated is capable of indicating ninety-nine thousand nine hundred and ninety-nine units there are five channels a^4, and as the machine is designed for computing transactions in money of the United States, these channels are respectively the representative of cents, dimes, dollars, and hundreds of dollars, and the spaces of each channel are numbered from the bottom upwardly thus: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, and by operation of the machine as will hereinafter appear, whenever there are ten balls in any of the channels, except the highest in denomination, they are discharged, and one ball is added to the next highest channel. In Fig. 1 the dial indicates $122.39.

In a patent issued to me on March 10, 1894, No. 516,985, I illustrate a machine having the capabilities of the one here represented, but in that machine the results are obtained by very different mechanism, and the processes of the machine differ materially. For example, in the patented machine the tenth ball in each channel is carried over and discharged into the next highest channel and the remaining nine balls escape into a reservoir from which they run down in channels where they are fed to counters which when operated, lift them up and discharge them into the dial channels; while in the present machine no balls are carried over into channels of higher denomination, but all ten are discharged, and at the same time a new ball is added to the next higher channel, and in this machine the balls are not lifted by the counters, but are conveyed, after leaving the dial channels,

up into an elevated reservoir and from there pass by gravity into conduits leading toward the dial, from which conduits they are separated by counters and discharged into the dial chambers.

Now looking at Figs. 5 and 3, A^2 is the reservoir, a^2 are the conduits leading from the reservoir and J′ the conduits leading up to the reservoir, and a^4, the dial channels. By observing Fig. 3 it will be seen that the conduits a^2 and the channnels a^3 above the dials A^3 lie side by side and parallel, and throughout the space where these ways are thus contiguous there are flexible covers a' over the conduits a^2, that retain the balls in place but will yield, under pressure and allow the balls to be ejected from under said covers sidewise into the channels a^4. It will be seen that these covers are divided into sections by slots a. Thus the first cover a' on the right of Fig. 3 has, beginning at its lower end, a section covering one ball, then a section covering two balls, then a section covering three balls, then a section covering five balls, and then another covering five. Now, as will be explained in detail farther on, when key 1 is pressed, the ball under the narrowest section of cover a' is ejected into channel a^4 and rolls down into view, and when key 2 is pressed the two balls under the next section are ejected, and so on, and when keys 3 and 1 are pressed simultaneously four balls will be ejected. These sections I have numbered according to the number of balls held by them. In the other covers is found, at the bottom, a section marked o, which holds a ball to be ejected whenever ten balls are released from the next lower channel. The second cover a' from the right of Fig. 3 covers balls representing tens of units or dimes, and there are sections for 1, 2, 3, 5 and also two balls in a section marked 2′, and in the next or third cover there are sections for 1, 2 and 5 balls. In all the channels except the first there are sections from which balls are not ejected. These are located to fill the channel and allow a more convenient location of the levers.

The sections marked 2′ and 5′ in the tens and units covers cover balls that are ejected simultaneously when the twenty-five-cent key is actuated. When the ten-cent key is actuated a ball is ejected from under the cover section 1 in the second cover from the right of Fig. 3; when the twenty-cent key is actuated two balls held by section 2 of the same cover are ejected; when the thirty-cent key is actuated the balls are ejected from under section 3; when the fifty-cent key is depressed five balls are ejected from under cover section 5; when the one-dollar key is depressed the ball under section 1 of the third cover is ejected; when the two-dollar key is depressed the balls under section 2 of the third cover are ejected, and when key $5 is depressed the five balls held by cover section 5 of the third cover are ejected. It will therefore be understood that keys 1, 2, 3, and 5 act to eject balls from under the first cover; keys 10, 20, 30, 50, act to eject balls from under the second cover; keys $1, $2, $3, act to eject balls from under the third cover, and key 25 acts to eject two balls from under the second cover and five from under the first. It now remains to describe the means by which these results are effected, together with the means by which the balls are returned to the reservoir after being discharged ftom the dial.

It will be seen that the balls pass from the reservoir through the conduits a^2 by gravity and find their places automatically under the covers a', also that the balls when ejected from the conduit a^2 fall into the channels a^4 and are displayed on the dial. The direct means for ejecting the balls from under the cover-sections are wedge-formed plungers e' carried on levers E, below the frame piece A^4, said plungers acting up through slots in said part A^4. (These plungers may be called ejectors, or separators.) These ejectors e' vary in width according to the number of balls they are designed to displace. There are, in the machine illustrated, twelve keys, and there are twelve ejector-levers E, which are pivoted at e^2 on one of the frame pieces A^5 and their loose ends are supported by the ledge a^5 on the opposite piece A^5, and I have pivoted each alternate bar on one frame piece A^5 and the other on the other piece A^5. On each bar E there is a depending lug e which contacts with the proper key. (See Fig. 9 for the best illustration of this.)

