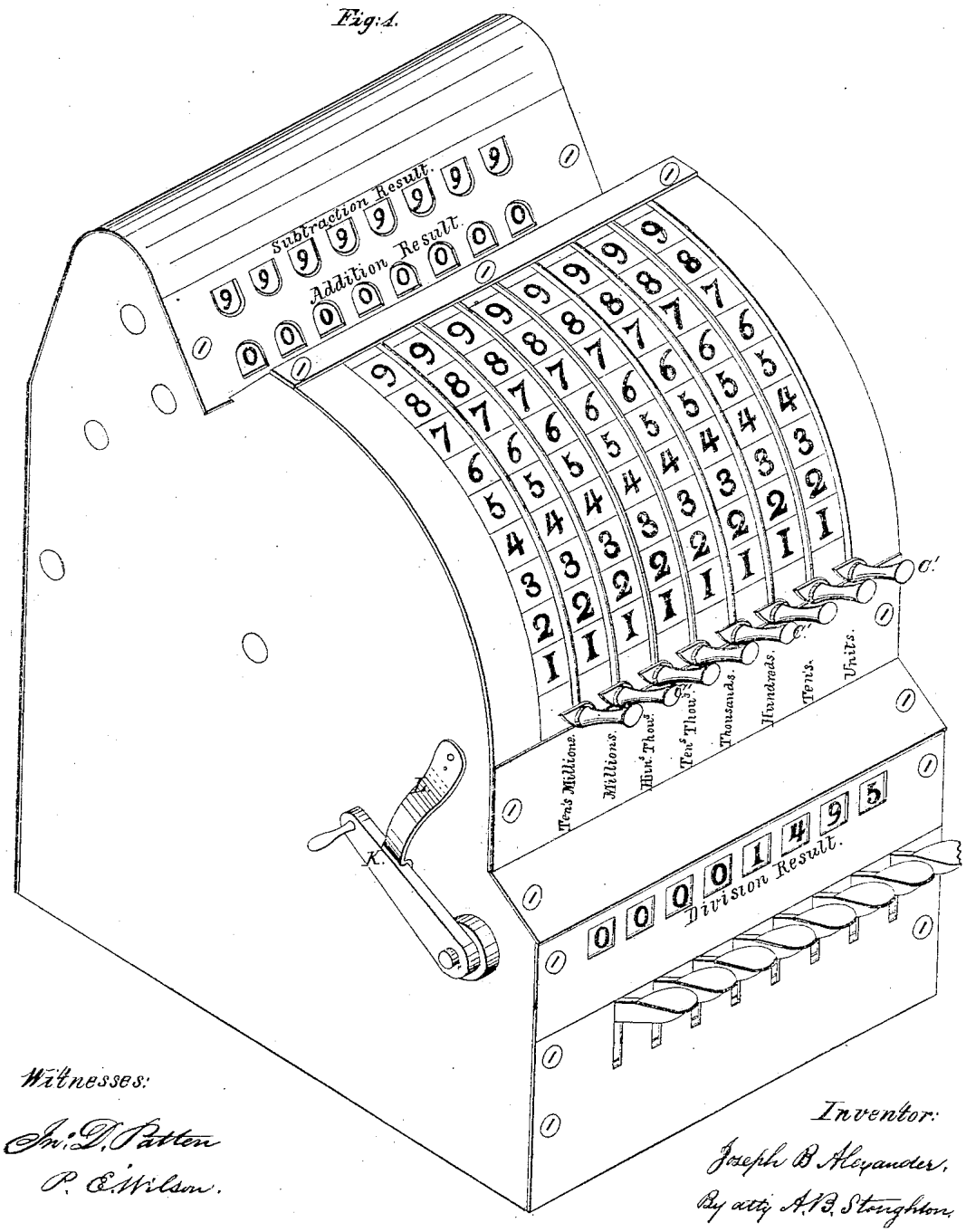
3 Sheets—Sheet 1.

J. B. ALEXANDER.

CALCULATING MACHINE.

