3 Sheets--Sheet 1.

E. D. BARBOUR.

Improvement in Calculating-Machines.

No. 130,404. Patented Aug. 13, 1872.

Fig. 1.

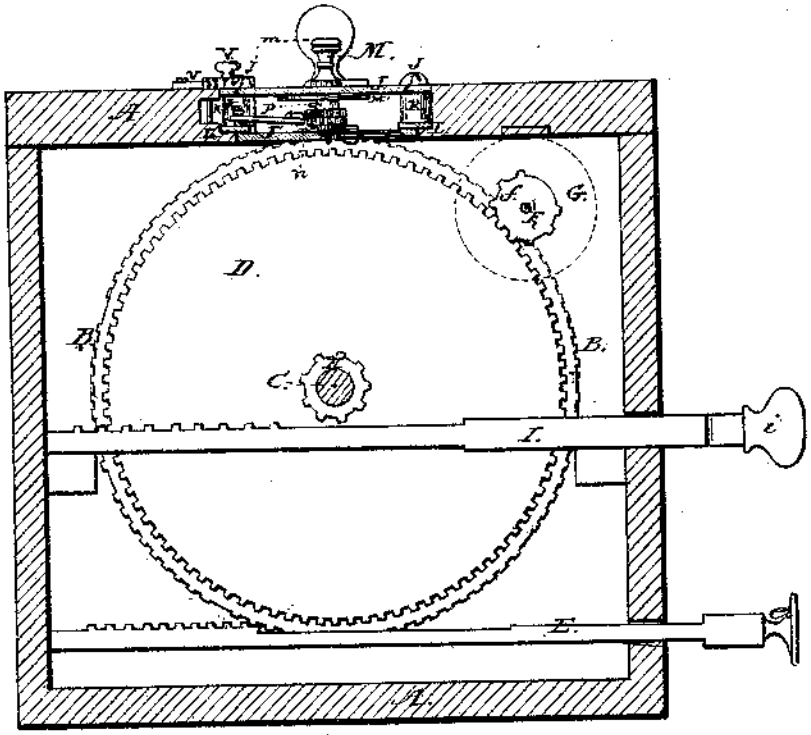


Fig. 2.

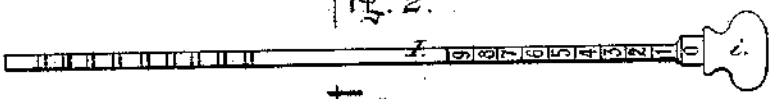
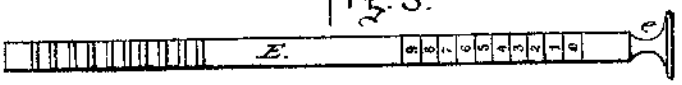


Fig. 3.



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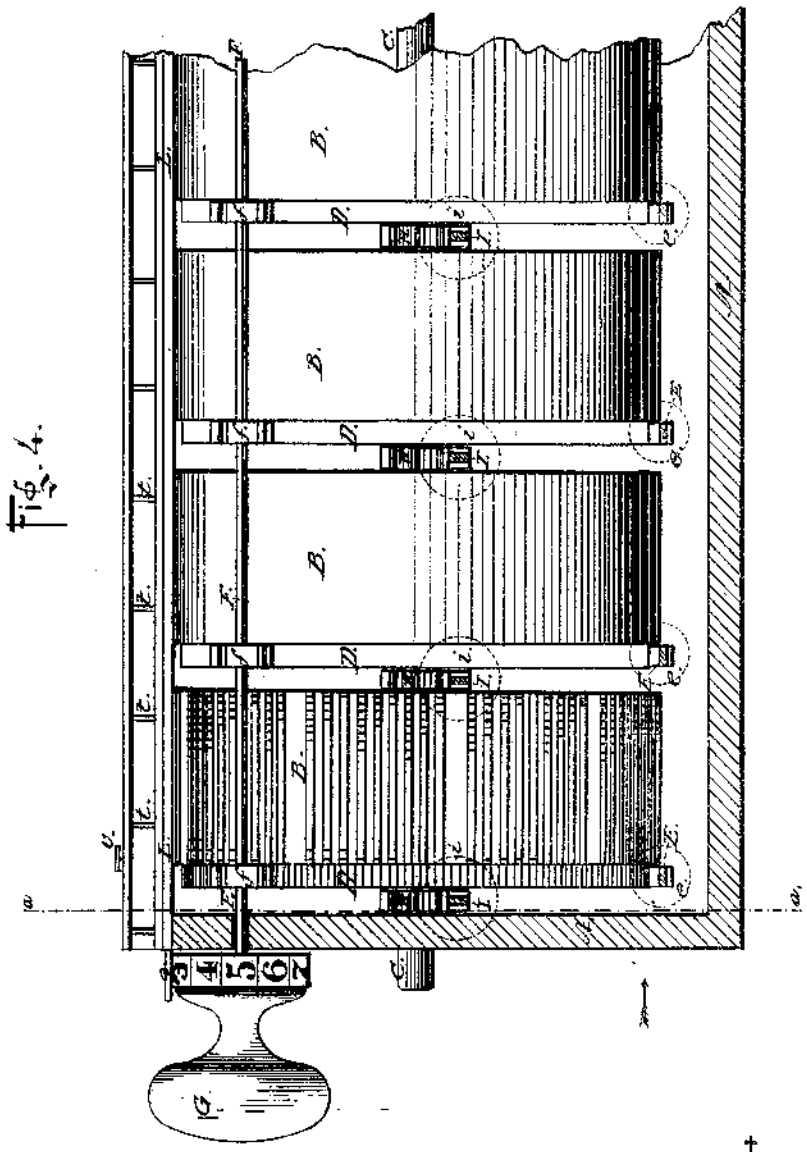

