J. BRICKEN.

CALCULATING MACHINE.

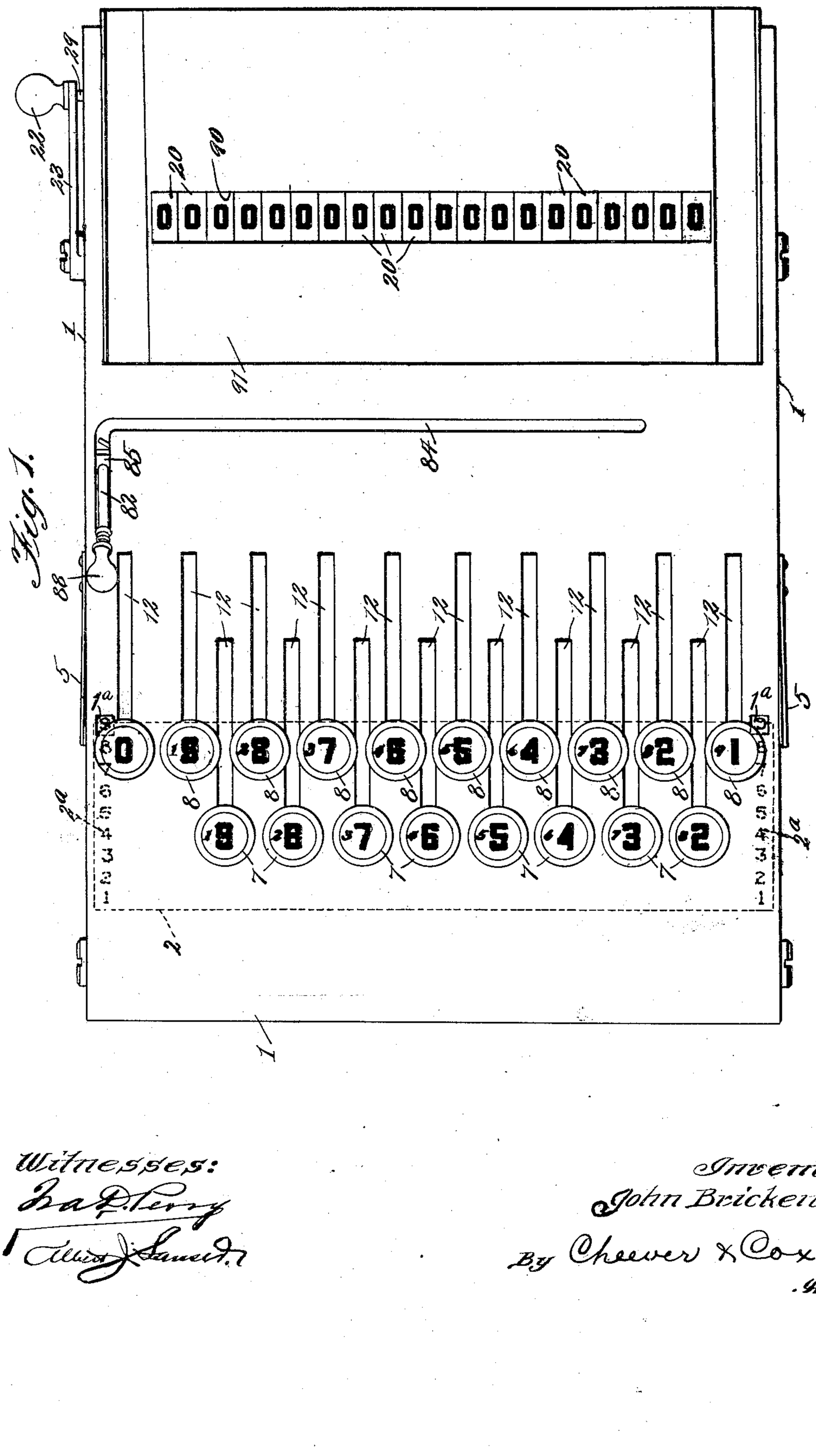
APPLICATION FILED FEB. 25, 1909.

938,550.

Patented Nov. 2, 1909.

11 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

Ira P. Perry

Alice J. Lamoth

Inventor:

John Bricken

By Cheever & Cox

Attys

938,550.

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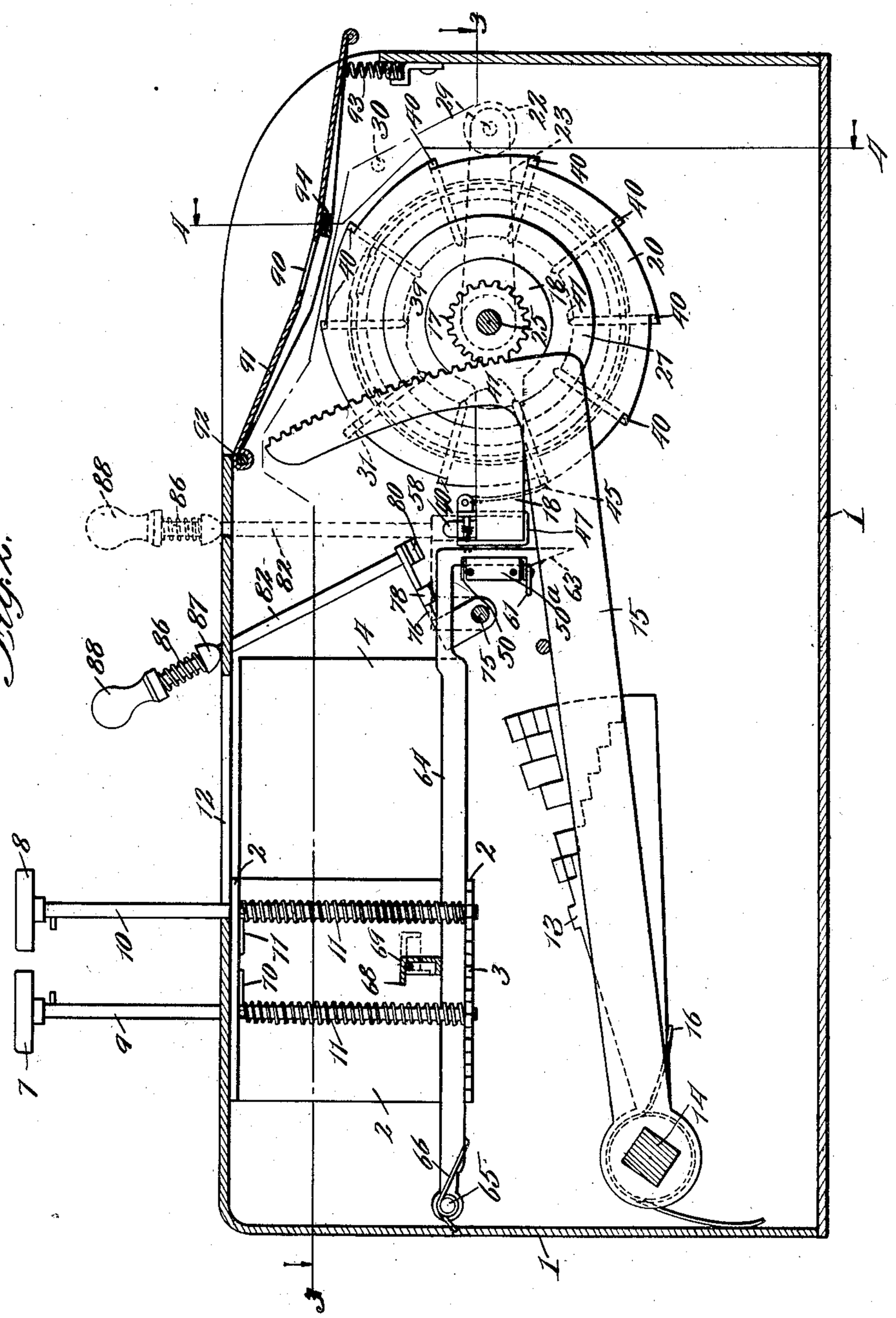
CALCULATING MACHINE.