No. 41,898. Patented Mar. 15, 1864.

Fig: 1.



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CALCULATING MACHINE.

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Fig: 4.

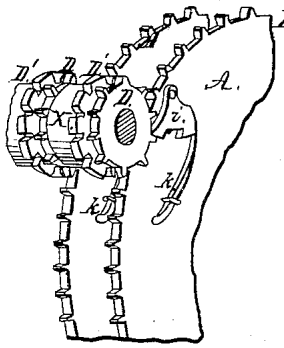

Fig: 3.

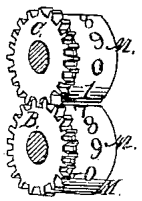

Fig: 2.

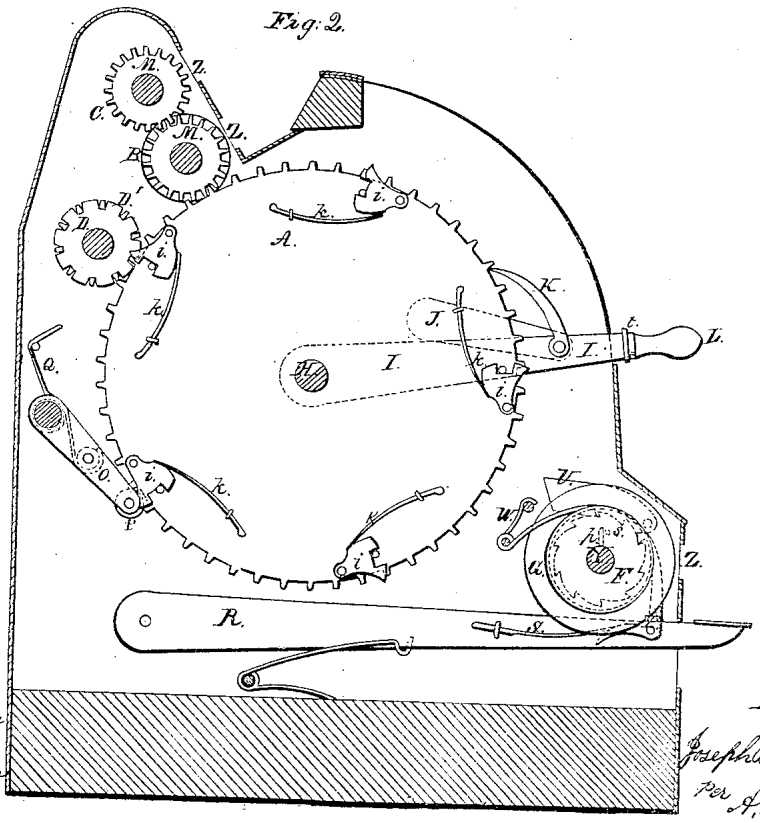

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Fig. 6.

