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# UNITED STATES PATENT OFFICE.

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## ADDING-MACHINE.

982,901.

Specification of Letters Patent.

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*To all whom it may concern:*

Be it known that we, CLAYTON THOMPSON and CHARLES W. NEWTON, citizens of the United States of America, and residents of Des Moines, Polk county, Iowa, have invented a new and useful Adding-Machine, of which the following is a specification.

The object of this invention is to provide means for utilizing a key-board and gravity-operated balls for an adding machine.

A further object of this invention is to provide means for utilizing a key-board, gravity-operated balls and a measuring device in an adding machine.

A further object of this invention is to provide improved means for reversing the movement of gravity-operated balls in an adding machine.

A further object of this invention is to provide a key-board and independently operated mechanisms for cutting out and segregating variable quantities of gravity-operated balls in an adding machine.

Our invention consists in the construction, arrangement and combination of elements hereinafter set forth, pointed out in our claims and illustrated by the accompanying drawing, in which—

Figure 1 is a side elevation of the complete machine. Fig. 2 is a front elevation of the same, the dotted lines indicating the positions of runways for the balls. Fig. 3 is a cross-section on the indicated line 3—3 of Fig. 6. Fig. 4 is an elevation on an enlarged scale illustrating the means employed to cut out variable numbers of balls. Fig. 5 is a cross section on an enlarged scale on the indicated line 5—5 of Fig. 2. Fig. 6 is a vertical section on the indicated line 6—6 of Fig. 2 and also on the indicated line 6—6 of Fig. 3. Fig. 7 is a section on line 7—7 of Fig. 2, on an enlarged scale.

In the construction of the machine as shown the numeral 10 designates a base and 11, 12 standards fixed to and rising from said base. A back plate 13 is mounted vertically between and hinged near its center to the standards 11, 12 on a transverse rod 14. A notch or opening 15 is formed in the lower portion of the back plate 13. A housing 16 is fixed to and extends rearwardly from the rear portion of the back plate 13. A bottom piece 17 is fixed to and extends forward and rearward from the lower end of the back plate 13 and also is fixed to the

lower end of the housing 16. The housing is fixed to the upper face of the bottom piece 17 in front of the back plate 13 and the upper wall 18 of said housing is inclined forwardly from said back plate.

Face plates, hereinafter designated as a magazine plate 19 and a registering plate 20, are mounted on the front of the back plate 13, one above the other and spaced apart. The magazine plate 19 preferably is formed in two parts and is provided with an internal sinuous runway 21, half of which is formed in each part. The two parts of the magazine plate 19 preferably are conjunctively secured to the upper portion of the back plate 13 by screws 22. The registering plate 20 preferably is formed in two parts with an internal sinuous runway 23 formed one half in each part, and the two parts of said plate preferably are conjunctively secured to the lower portion of the back plate 13 by screws 24. The magazine plate and registering plate preferably are made of glass having the runways 21, 23 molded in the parts thereof. The plates 19, 20 preferably are separated or spaced apart by spaced blocks 25, 26 and a bracket 27 is mounted between said plates and between said blocks and is covered on its front face by a plate 28. The bracket 27 is provided with a vertical tube or cylinder 29 located in the center of the space between the magazine plate 19 and registering plate 20 and between the blocks 25, 26. The tube 29 communicates at its upper end with the lower end of the sinuous runway 21 and communicates at its lower end with the upper end of the sinuous runway 23. A rod 30 is mounted for rotation in vertical position in the bracket 27 at one side and in the rear of the tube 29. A cutoff arm or valve 31 is fixed to and extends transversely of the rod 30 and one end portion of said valve is curved laterally and extends through registering slots in the lower portion of the tube 29. A yoke 32 is fixed to and extends laterally from the rod 30 and a spring 33 is coiled about said rod and engages at one end with the housing 16 and at the other end with the yoke 32 in such manner as to hold said yoke, rod and the valve 31 so that the curved end portion of said valve normally will extend through the slots in and across the bottom of the tube 29.