Fig. 4.

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Fig. 6.

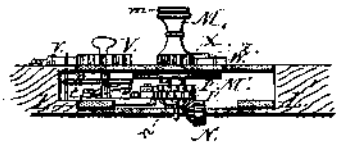


Fig. 5.

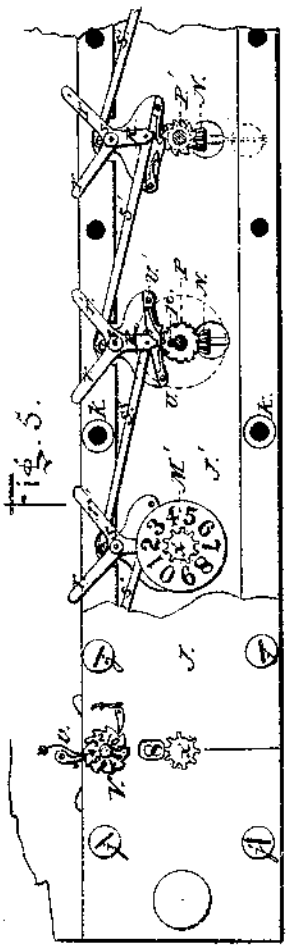


Fig. 7.

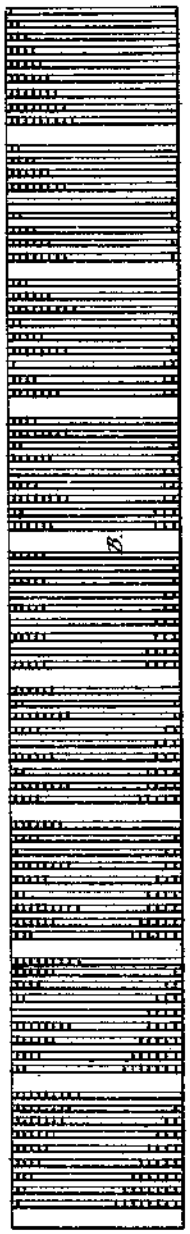
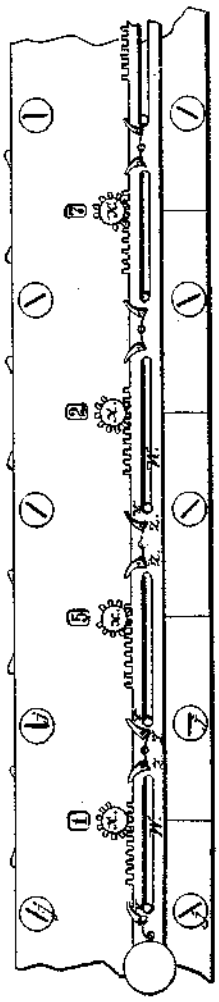


Fig. 8.



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UNITED STATES PATENT OFFICE.

EDMUND D. BARBOUR, OF BOSTON, MASSACHUSETTS.

IMPROVEMENT IN CALCULATING-MACHINES.

Specification forming part of Letters Patent No. **130,404**, dated August 13, 1872.