APPLICATION FILED FEB. 25, 1909.

Patented Nov. 2, 1909.

11 SHEETS—SHEET 2.

Fig. 2.



Witnesses:

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Attys

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11 SHEETS—SHEET 3.

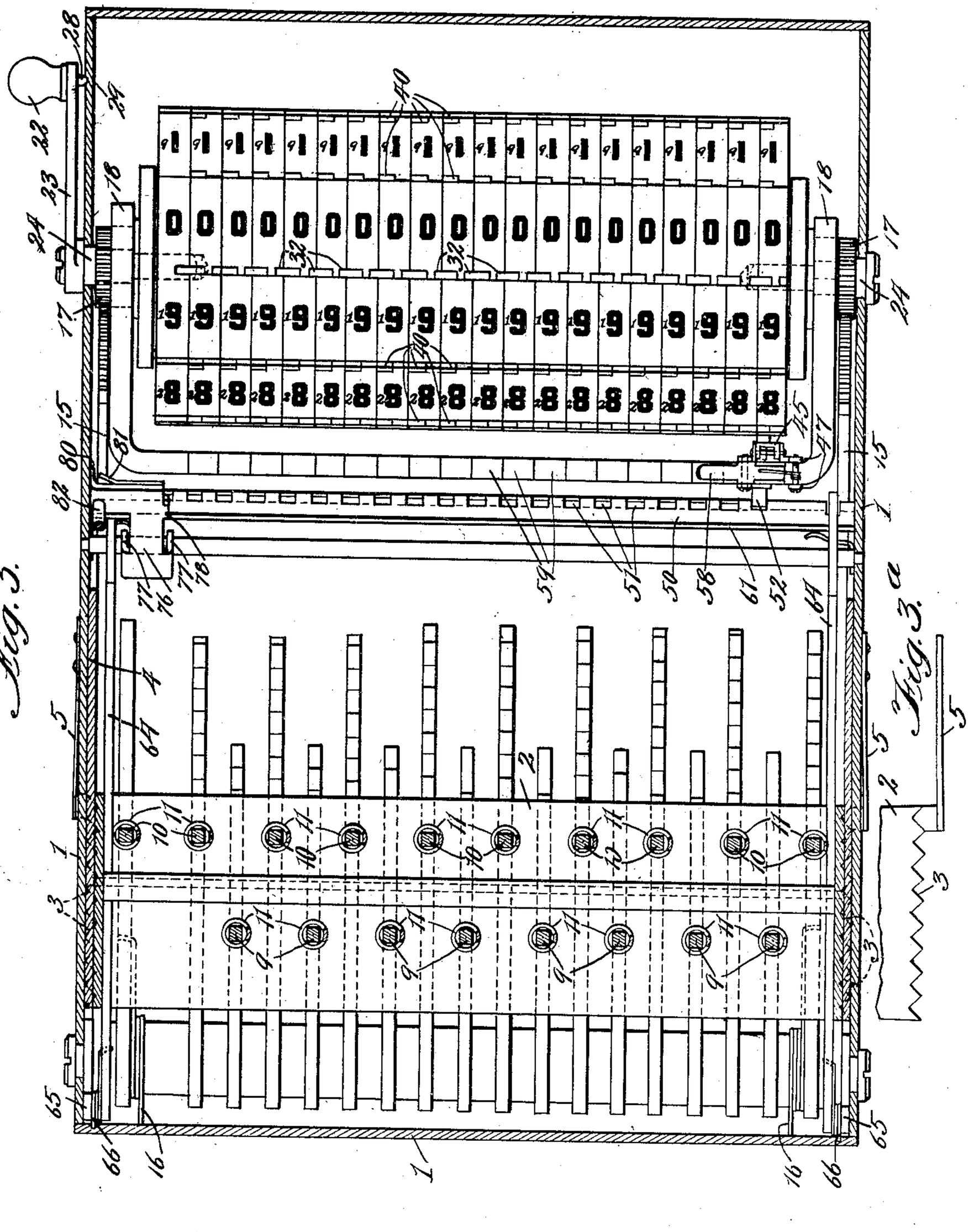

Fig. 3.

Fig. 3a.

Witnesses:

Ira D. Perry

Wm. J. Sauser.

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APPLICATION FILED FEB. 25, 1909.

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11 SHEETS—SHEET 4.