A series of balls 34, in this instance ap-



proximately four hundred twenty-five, are mounted in the sinuous runway 21 before the magazine plate 19 is mounted on the back plate 13 and may flow successively by gravity into the tube 29, the lowermost of said balls resting on the laterally curved end portion of the valve 31. A series of rods 35, in this instance nine in number, are mounted vertically in the housing 16 and journaled at their ends in bearings 36, 37 fixed respectively to the top of the housing and to the bottom piece 17. Crank arms 38 are fixed to and project laterally from upper end portions of the rod 35 and are arranged in different horizontal planes spaced apart distances approximating to the diameter of either of the balls 34.

Measuring valves 39 are mounted in horizontal positions and in different planes in the upper portion of the housing 16 and are pivoted at their rear ends respectively to the inner ends of the crank arms 38. The measuring valves 39 are of different lengths owing to the different positions of the rods 35 relative to the back plate 13 but said valves are all in the same vertical plane and arranged one above the other. Inner end portions of the measuring valves 39 extend through slots in the bracket 27 and also extend into slots in a guide 40 immediately at the rear of the tube 29, said tube also being formed with slots registering with the slots in the guide and with said valves. Each measuring valve 39 is formed with a lip 41 at the rear of and adapted to engage at times with the yoke 32. The lowermost measuring valve 39 is spaced from the cutoff valve 31 a distance approximating to the diameter of either ball 34.

Crank arms 42 are fixed to and extend laterally from the rods 35 adjacent to the bearing 37. The crank arms 42 are arranged at different elevations but are all preferably of the same length and extend to and slightly across the median line of the housing 16 in the same vertical plane with the measuring valves 39. A series of bell-cranks 43 are journaled in rows to bearings 44 fixed to and depending from the upper wall 18 of the front housing and rods 45, of various lengths, connect said bell-cranks respectively to the inner ends of the crank arms 42.

Keys 46, in this instance nine in number, are mounted loosely through vertical key seats or apertures in the wall 18 of the front housing and are pivoted at their lower ends to the arms of the bell-cranks 43 opposite to the pivotal connection of said bell-cranks with the rods 45. The keys 46, bell-cranks 43, rods 45, cranks 42, valves 39, crank arms 38, rods 35 are all retained normally in initial positions by the spring 33 acting on the yoke 32 and through said yoke acting on a lip 41 of one or all of the measuring valves 39. In this normal position all of the measuring

valves are retained outside the tube 29 and all of the keys 46 are retained in their uppermost positions.

An arm 47 is pivoted at the rear end portion of the cutoff valve 31 and extends laterally through a guide on the housing 16 in a plane normally above the pivotal rod or hinge pin 14. The standard 12 is formed with a lip or stop 48 in the orbit of travel of the outer end of the arm 47 and it is the function of said lip or stop to move said arm longitudinally and through said arm oscillate the cutoff valve 31 into open position.

The length of the sinuous runway 23 preferably is graduated and marked by indices designating the diameters of balls 34 or multiples thereof, such graduations and indices appearing on the front face of the registering plate 20. The keys 46 preferably are provided with numerals on their upper faces corresponding to the digits "1" to "9" inclusive. A cavity or space (dotted lines Fig. 1) is formed in the base 10 to permit the movable devices to rotate on the axis provided by the rod 14.

In the practical use of this device and before the use thereof the parts are arranged and located as shown except that all of the balls 34 are contained in the sinuous runway 21 and supported by contact of the lowermost ball with the cutoff valve 31. The amounts or figures to be added are then operated upon by columns, the unit column first, tens column second, and so on progressively. The columns may be added by reading from the top downward or from the bottom upward as desired in the following order: A key 46 corresponding to the first digit of the column is depressed manually and such movement is transmitted through a bell-crank 43, rod 45, crank arm 42, rod 35, crank arm 38, and measuring valve 39 to the end of moving the corresponding measuring valve through the slot in and across the tube 29 above a corresponding number of balls in said tube. Such movement of the measuring valve across the tube prevents downward progress of the balls above said valve and at the same time the lip 41 on said measuring valve engages the yoke 32 and through it compresses the spring 33, rotates the rod 30 and removes the cutoff valve 31 from the tube 29, thus permitting all of the balls below the operated measuring valve to fall from the tube 29 into the runway 23 and find their way successively along said runway to points of rest in the lower portion thereof. Thus if the digit "1" appear first in the column, the key having the index "1" would be depressed and through the mechanism provided would move the lowermost measuring valve 39 (Fig. 6) into a position between the lowermost and second balls in the tube 29 and open the tube by