SPECIFICATION.

To all whom it may concern:

Be it known that I, EDMUND D. BARBOUR, of the city of Boston, county of Suffolk and State of Massachusetts, have invented a new and useful Improvement in Calculators; and I do declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing forming part of this specification, in which—

Figure 1 is a transverse section on dotted line *a a* of Fig. 4. Figs. 2 and 3 are sliding rack-bars for adjusting cylinders. Fig. 4 is a longitudinal section of the case; Fig. 5, plan of registering-slide; Fig. 6, section through registering slide; Fig. 7, arrangement of cog-teeth, for the decimal system, on periphery of cylinder, developed on a plane; Fig. 8, plan of erasing device.

My invention relates to an improved calculating-machine, which can be adapted to the decimal, duodecimal, or any other numerical system; to computation in compound numbers, such as those pertaining to all weights and measures; to decimal and vulgar fractions; to English money, &c., &c.; to extracting the square and cube roots; and to performing all other arithmetical operations.

The invention consists, first, in the arrangement of a series of cylinders revolving upon a shaft, or plates sliding in parallel grooves, in close proximity, but independently of each other, with cog-teeth distributed upon their periphery or face by predetermined calculations, so that when the said cylinders or slides are arranged in certain relations to each other, certain rows of the cog-teeth of the different cylinders or plates are brought into line, and by means of a registering device, having pinions which are caused to engage with the cog-teeth of the cylinders or plates, a sliding movement of said register communicates motion to dials, causing the dials to turn as many parts of a revolution as there are cog-teeth engaged on the cylinder or plates; secondly, in the construction of a registering-slide, composed of two plates secured together, with a space between, and having pinions arranged on the bottom plate with their teeth projecting through it a sufficient distance to engage with the cog-teeth of said cylinders or plates, and also connecting between said plates with vertical spindles having dials attached, so that the movement of each pinion, produced by its contact with the cog-teeth of the cylinders or plates, may be registered and indicated upon the dials; thirdly, in the means employed for setting the said cylinders or plates in a certain relation to each other, preparatory to performing any arithmetical operation, by the action of the said registering device hereinafter fully described; fourthly, in the means employed for the purpose of revolving the cylinder, or moving the plates simultaneously, when required; fifthly, in the arrangement of levers, with pawls and ratchet-wheels, connected to said registering device, for effecting the carrying of the tens; sixthly, in the attachment of supplementary dials to the registering device, and means for obtaining the quotient in division, all of which is clearly set forth in the following description.

Similar letters of reference indicate corresponding parts.

A, Figures 1 and 4, represents the case or frame in which the machinery operates; B B, Figs. 1 and 4, cylinders revolving loosely on the shaft C; these cylinders have upon their periphery raised teeth or cogs arranged according to the nature of the computations to be performed. Fig. 7 shows this arrangement for computations on the decimal system, developed on a plane. Instead of employing cylinders for this purpose, endless chains or plates of metal, or other equivalent devices, may be substituted. D D, Figs. 1 and 4, are spur-gear wheels of ninety teeth attached to one side of each cylinder; these wheels are geared to the sliding bars E E, Figs. 1, 3, and 4, which have handles or knobs *e e*. By means of these sliding bars each cylinder is moved independently of the others one-ninetieth of a revolution for each graduation marked upon the bars. F F is a rod having the gear-wheels *f*, which engage with the wheels D D for the purpose of revolving the cylinders simultaneously, by means of the knob or handle G, which is graduated on its periphery at *g* for regulating the desired movement. The wheels *f f* are deprived of a portion of their teeth for allowing the wheels D D to pass clear when moved by handles *e e* or *i i*. H H, Figs. 1 and 4, are wheels, of nine teeth, attached to each cylinder, and geared with