The key levers B′ are pivoted on a cross rod b' and rest at their rear ends on the rod B^2 and on each lever is a hub or boss b^2, by which they are all kept properly spaced. The rear ends of the key levers are pointed at b, and increase in width by a regular catenary curve.

A bail or frame formed of two side levers C C, and cross rods C′ and C^2 is pivoted also, on the rod b', the rod C′, being below the key levers B′, in front of the pivot and the rod C^2, being above the key levers back of the pivot, so that whenever any one or more of the key-levers are depressed the bail or frame is tilted. The side pieces C of the frame or bail extend back of the cross rod C^2 and connect by pivots c with toggle-links D^3. A rock shaft D, passes across the machine below the rear ends of the key-levers and toggle-links D′ connect it with toggle-links D^3 and a rod D^2 which serves as a pivot for the toggle-links passes across the machine immediately in the rear of the points b, of the key levers when they are at rest. By observing Fig. 5 this construction will be clearly seen, and the parts are shown by dotted lines in changed position. Whenever any one or more keys are depressed, the bail C, C′, C^2, lifts the toggle-link D^3 and this draws the rod D^2 forward over the tops of the key levers that are at rest and under those that are in action, and as a ratchet device, to be explained farther

on, serves to prevent any reaction of a key lever after it begins a movement until said movement is completed. The rod D^2 serves to lock all unactuated key levers against action until the acting key lever has completed its action. The shaft D is rocked by the toggles D', D^3, as before stated. On the outer end of the shaft D, at the right of Figs. 1 and 3 and the left of Fig. 9, is a crank arm D^4, seen also in elevation in Fig. 7. Near the front of the machine is another rock shaft H, which is provided with a crank arm D^6, and a bar D^5, connects the rock arm D^4 therewith, so that as the shaft D, is rocked, the shaft H, is also rocked.

On the left side of the machine, opposite the rock arm D^6, on the shaft H, is a pawl arm H^3, carrying a pawl k (see Fig. 6) which acts upon an arc-formed ratchet K, that is pivoted at k^3 and is yieldingly held in position by a spring k^4. On the lower end of the arc-formed piece K, that is pivoted at k^3 and is yieldingly held in position by a spring k^4. On the lower end of the arc-formed piece K is a cam face K' and on the side above the cam face are ratchet teeth k', which point upwardly and on the edge are ratchet teeth k^2 that point downwardly. The shaft H is capable of longitudinal movement which movement is resisted by a spring h^6. (See Fig. 8.)

When the shaft H, is rocked, the pawl k, moves up the cam face K' and draws the shaft H longitudinally toward the left of the machine and then the pawl passes over the ratchet teeth k' and as soon as it reaches the top the spring h^6 draws the shaft H back and the pawl k is brought against the edge of the ratchet K and upon the teeth k^2, over which it descends, the spring k^4, yielding to allow the movement. It will thus be seen that at each movement of a key lever or of any number of them moved simultaneously, the ratchet K prevents any backward movement and compels a completed movement to be made, and the bail C, C', C^2, above described, prevents a movement being begun by one key and finished by another.

On the longitudinally moving pitman bar D^5 which connects the rock arms D^4 and D^6 there is a cam d^5. This cam contacts with the end of a cross bar F, which has a cam face f at its end, and moves the bar longitudinally, and a spring f^2 on the opposite side of the machine reacts the bar F. (See Figs. 3 and 8.) At intervals along the bar F, are fingers f', that pass up through openings in the grooved plate A^4 below the dial and exactly far enough above the lower end of the channels a^4 to admit ten balls below the points of said fingers. In depressions in the plate A^4 between the channels a^4 there are pivoted levers G, that are held vertically by springs g^5 and have lugs g on a line with the fingers f' on the bar F. These pivoted levers also have arms g' at their lower end which serve as gates to close the lower ends of the grooves a^4, and at their upper ends they have fingers g^3 on the opposite side from the lugs g and arms g', which stand immediately back of the lowest ball in the conduits a^3 and which are held in place by the sections o of the spring covers a'.

It will be seen that whenever any one or more of the keys are depressed the bar F is moved longitudinally. Now when this occurs, the fingers f' on said bar move across the channels a^4 and if there are more than ten balls in any of said channels (as for example see the dotted ball in Fig. 3), the eleventh ball will be gripped between the finger f' on the bar F, and the lug g on the lever G, and as the movement proceeds, the lever G, will be moved pivotally, and this will open the gate at the bottom of the channel a^4 and allow the ten balls to escape and it will also cause the finger g^2 to push a ball into the next higher channel. When the bar F reacts, the levers G will react and the ball held between the finger f' and the lug g will be released and will fall to the bottom of the channel where it will be held by the gate g'. As the balls leave the channels a^4 they pass into a circumferential, open-sided groove h', in the edges of semi-circular blocks H' that are secured by screws h to the frame pieces A^4 and A^6, and through them the shaft H passes loosely. (See Figs. 5, 7, and 8.)