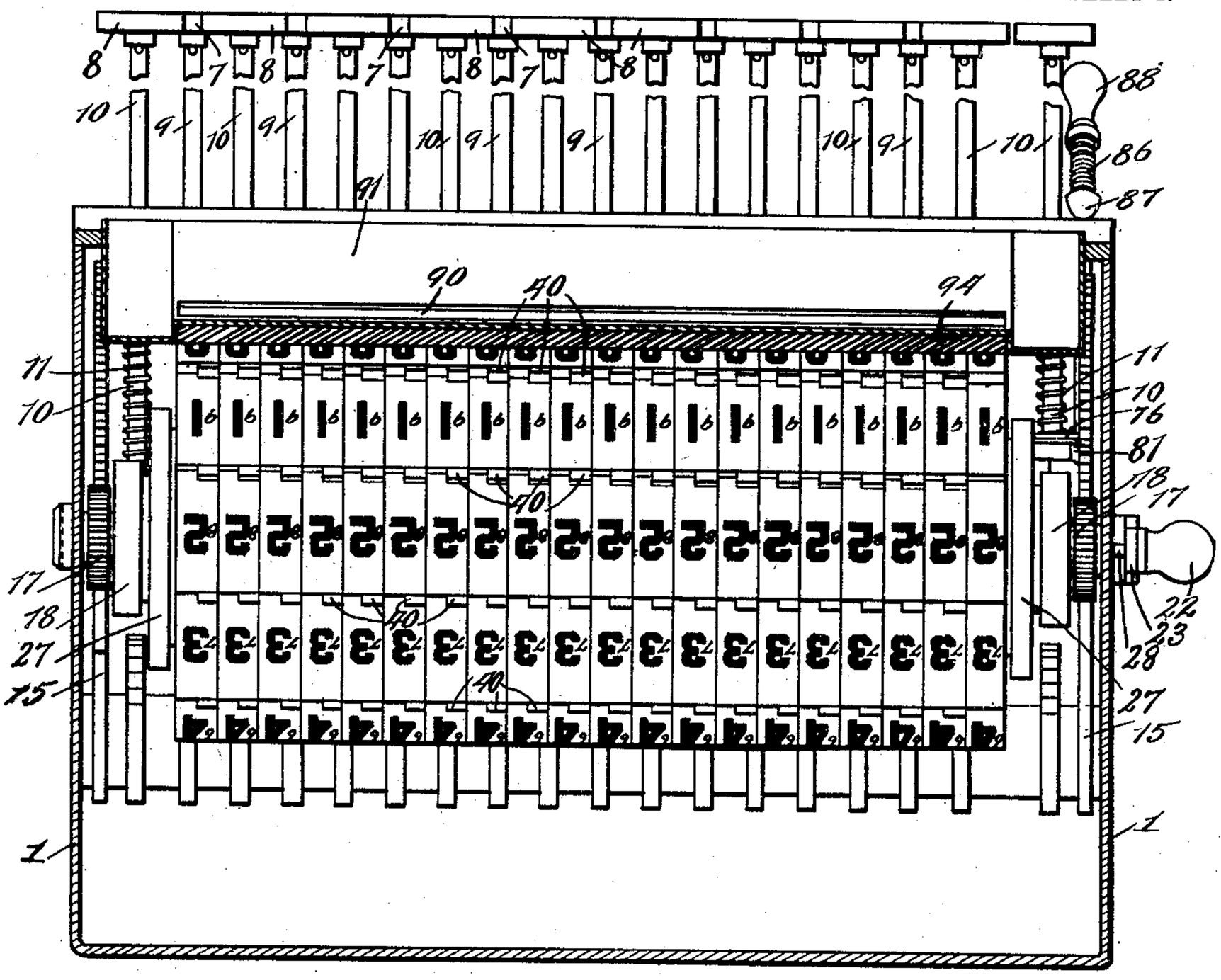

Fig. 4.

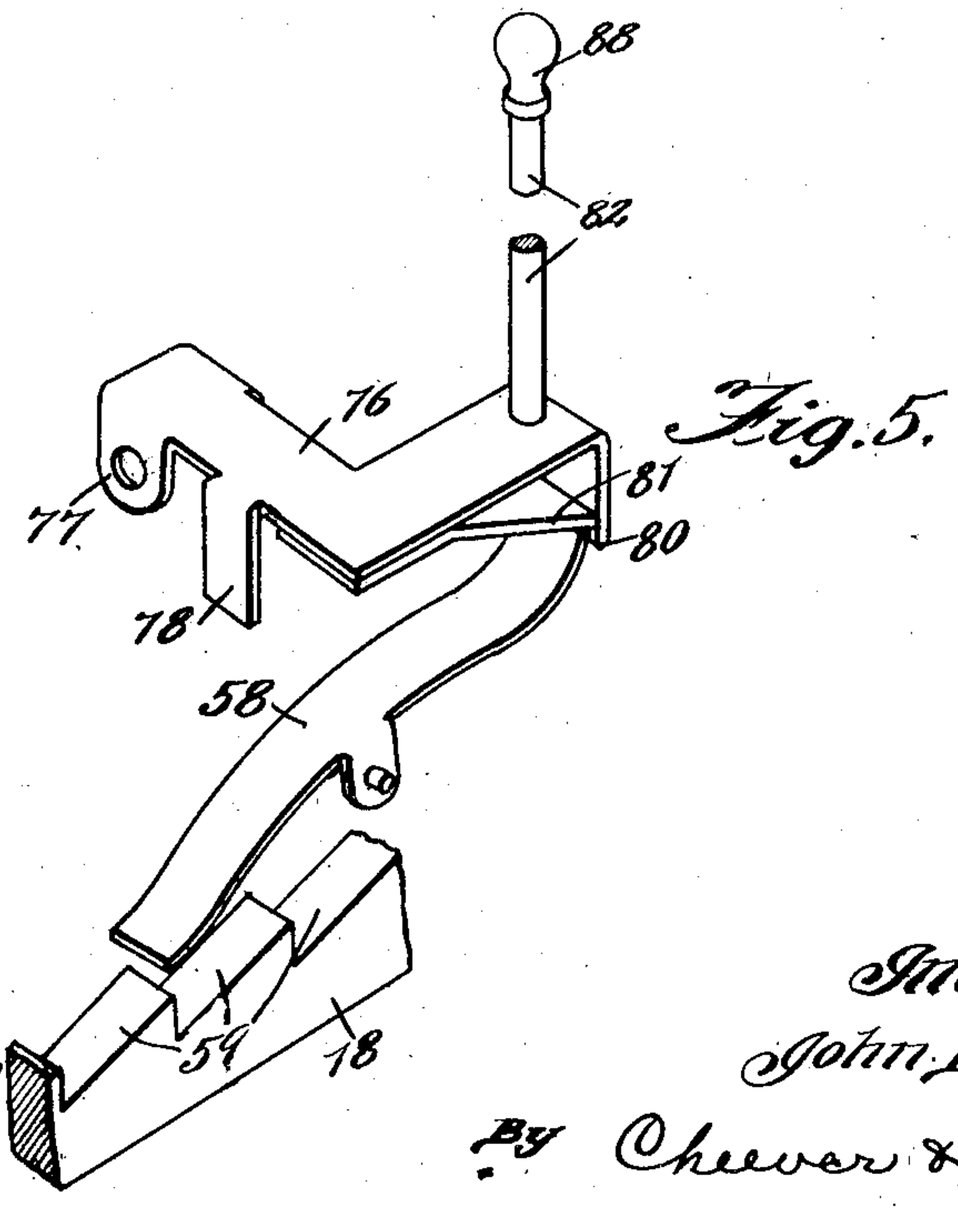

Fig. 5.