removal of the cutoff valve 31 so that the lowermost ball 34 would escape from the tube, follow the runway 23 and come to rest in the lowermost end of said runway adjacent the graduated index "1". The digits of a column are successively ascertained and recorded by depressing the corresponding key 46 until all of the digits in the column have been recorded by the transfer of a corresponding number of balls from the magazine and tube 29 to the runway 23. Thereupon the sum of such digits may be ascertained by reading the sum of the balls contained in the registering plate and indicated by the graduations and indices on the registering plate. Such sum is then set down in numerals by manual operation and for purposes of illustration is presumed to be "136". Then the back plate 13, housings and mechanisms carried thereby are inverted by forward movement of the lower end thereof manually and such movement causes the balls to travel reversely in the runway 23, tube 29 and runway 21, the operation of the stop or lip 48 on the arm 47 causing the removal of the cutoff valve 31 from the tube 29 so that the balls may fall from the registering plate through said tube. When all of the balls have been returned to the magazine plate, the back plate 13 and parts carried thereby are returned to the initial positions shown by manual operation, the arm 47 passes out of the influence of the stop or lip 48 and the valve 31 again crosses the tube 29. The operator then proceeds to add the tens column and first records the "13" to be carried from the sum previously ascertained by depressing the keys "6" and "7" respectively and then proceeds from one end or the other of said column with successive recording of the various digits thereof. When the sum of the tens column is ascertained it is set down manually in a suitable place, the balls returned to the magazine plate and further columns, if any there be, are recorded in like manner.

In Fig. 7 we show a section of the plate through a runway which may be either 21 or 23. In this view the edges of the runway are shown curved transversely. This is to facilitate molding the runways smoothly in the glass members and to insure smooth, unobstructed paths for the balls, either at the top or bottom of the runway.

We claim as our invention—

1. In an adding machine, a base, a frame mounted on said base, a column of gravity-operated balls in said frame, and manually-operated measuring devices on said frame adapted for cutting out and segregating variable quantities of said balls from the column, said frame adapted to be oscillated through an arc to reverse the gravity travel of said balls.

2. In an adding machine, a base, a frame mounted on said base, a column of gravity-operated balls in said frame, independently operated mechanisms on said frame for cutting out and segregating variable quantities of said balls from the column, and a manually-operated key board on said frame, the keys of which are independently connected to the cutting out mechanisms, said frame adapted to be oscillated through an arc to reverse the gravity travel of said balls.

3. In an adding machine, a base, a frame mounted on said base, a sinuous column of gravity-operated balls in said frame, independently operated mechanisms on said frame for cutting out and segregating variable quantities of said balls from the column, and a manually-operated key board on said frame, the keys of which are independently connected to the cutting out mechanisms, said frame adapted to be oscillated through an arc to reverse the gravity travel of said balls.

4. In an adding machine, a base, a frame mounted on said base, a column of gravity-operated balls in said frame, a graduated runway in said frame communicating with said balls, independently operated cutting out mechanisms on said frame adapted to intersect said column of balls whereby variable quantities of the balls may be segregated from the column and delivered to the graduated runway, and a manually-operated key board on said frame, the keys of which are independently connected to the cutting out mechanisms, said frame adapted to be oscillated through an arc to reverse the gravity travel of said balls.