It will be seen that the shaft H at each action both rocks and moves longitudinally. On said shaft H in proximity to each of said half disks H' are arms H^2 secured to the shaft, and having pins h^2 at their ends toward the half disks. When the shaft H, is moved, it first rocks, and as it does so moves to the left, then moves to the right and then rocks back. The longitudinal movement toward the left at the beginning of the stroke causes the pins h^2, to enter the slots h', and as the arms are advanced, the pins push the balls before them, in the slots h' out of the disks into tubes J which lead up to the reservoir, and a pawl I prevents the ejected balls from returning. The arms H^2, then move to the right with the shaft H, thus withdrawing the pins from the slotted grooves h', and then the arms rock back into normal position.

As represented in the drawings there are in fact a series of reservoirs, for the conduits are separate and distinct from each other so that the balls of one conduit never enter the other conduits. This I consider to be advantageous, because where there is a common reservoir from which the balls are expected to pass into the several ways they are apt to become clogged by arching; but I do not intend to be necessarily confined to a series of reservoirs.

It will be seen that in the machine as constructed there are a series of separate ways for the balls, one for units, one for tens, one for hundreds, and so on, and that balls used in one way never enter the other ways. Each way is a complete circuit with its ends lapping and the counting or tallying is effected

by transferring the balls from one end of the circuit to the other at the point of lapping, as where the grooves a^2 and a^4 are side by side.

I do not wish to be limited to the use of balls, as other forms of tally pieces may be used.

The gate g' closing the bottom of the groove of highest denomination is on a lever G' which is intended to be operated manually, and not as are the levers G.

The machine is not limited to adding by tens or multiples of ten. The first groove or way may represent, for example five cent fares, and the next dollars or twenty fares and so on.

What I claim as new is—

1. In an adding machine, the combination of a circuitous way for the continuous passage of tally pieces; a series of tally pieces in said way; a dial for observing the tally pieces at a certain point in said way and indicating the number of pieces in view in said way; a series of key levers of different designated values; mechanisms connected with said key lever, that actuate a number of tally pieces in said way equal to the designated value of the key levers operated upon.

2. In an adding machine, the combination of a series of circuitous ways, for the passage of tally pieces, one for units, one for tens, one for hundreds, &c.; a series of tally pieces in each of said ways; a dial for observing the tally pieces at a certain point in said ways and indicating the number of such pieces in view in each of said ways; a series of key-levers having keys designated by numerals; mechanism whereby the keys having designated numerals representing units, tens or hundreds only will, when actuated, operate to bring a corresponding number of tally-pieces into view in the corresponding ways, and whereby the keys having designating numerals combining both tens and units will, when actuated, operate to bring a corresponding number of tally-pieces into view in the tens and the units ways respectively; and mechanisms, operated from said keys, whereby the tally-pieces are discharged from view and moved onward in said ways into position for reuse, the movements of said tally pieces being continuous in the way to which they belong.

3. In an adding machine, the combination of a series of ways representing in serial order a series of denominations such as cents, dimes, dollars, or five cents, dollars, hundreds of dollars as the case may be; tally pieces movable in each of said ways and representing units of each of said denominations; and a series of mechanisms, one for each way, which are operated only when the tally pieces accumulated in the way to which they belong equal the tally pieces in the next higher way, and when operated, actuate a tally piece in the next higher way and discharge from view the equivalent thereof in the way to which said mechanism belongs.

4. In an adding machine, the combination of a series of ways for the passage and exhibition of tally-pieces; said ways representing in serial order a series of denominations such as cents, dimes, dollars, or five cents, dollars, hundreds of dollars, as the case may be; tally-pieces movable in each of said ways and representing units of each of said denominations; a series of gates, one for each way, which are operated only when the tally-pieces accumulated in the way to which they belong equal the value of one tally-piece in the next higher way, and when operated actuate a talley-piece in the next higher way and discharge from view the equivalent thereof in the way to which the operated gate belongs.

5. In an adding machine, the combination of a series of circuitous ways for the continuous passage and exhibition of tally pieces; said ways representing in serial order a series of denominations such as cents, dimes, dollars, or five cents, dollars, hundreds of dollars, as the case may be; tally pieces, each moving continuously in the way to which it belongs, representing units of each of said denominations; a series of mechanisms, one for each way, which are operated only when the tally pieces accumulated in the way to which they belong equal the tally pieces in the next higher way, and when actuated operate a tally piece in the next higher way and discharge from view the equivalent thereof in the way to which said mechanism belongs.