Witnesses:

Inventor:

John Bricken

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Attys.

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APPLICATION FILED FEB. 25, 1909.

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11 SHEETS—SHEET 5.

Fig. 6.

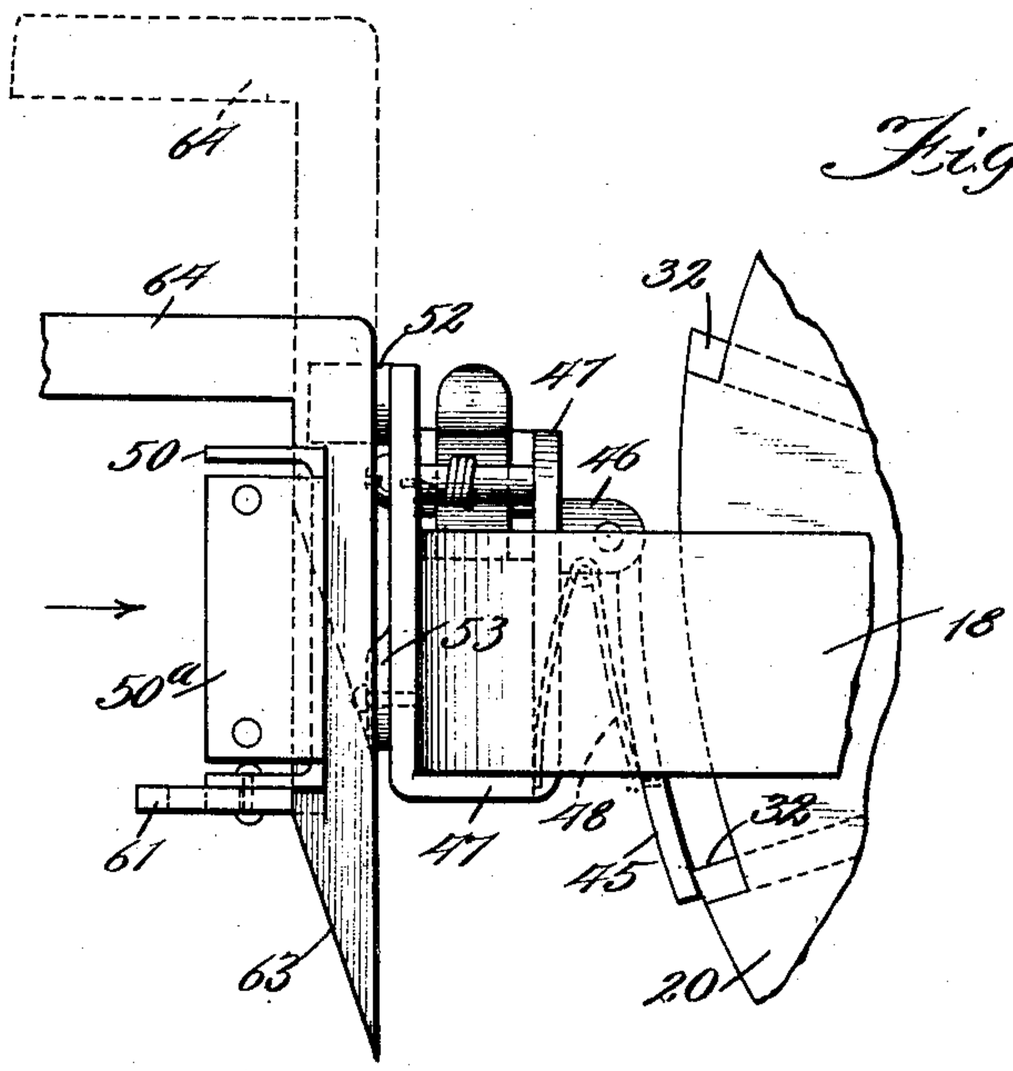

Fig. 7.

Witnesses:

Inventor:

John Bricken

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Attys

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APPLICATION FILED FEB. 25, 1909.

938,550.

Patented Nov. 2, 1909.

11 SHEETS—SHEET 6.

Fig. 8.

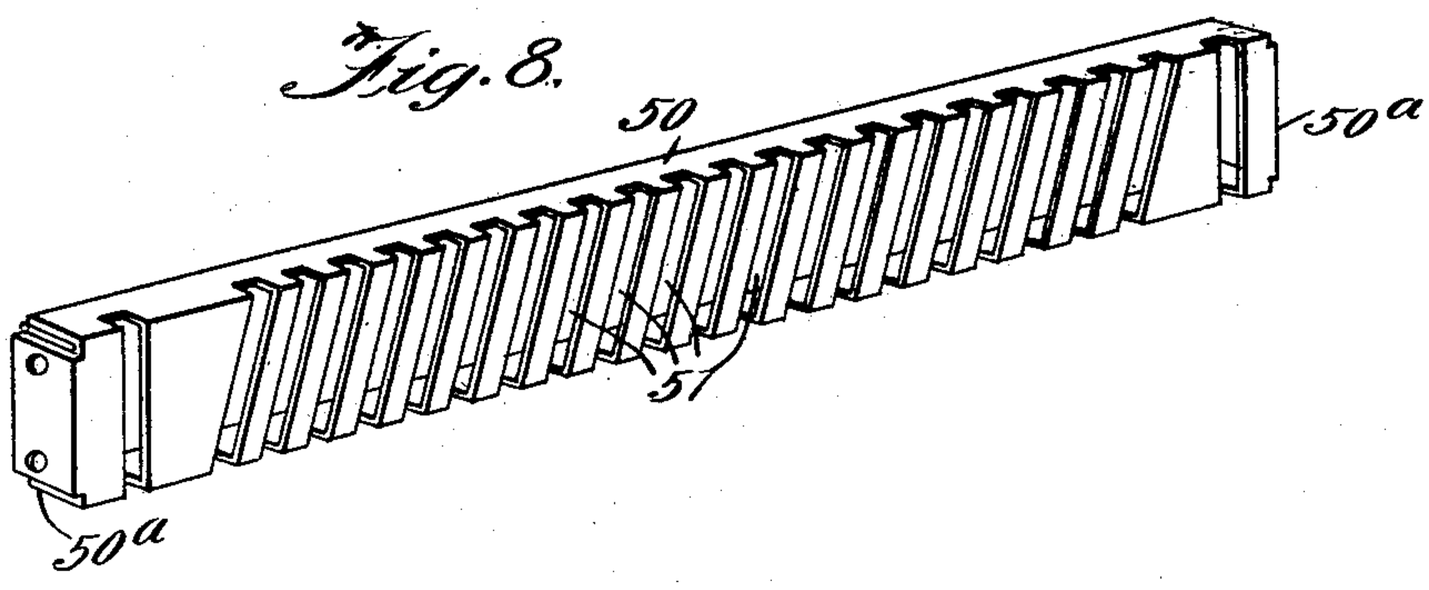


Fig. 9.