the sliding bars I I, Figs, 1, 3, and 4, for the purpose of turning the cylinders one-ninth of a revolution for each graduation marked upon the bars. J and J′, Figs. 5, 6, and 8, is the registering slide, formed of two plates with a space between, secured together by the screws *j j* passing through pillars *k k*; this slide is moved to the right or left in guides L L, Figs. 4 and 6. Between the plates J and J′, and at equal distances apart, are arranged vertical shafts or spindles M M, Figs. 1 and 6, carrying the dials M′, and having small handles *m m* on the upper end. Upon the spindles M are beveled gear-wheels *n* which engage with pinions N arranged in the plate J′. These pinions N engage with the raised teeth or cogs upon the periphery of the cylinders B B, traversing the units of one denomination and the tens of the next lower denomination at a single step. Upon the spindle M are also secured the reversed ratchet-wheels P and P′, Fig. 5, and the projection *p*. R R, Fig. 5, are levers pivoted at *s*, having arms *r* and *r′*. This lever is brought in contact with the projection *p* at every revolution of the spindles M M and dials M′ M′, and one of its arms *r* or *r′* placed in a position to be tripped by one of the studs *t t*, Fig. 4, arranged in the guides L, when the registering-slide is moved. By this movement motion is communicated through the rods *s′*, pawls U or U′, and ratchet-wheels P or P′, thereby moving the dial on the left one-tenth of a revolution. In this manner the tens are carried. This pawl U and U′ is double-acting to operate when the slide is moved in either direction, and the double ratchet-wheels P and P′ are reversed to correspond. V V, Fig. 5, are ratchet-wheels pivoted to the plate J, having a dial upon their face. These wheels are operated by means of a single tripping-pawl, *v*, Figs. 1 and 5, when the registering-slide is moved from right to left. In this way the quotient in division is registered. Fig. 8 represents the canceling or erasing device for restoring the several dials to zero, and consists of a slotted rack, W, sliding on pins Y Y, and having teeth or cogs arranged on one of its edges which engage with the cog-wheels *x x* on the spindles M M. These wheels have nine teeth and one blank, the blank being directly opposite the zero of the dials. The detent-pawls *z z* are attached to the slotted bar W, and move with it, thereby engaging and releasing each pawl as required. These pawls prevent any backward movement of the spindles M M, which may be produced not only by the action of the pawls U and U′, but from any other cause.

Operation.

The operation of the machine is as follows:

Multiplication.—By drawing out the knobs *i i* until the graduations on the bars I I indicate the sum to be multiplied, and then turning the handle G at the end of shaft F until the graduations at *g* indicate the right-hand figure of the multiplier, the cylinders B B are turned so that the rows of teeth on them corresponding to the graduations are placed directly under pinions N of the registering-slide J; then, by drawing slide J one step to the right, the pinions N are made to engage the teeth on the right-hand or units' side of one cylinder and teeth on the left or tens' side of the next right-hand cylinder, and to turn the spindles M M as many parts of a revolution as there are teeth engaged on the cylinders. The dials M′ attached to spindles M now show, through the openings in slide J, the result of the multiplication by the first figure of the multiplier. To multiply by the second figure of the multiplier, turn the handle G either way until the proper figure appears and draw the slide J another step to the right. The openings on slide J now show the second multiplication performed and added to the first. To multiply by the other figures of the multiplier, repeat what was done with reference to the second figure, and the results of the repeated multiplications will successively appear at the openings in slide J. The tens are carried as follows: Whenever a spindle, M, with its dial M′, has made a complete revolution, the projection *p* on the spindle, directly opposite to the zero on the dial, moves the lever R to the left and throws the arm *r* into a position where it may come in contact with the fixed studs *t t* in the guides L. These studs, when the slide J is drawn to the right, move the arms *r* back to their original position after the pinions N have traversed all the teeth below them on the cylinders, and communicate motion to the extent of one-tenth of a revolution, by means of rod *s′*, pawl U, and ratchet P, to the next left-hand spindle and dial. By this arrangement there is never more than one ten of each denomination to carry at a time, and the carrying of that is kept back by the lever R until the next left-hand spindle, being clear, no longer turned by its own pinion N, is ready to receive the tens from below.

The difficulty heretofore experienced in constructing calculators so that the units, tens, hundreds, &c., might all commence to be operated upon together, and yet bring the carried tens into their proper places, is now, I believe, obviated for the first time.

The working parts of the machine now being described are arranged for the decimal system, the teeth upon the bars, cylinders, pinions, ratchets, slide, &c., being all in accordance with that order; but by a different arrangement of the teeth and corresponding alteration in the other parts, the duodecimal or any other numerical system can be substituted. The working parts, teeth, &c., can also be arranged so that computation in compound numbers may be performed, such as those pertaining to weights, measures, fractions, English money, &c. Neither is there any limit to the calculating power of these machines, it being only necessary to increase the number of cyl-

inders and their corresponding parts, which are alike throughout the machine. This machine is, I believe, the first that multiplies truly and directly instead of doing so by repeated additions.