6. In an adding machine, the combination of a series of circuitous ways for the passage and exhibition of tally-pieces; said ways representing in serial order a series of denominations such as cents, dimes, dollars, or five cents, dollars, hundreds of dollars, as the case may be; tally-pieces each moving continuously in the way to which it belongs and representing units of each of said denominations; a series of gates, one for each way, which are operated only when the tally-pieces accumulated in the way to which they belong equal the value of one tally-piece in the next higher way, and when operated actuate a tally-piece in the next higher way and discharge from view the equivalent thereof in the way to which the operated gate belongs.

7. In an adding machine, the combination of a series of ways for the passage of tally-pieces, said ways representing, in serial order, units, tens, hundreds, &c.; a series of tally-pieces in each of said ways; a dial at which the tally-pieces in each of said ways are held in view; a series of keys of different indicated value, one or more for each of said ways; and a series of mechanisms, one for each way and controlled by said keys, which when operated, cause as many tally-pieces to move, within their associated way, as equal the designated value of the operated key or keys, and to discharge from view at the dial ten tally-pieces whenever more than ten have

accumulated, and, at the same time, actuate one of the tally-pieces contained in the way of next higher denomination.

8. In an adding machine, the combination of a series of ways for the passage and exhibition of tally pieces; said ways representing in serial order a series of denominations such as cents, dimes, dollars, or five cents, dollars, hundreds of dollars as the case may be: tally pieces movable in each of said ways and representing units of each of said denominations; a series of mechanisms one for each way, which are operated only when the tally pieces accumulated in the way to which they belong, equal the tally pieces in the next higher way, and when operated actuate a tally piece in the next higher way and discharge from view the equivalent thereof in the way to which said mechanism belongs; and means for moving the tally pieces discharged into position for re-use.

9. In an adding machine, the combination of a series of circuitous ways for the continuous passage of tally-pieces, said ways representing in serial order a series of denominations, which increase in value in a regular ratio; a series of tally-pieces confined in each of said ways; a series of gates, one for each way, which close said ways and cause the tally-pieces to accumulate for exhibition; mechanisms for opening said gates when the accumulated tally-pieces in the way which they respectively close equal the value of one tally-piece in the next higher way; means on said gates for actuating said tally-piece in the next higher way when said gates are opened; and means for moving the tally-pieces discharged by said gates into position for use.

10. In an adding machine, the combination of a series of circuitous ways for the passage of tally-pieces, the ends of which ways lap past each other, and mechanisms for transferring the tally-pieces from one of said lapped ends to the other.

11. In an adding machine, the combination of a series of circuitous ways for the passage of tally-pieces, the ends a^2 and a^4 of which ways lap past each other; spring covers a' for yieldingly holding the tally-pieces in the grooves a^2; separators e', for pushing the tally-pieces from the groove a^2 past the cover a' and into the groove a^4, and key-actuated mechanism for operating said separators.

12. In a machine of the class herein shown, the combination of a series of key-levers B′, having their rear ends pointed as shown; a bail pivotod concentrically with said key-levers and moved by the action of each of said keys; the toggles D′, D^3 moved by said bail; and the rod D^2 carried by said toggles into position below any operated key-lever and above the unoperated key-levers and thereby holding the unoperated key-levers against operation.

13. In a machine of the class herein shown, the combination of the key-levers; a bail or frame moved by said key-levers, the rock-shaft D moved by said frame acting through the toggles D′, D^3; the rock-shaft H, moved by gearing connecting it with the rock shaft D; a pawl arm H^3 on said shaft H, that carries a pawl k and a ratchet K that engages said pawl and compels each key movement to be continued until finished.

14. In a machine of the class herein shown, the combination with the ways through which the tally-pieces are moved of the shaft H, which is adapted to be rocked and moved longitudinally through the action of the key-levers; arms H^2 on said shaft carrying pins h^2, which operate to move the tally-pieces in said ways against the action of gravity as said shaft is actuated; and means for preventing the reaction of said tally-pieces by gravity.

15. In a machine of the class herein shown, the combination with the plate A^4, having a series of sets of parallel grooves a^2 a^4; a series of bars E, below said plate having thereon separators e' which move in openings in said plate and act to transfer tally-pieces from the grooves a^2 to the grooves a^4; and key-levers that operate said bars E.

16. In a machine of the class herein shown, the combination with the ways through which the tally-pieces pass of gates G, for closing said ways and actuating a tally piece in the next higher way; the transverse bar F, having fingers f', for moving said gates; and key-actuated mechanism for moving said bar F, longitudinally.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM H. CLARK.

Witnesses:
JNO. K. HALLOCK,
H. A. STRONG.