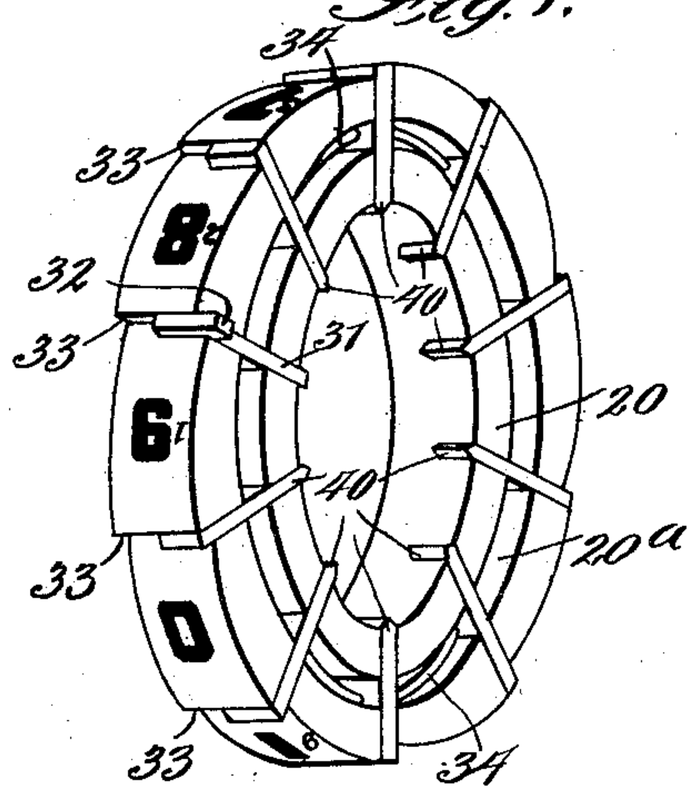


Fig. 10.

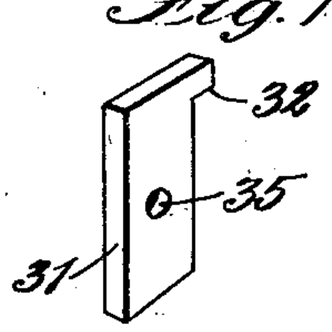


Fig. 11.

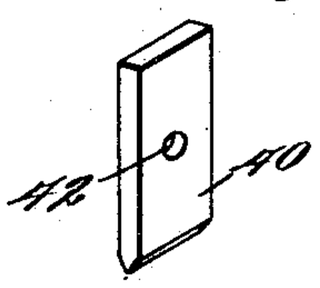
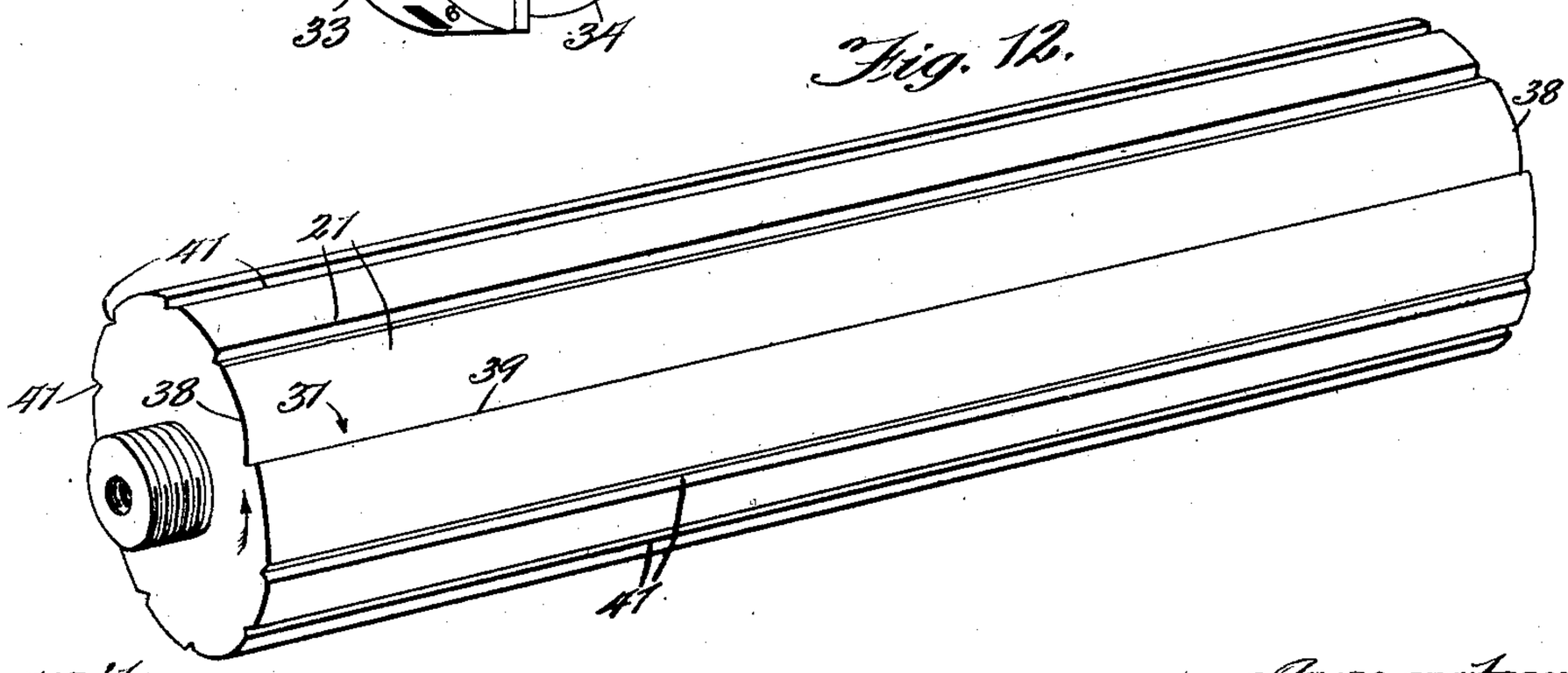


Fig. 12.