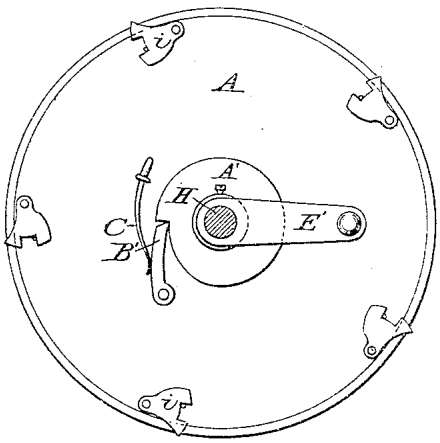
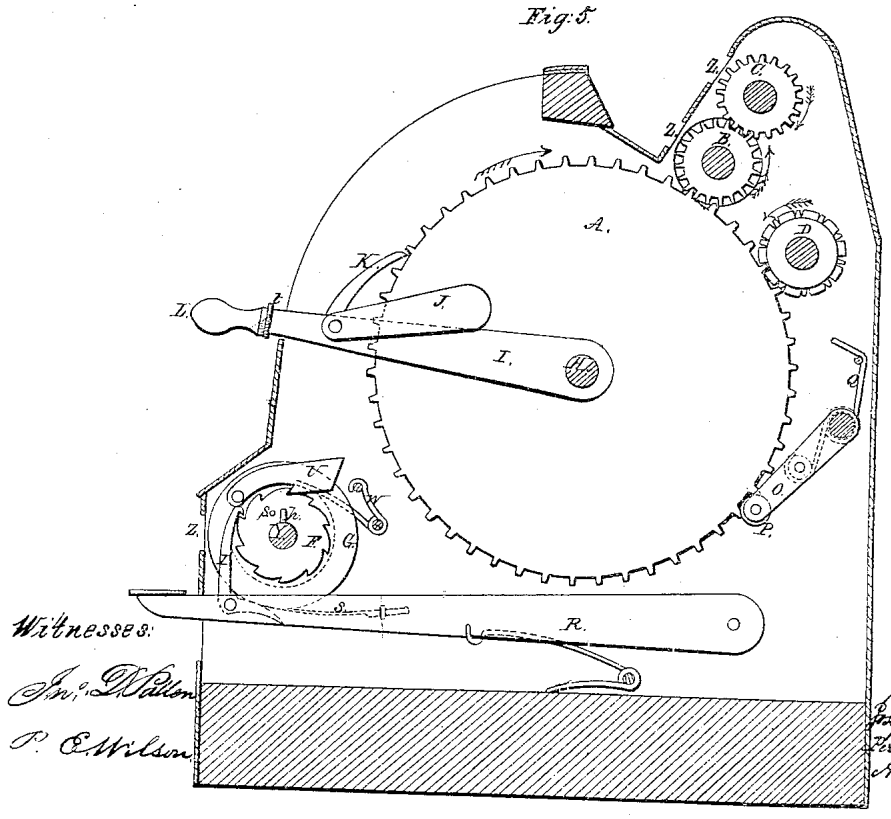


Fig. 5.



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UNITED STATES PATENT OFFICE.

JOSEPH B. ALEXANDER, OF BALTIMORE, MARYLAND.

IMPROVEMENT IN CALCULATING-MACHINES.

Specification forming part of Letters Patent No. **41,898**, dated March 15, 1864.

To all whom it may concern:

Be it known that I, JOSEPH B. ALEXANDER, of the city and county of Baltimore, and State of Maryland, have invented certain new and useful Improvements in Calculating-Machines; and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the accompanying drawings, making a part of this specification, in which—

Figure 1 represents in perspective an external view of the machine. Fig. 2 represents a vertical section through the same. Figs. 3 and 4 represent in perspective detached portions of the machine not distinctly seen in the other figures. Fig. 5 represents a vertical section through the machine, and showing the opposite sides of the wheels from those shown in Fig. 2. Fig. 6 represents a plan of setting the main wheels all at zero at one operation, for rearranging them to commence a new operation.

Similar letters of reference, where they occur in the several figures, denote like parts of the machine in all cases.

My invention consists in a series of eight (more or less) sets of wheels and figured drums, so geared and combined and each set so connected with the set next adjacent to it on the left-hand side as to faithfully record the result of any sum in the four cardinal rules of arithmetic—viz., addition, subtraction, multiplication, and division.

The machine is so arranged and combined as to produce a correct result whether worked from the left to the right or from the right to the left. One set of wheels are marked units, another tens, another hundreds, another thousands, &c., as seen in Fig. 1, each set of wheels, when added to the adjacent one on its left, increasing the power of its right-hand set by ten.

To enable others skilled in the art to make and use my invention, I will proceed to describe the same with reference to the drawings.

In a suitable box or case I arrange a series of wheels, of which A represents one, made of brass or other suitable metal, and having on its perimeter fifty cogs or teeth, and revolving loosely upon the shaft H.

I is a lever, with its inner end supported loosely by the shaft H, and L is the handle of said lever, to which is attached an indicator, *t*.