Addition.—Draw out the knobs *e e* until the first of the sums to be added appears on the bars E; then draw the slide J one step to the right, and the opening in the top plate of J will show the figures transferred from the bars to the dials. Return the slide to its first position until the second sum to be added is made to appear on the bars E, and then draw the slide J again to the right one step. Repeat this process for each sum to be added, and the correct results will appear at the openings.

Subtraction.—Draw out the knobs *e e* until the larger sum appears on the bars E. Then draw the slide J one step to the right, and the openings on top of the slide show the figures transferred to the dials. Then set the knobs *e e* so as to indicate the smaller sum, and move the slide back to its original position. The openings show the correct remainder.

Division is performed, as in practice, by operating first upon the left-hand figures of the dividend until they are reduced to a remainder smaller than the divisor and then adding the other figures, one by one, from the dividend, until the final remainder is shown smaller than the divisor. First place all the figures of the dividend upon the slide J, either by turning the knobs *m m* on top of the spindles, or by transferring them from the knobs *e e*, taking care to have the left-hand figure of the dividend appear in the left-hand dial in slide J. Then draw out the knobs *e e* on the left until the divisor appears directly under those figures of the dividend which are first to be divided. Then move the slide J one step from right to left and back again, repeating the operation until a smaller sum than the divisor appears in the openings. The number of times that the slide J is drawn from right to left will be shown on the dials V, and will stand as the first left-hand figure of the quotient. To the remainder first obtained add another figure from the dividend by moving the slide another step to the left and then draw the slide from right to left and back again, repeating the operation until the second remainder appears on the dials M and the second figure of the quotient appears on the second dial V. To this second remainder add another figure of the dividend, and continue in the way described until all the figures in the dividend have been brought into the calculation. The quotient will appear on the dials V in its proper order, and the final remainder will appear on the dials M′. The effect of moving the slide J from right to left, instead of the other way, will be to revolve the spindle M and dial M′ in a direction opposite to that turned in multiplication, and cause the projection *p* to place arm *r′* in such a position that contact with the studs *t t*, when the slide J moves from right to left, will communicate motion, through rod *s′*, pawl U′, and ratchet P′, to the next left-hand spindle and dial, moving that spindle and dial one-tenth of a revolution and taking off one from the tens' place.

Multiplication can also be performed by using the knobs *e e* instead of *i i* and reversing the operation described above for division; but in that case the result is not so directly obtained, as the slide J must move from left to right and back again as many times as one is contained in each figure of the multiplier. As my machine can be adapted in that way, I do not confine myself to the use of knobs *i i* and connections, in multiplication, but intend to construct calculators so that multiplication, as well as addition, subtraction, and division, can be performed on knobs *e e*, and on that portion of the cog-teeth attached to the periphery of the cylinders which are necessary for the purpose.

It is also my intention to use two registering-slides instead of one, where they are preferred, the arms I, pawls U, and ratchets P being put upon one slide for computations in addition and multiplication, and the arms *r′*, pawls U′, and ratchets P′ being put upon the other slide in subtraction and division, adjusting and applying the means already described so as to produce this result.

It is obvious that a printing device can be attached to and advantageously used in connection with this machine for printing, and thus permanently recording the results of the different arithmetical operations.

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

1. In a calculating-machine, the cylinders B, or their equivalents, having cog-teeth distributed upon their periphery, so as to represent a series of units of one denomination on the right-hand side thereof and units of the next higher denomination on the left-hand side thereof, the adjacent sides of the adjacent cylinders being of the same denomination, and the successive cylinders being so arranged that certain teeth may be brought in a straight line across their respective faces, for the purpose herein set forth.

2. In combination with the cylinders B, or their equivalents, having the cog-teeth distributed upon their periphery, I claim, broadly, the registering-slide J, with pinions N engaging the cog-teeth of the cylinders and communicating the motion of said pinions by suitable mechanism to the registering-dials, substantially as described.

3. In combination with the cylinders B, the graduated racks E and I, for placing the cylinders in their relative positions preparatory to being operated upon by pinion N of the registering device J, substantially and for the purpose herein set forth.

4. In combination with the cylinders B, the

shaft F and pinions *f*, and graduated handle G, for the purpose herein described.

5. In combination with the registering device J, the projection *p*, the lever R, the connecting-rod S, the pawl U, the ratchet-wheel P, and the stud *t*, for the purpose herein set forth.

6. In combination with the registering device J, the supplementary ratchet-dial V and pawl *v*, for the purpose herein set forth.

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Witnesses:

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JOS. T. K. PLANT.