Witnesses:

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Albert J. Lausen

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11 SHEETS—SHEET 7.

Fig. 15.

i	*h*	*g*	*f*	*e*	*d*	*c*	*b*	*a*	
9	8	7	6	5	4	3	2	1	*A*
^{1}8	^{1}6	^{1}4	^{1}2	^{1}0	8	6	4	2	*B*
^{2}7	^{2}4	^{2}1	^{1}8	^{1}5	^{1}2	9	6	3	*C*
^{3}8	^{3}2	^{2}8	^{2}4	^{2}0	^{1}6	^{1}2	8	4	*D*
^{4}5	^{4}0	^{3}5	^{3}0	^{2}5	^{2}0	^{1}5	^{1}0	5	*E*
^{5}4	^{4}8	^{4}2	^{3}6	^{3}0	^{2}4	^{1}8	^{1}2	6	*F*
^{6}3	^{5}6	^{4}9	^{4}2	^{3}5	^{2}8	^{2}1	^{1}4	7	*G*
^{7}2	^{6}4	^{5}6	^{4}8	^{4}0	^{3}2	^{2}4	^{1}6	8	*H*
^{8}1	^{7}2	^{6}3	^{5}4	^{4}5	^{3}6	^{2}7	^{1}8	9	*I*

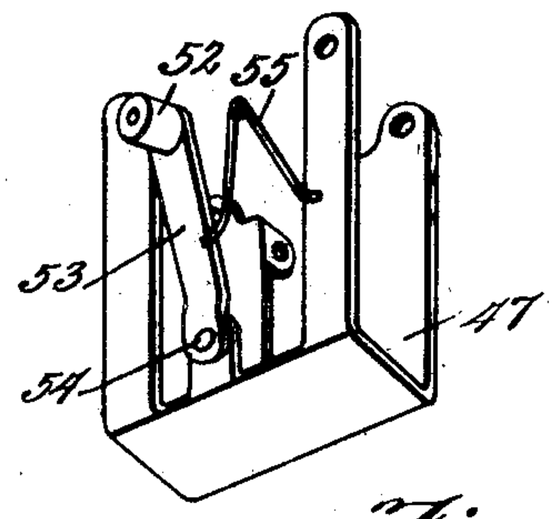
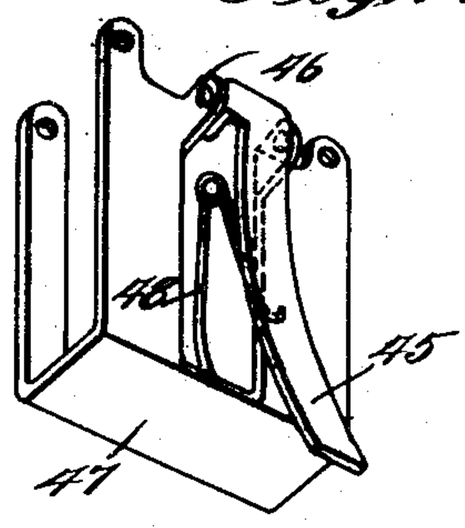


Fig. 13.

Fig. 14.



Witnesses:

Inventor:

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CALCULATING MACHINE.

APPLICATION FILED FEB. 25, 1909.

938,550.

Patented Nov. 2, 1909.

11 SHEETS—SHEET 8.

Fig. 18.

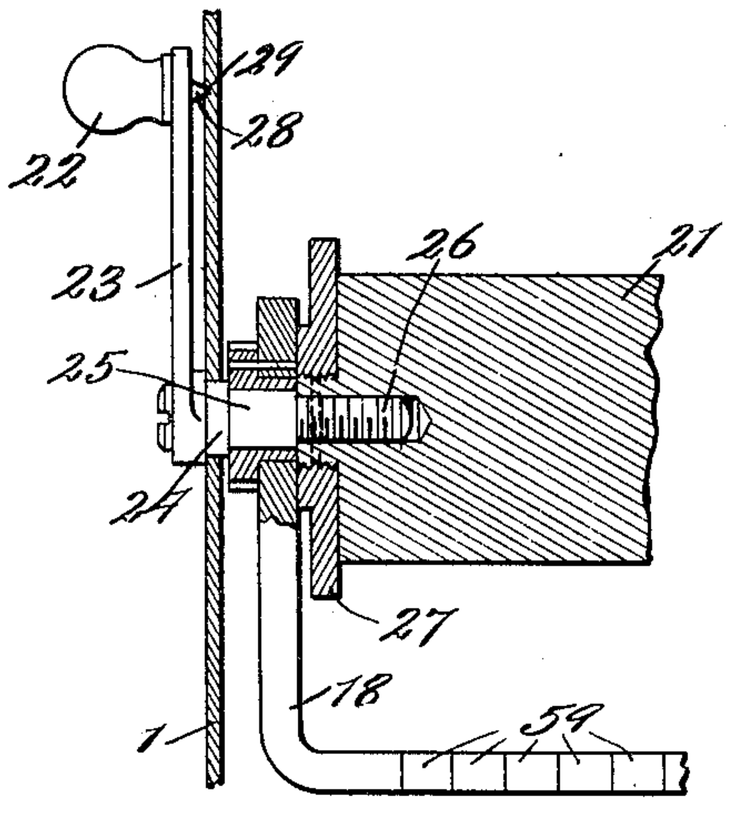


Fig. 16.