K is a ratchet or catch attached to the lever I, and J a weight on the ratchet to keep it in its proper working position.

B is a wheel containing ten teeth, to which is attached a drum, M, on which is marked at regular intervals the figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 0. This wheel gears with the main wheel, A, and records the result of addition, as will be hereinafter explained.

C is a wheel similar to that B, and gears with it, and, being figured like B, marks the subtraction result; for, as a movement of the wheel B adds a figure to the one standing at the aperture Z, so does the same movement subtract a figure from the one standing on C at its aperture.

D and D′ compose a double pinion connected by the drum X. The wheel D is moved one notch by a spring cog or tooth working on a pivot on the left-hand side of the main wheel A. These spring-cogs *i* occur at every tenth tooth on the wheel A, as is distinctly seen in Fig. 2. When one of these spring-cogs *i* comes in contact with a tooth of wheel D, it moves said wheel the extent of one notch and then escapes, and thus D′ is moved one notch, and as D′ is geared into the teeth of the next wheel similar to A, it consequently moves that wheel one notch, and therefore at every ten carries one up on that wheel, and so on throughout the series.

P is a pulley or roller hung upon an arm, O, and fitting between the teeth of the wheel A, and forced therein by the spring Q. When the wheel A moves until one of its teeth passes the center of the roller P, said wheel suddenly moves forward under the pressure of the lever I; but if the tooth does not reach the center and the lever is withdrawn the wheel A starts back. By this arrangement it is impossible to make a mistake by carrying the indicator attached to the lever a little over or a little under the line drawn above the figure to be reached on the face-plate, as seen in Fig. 1.

Z Z are apertures along each line of figured drums M, through which are presented a row of figures showing the result of the working of the levers and where the answers to the

sums worked are to be found, and which may be immediately restored to naughts by the turning of a crank, and a device such as that shown at Fig. 6.

F is a ratchet-wheel attached to a drum, G, with a pin projecting from its side, as at *s*. The shaft Y of this ratchet-wheel, which is turned by a crank, has a pin, as at *p*, between each wheel F and drum G throughout the series. These pins *p*, coming in contact, restore all the figured drums to naughts or to the zero-marks by one revolution, and may stop at the spring-check, as seen at L, Fig. 1, in connection with another cylinder series there shown. The wheel F is one of the series which records division, and is operated by the lever R, which, when depressed, pulls down the ratchet-wheel one notch at a time by the hook T, which is kept in place by a spring, S; or a weight may be used. The lever R is thrown up again by a spring at its fulcrum, and thus sets the hook T in another notch.

W is a spring rubbing in a groove in the drum G to retard its velocity when moved, and U is a catch to prevent any backward motion of the wheel or drum when the hook T ascends.

Fig. 2 represents a view of the left-hand sides of a set of wheels in the series, and the letters of reference are the same as in Fig. 5.

i i i, &c., show the spring-cogs working by the springs *kkk*. When the spring-cog which matches every tenth cog on the wheel A comes in contact with the double pinion D, it marks the figure 9 on the drum of the addition-wheel, to be seen through the aperture Z. If moved one notch forward, the wheel D moves one notch, and D′ is moved one notch. The figure 0 stands in the aperture in place of 9, and the figure 1 stands in the aperture on the drum of the next set to the left. If the spring-cog has reached the downward tooth of wheel D, marking 9, and the next set of wheels be moved, D being attached to D′, which latter gearing into wheel A of the next set, both would be moved. Consequently the spring-cog would fly under the moving teeth of D, rising behind each passing tooth and ready to move D forward one notch whenever the first set is worked again.

That the external working of my machine may be more fully understood I will give a more minute description by reference to Fig. 1 of the drawings. If one of the levers marked C′ be raised to the figure 4 on the face-plate, then the figure 4 will stand in the aperture of its corresponding drum in the addition-line. The lever C′ will fall back to the starting-point by its own weight. Its catch slips over the cogs of the main wheel in its descent, but catches the first cog in going up, and holds until it carries the wheel over as far as to the desired figure. Now that I have added 4 to naught or zero, if the lever be again moved to 5 on the face-plate, 9 will stand in the aperture, as the sum of 4 and 5 make 9. If the lever be again raised to 1 on the face-plate, 0 will stand in the aperture and 1 will stand in the aperture of the next set, and recording 10, and so on.