5. In an adding machine, a movable frame formed with runways on opposite sides of its median line, said runways connected by a column tube, one runway adapted to contain gravity-operated balls, the other runway being graduated from its bottom upward in respect of the diameters of the balls and adapted to receive such balls from the column tube, cutting out mechanisms adapted to intersect said column tube, and a manually operated key board, the keys of which are independently connected to the cutting out mechanisms.

6. In an adding machine, a movable frame formed with runways on opposite sides of its median line, said runways connected by a column tube, one runway adapted to contain gravity-operated balls, the other runway being graduated from its bottom upward in respect of the diameters of the balls and adapted to receive such balls from the column tube, cutting out mechanisms adapted to intersect said column tube, a valve movable across said column tube and adapted for operation by either of the cutting out mechanisms and also adapted to sustain the column of balls alternately with



one or another of the cutting out mechanisms, and a manually operated key board, the keys of which are independently connected to the cutting out mechanisms.

5 7. In an adding machine, a movable frame formed with runways on opposite sides of its median line, said runways connected by a column tube, one runway adapted to contain gravity-operated balls, the other runway being graduated from its bottom upward in respect of the diameters of the balls and adapted to receive such balls from the column tube, cutting out mechanisms adapted to intersect said column tube, a valve movable across said column tube and adapted for operation by either of the cutting out mechanisms, and also adapted to sustain the column of balls alternately with one or another of the cutting out mechanisms, a manually operated key board, the keys of which are independently connected to the cutting out mechanisms, and means for actuating said valve independent of the cutting out mechanisms when the frame is in inverted position.

8. In an adding machine, a movable frame formed with runways on opposite sides of its median line, said runways connected by a column tube, one runway adapted to contain gravity-operated balls, the other runway being graduated from its bottom upward in respect of the diameters of the balls and adapted to receive such balls from the column tube, cutting out mechanisms adapted to intersect said column tube, and normally removed from said column tube, a valve movable across said column tube and adapted for operation by either of the cutting out mechanisms and also normally intersecting said column tube and adapted to sustain the column of balls alternately with one or another of the cutting out mechanisms, means for moving said valve out of the column tube when the frame is inverted, and a manually operated key board, the keys of which are independently connected to the cutting out mechanisms.

9. In an adding machine, a stand, a plate mounted for inversion on a horizontal axis in said stand, said plate formed with runways on opposite sides of its axis, and a column tube connecting said runways, said runways and tube adapted to contain gravity-operated balls, said tube formed with a plu-

55 rality of transverse slots, a housing in said plate, a plurality of rock shafts journaled in said housing and arranged parallel with said plate, crank arms on said shafts, measuring valves on said crank arms adapted to extend through all but one of the slots of and cross the column tube, a cut off valve extending through the remaining slot of and crossing the column tube, said cut off valve spring-held in normal position, means adapted to be acted upon by either of the measuring valves to move said cut off valve away from the column tube, crank arms on the lower end portions of said rock shafts, key levers suitably connected to said plate, rods connecting the key levers to the lower crank arms, and keys acting on said levers.

10. In an adding machine, a stand, a plate mounted for inversion on a horizontal axis in said stand, said plate formed with runways on opposite sides of its axis, and a column tube connecting said runways, said runways and tube adapted to contain gravity-operated balls, said tube formed with a plurality of transverse slots, a housing in said plate, a plurality of rock shafts journaled in said housing and arranged parallel with said plate, crank arms on said shafts, measuring valves on said crank arms adapted to extend through all but one of the slots of and cross the column tube, a cut off valve extending through the remaining slot of and crossing the column tube, said cut off valve spring-held in normal position, means adapted to be acted upon by either of the measuring valves to move said cut off valve away from the column tube, crank arms on the lower end portions of said rock shafts, key levers suitably connected to said plate, rods connecting the key levers to the lower crank arms, keys acting on said levers, a rod extending laterally from said cut off valve, and a lip on the stand adapted to actuate said rod and move the cut off valve away from the column tube when the plate and housing are inverted.

Signed by us at Des Moines, Iowa, this fifth day of November, 1909.

CLAYTON THOMPSON.  
CHARLES W. NEWTON.

Witnesses:

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