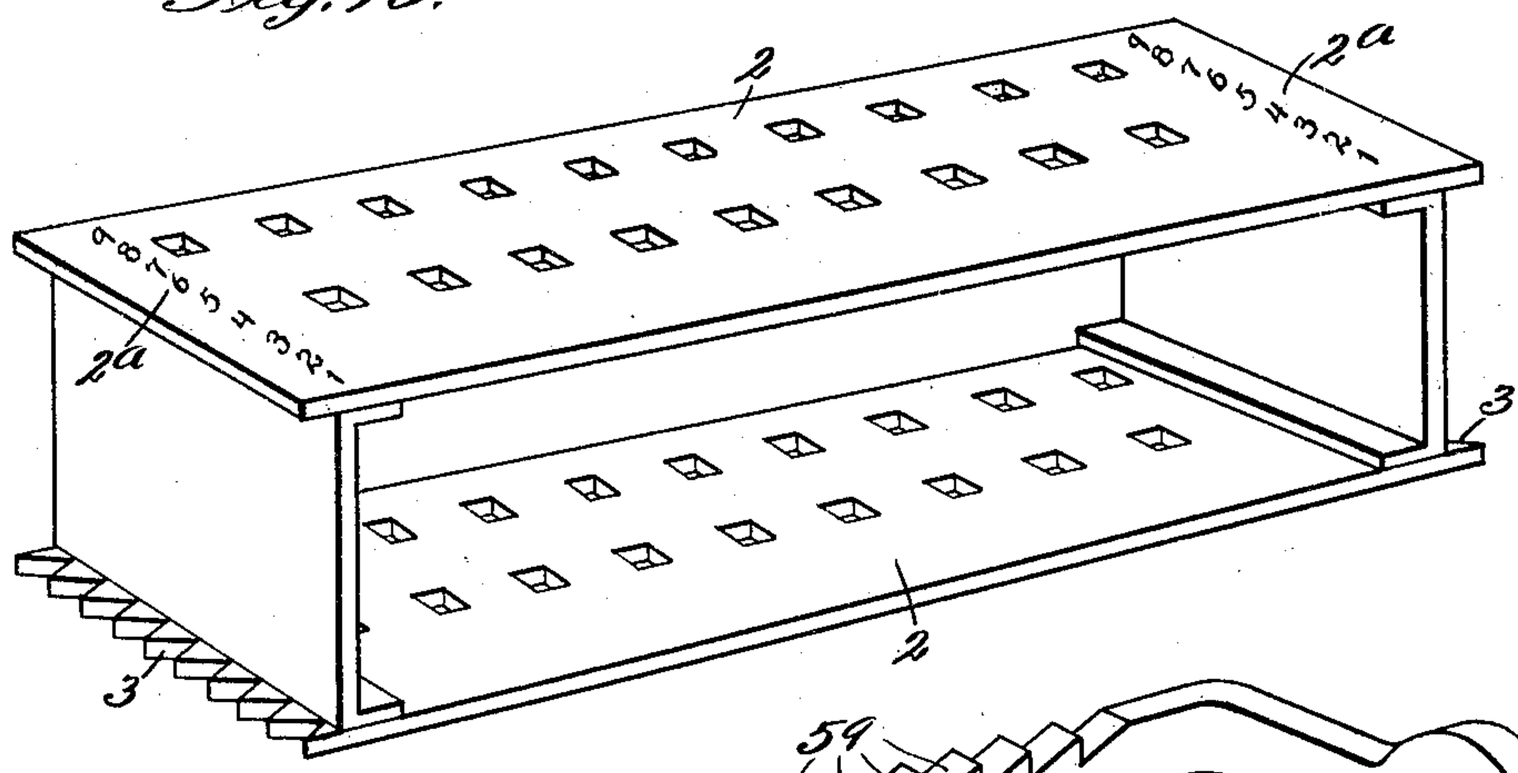
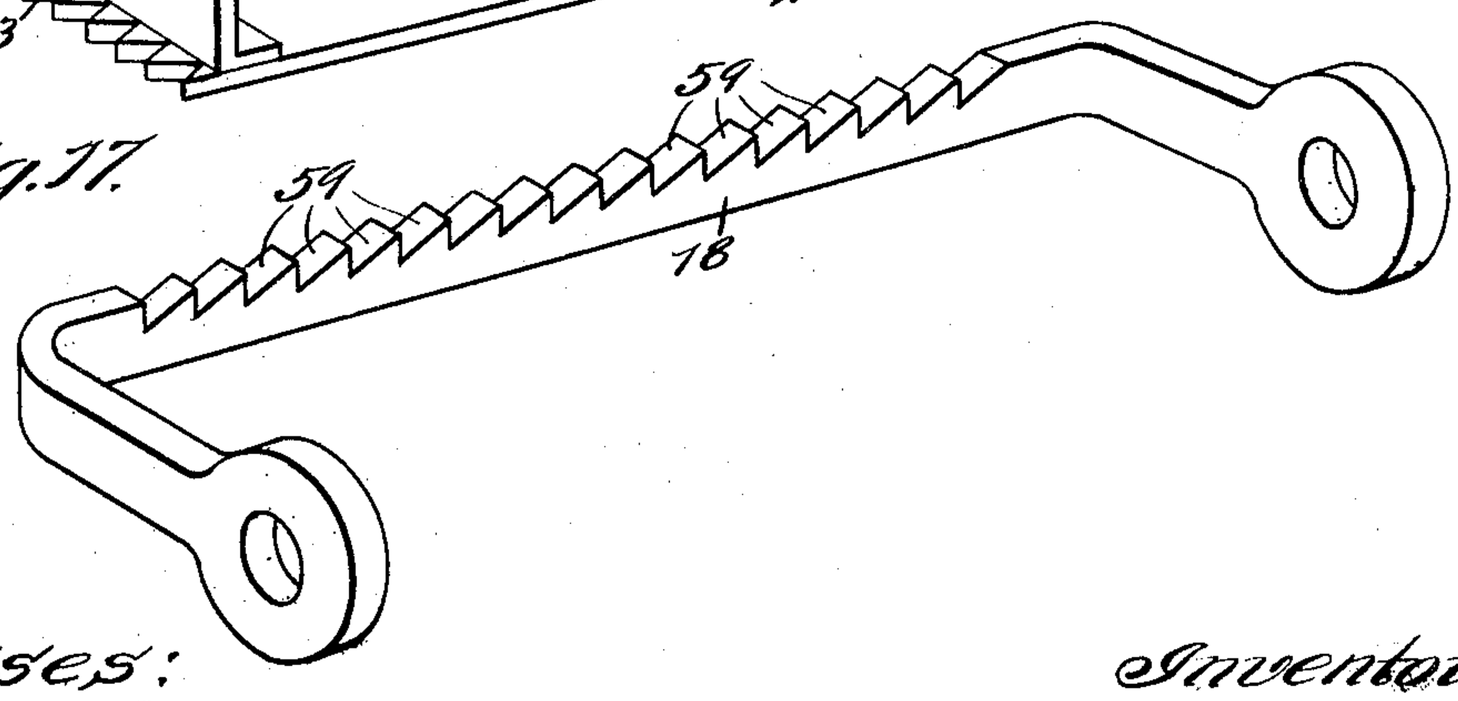


Fig. 17.



Witnesses:

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CALCULATING MACHINE.