To do a sum in addition, it is only necessary to carry the lever marked "units" to each figure on the face-plate as they stand in the unit-column to be added, taking care to bring the lever back for each figure to be added. When done with the first column, take the next lever, marked "tens," and play off all the figures in the second column to the left; then take the next lever, marked "hundreds," and play off all the figures in the next column to the left, and so on. When all the figures have been worked off in the columns in which they stand, the true result of the sum will be found standing in the apertures of the "addition result," as shown in Fig. 1. The machine will give the same result if worked backward or from left to right, and this constitutes one of the peculiarities of my machine.

To do a sum in multiplication, use the machine as in addition. For instance, if 435 is to be multiplied, take the first lever and move it to the figure 5 on the face-plate six times, move the next lever on the left to the figure 3 six times, move the next lever to the left to the figure 4 six times; now take the second lever (which would rest under the 3 of the figures 35) and move it to the figure 5 three times, move the next lever to the figure 3 three times, and the next lever to the figure 4 three times; then in the addition-line of apertures will be found the correct result. In multiplication the lever handled first must always be in the column of the figure used as a multiplier. Thus, if the multiplier be 6,472, for 2 commence with the units-lever and work to the left; for 7 commence with the tens-lever and then to the left again; for 4 commence with the hundreds-lever, and for 6 commence with the thousands-lever. Multiplication by my machine may be worked as well backward as forward, or from left to right or right to left, giving always a correct result, which will be shown at the openings "addition result."

To do subtraction, set up the largest sum in the subtraction-line, then work off the figures of the smaller sum with the levers on the columns on which they stand, and in the place of the first sum set up—the subtraction-line—will be found the true remainder, whether worked from right to left, or vice versa.

To do division, set up the sum to be divided in the subtraction-line of apertures, commence subtracting the divisor from the left-hand end of the sum, and for each time the divisor is taken out depress the key of the "division result" immediately corresponding with the position of the last figure in the divisor. When the division will no longer come out of the first figures of the sum, move it to the right and subtract again, taking care to use the next key to the right in the division result, and so on. When the divisor can no longer be subtracted from the sum, in the line of apertures

of the division result will be found the number of times the divisor will pass into the sum, and in the subtraction-line will be found the remainder, if there be one.

In Fig. 6 I have shown how all the series of wheels A may be brought into position, for beginning a new sum in any of the rules laid down, by one single operation, or by simply turning the crank E a single revolution. The wheels G of the division result are all restored into their normal position by the crank K′, Fig. 1, through the pins *s p*, heretofore described, and when arranged the crank is held by the catch-spring L.

Instead of the pins, I may use a series of cams, A′, which are fastened to the shaft H, while the wheels A are loose thereon; and on the sides of the wheels A are arranged a series of spring dogs or pawls, B, held against the cams A′ by the springs C′. These pawls, catching against the shoulders of the cams, will cause the wheels A to turn with them in one direction, while in the other direction they will slip over and allow the wheels to work independent of the cams. The operation or result is substantially the same as that of the pins, and may be regarded as a modification of that arrangement.

What I claim as new and as of my invention is—

1. The combination of the separate levers with the separate sets of wheels, so that the speed of calculations is gained from right to left or from left to right by arithmetical progression, as described and represented.

2. In combination with the wheels A, the spring-cogs *i*, substantially as and for the purpose set forth.

3. So combining a set of figured drums with suitable means of operating them as that they will show subtraction, working in combination with those which record addition, substantially as herein described and represented.

4. The combination and arrangement of figured drums, wheels, face-plates, and levers, so that addition, subtraction, multiplication, and division may be worked out on one machine, substantially as described.

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