APPLICATION FILED FEB. 25, 1909.

938,550.

Patented Nov. 2, 1909.

11 SHEETS--SHEET 9.

Fig. 19.

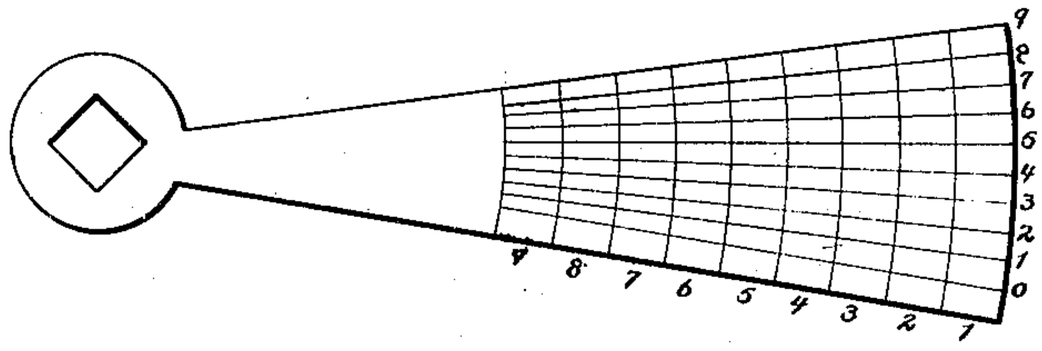

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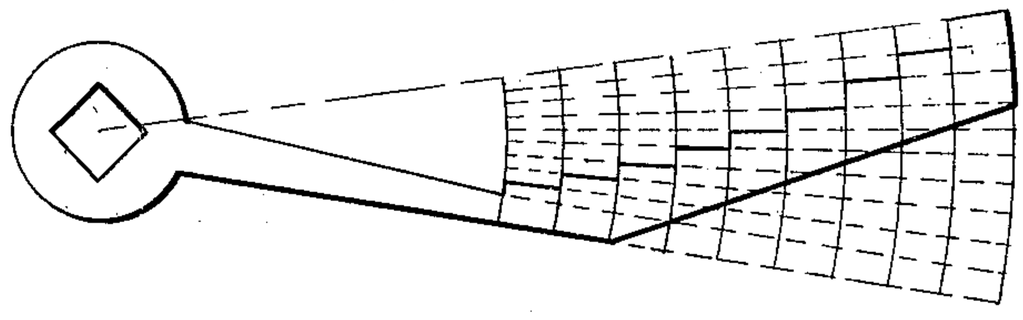
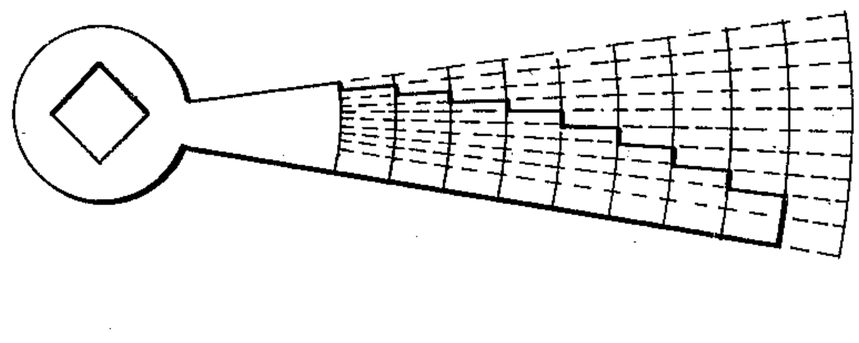
Fig. 20.



9 UNITS.

Fig. 21.



9 TENS.

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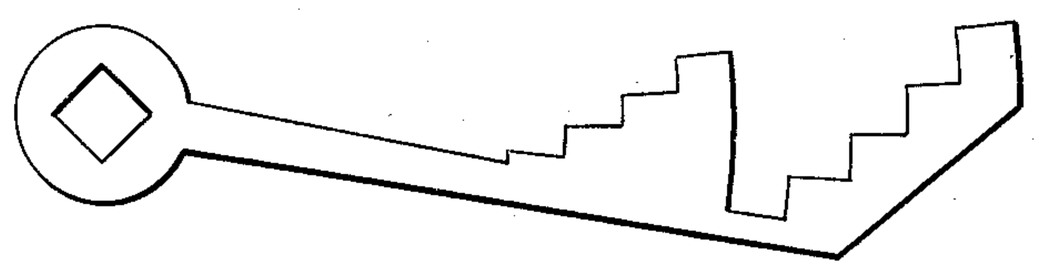
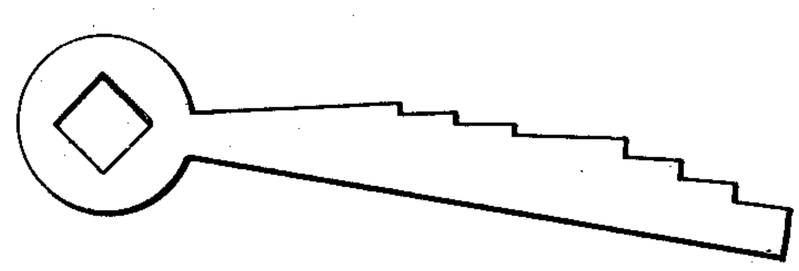


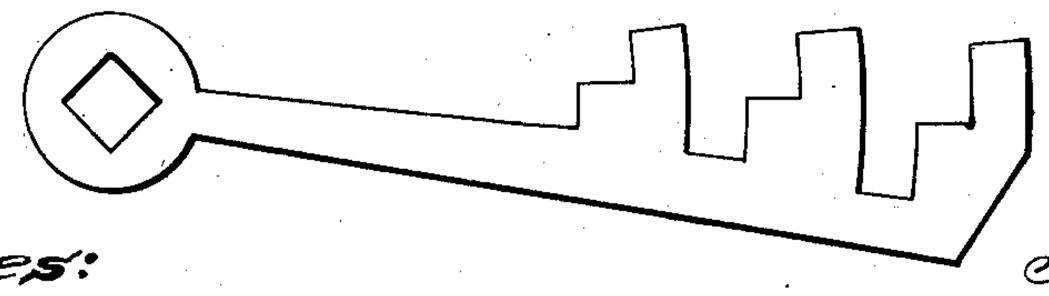
8 UNITS.

Fig. 23.



8 TENS.

Fig. 24.



7 UNITS.

Witnesses:

Albert J. Sawyer

Inventor:

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J. BRICKEN.

CALCULATING MACHINE.

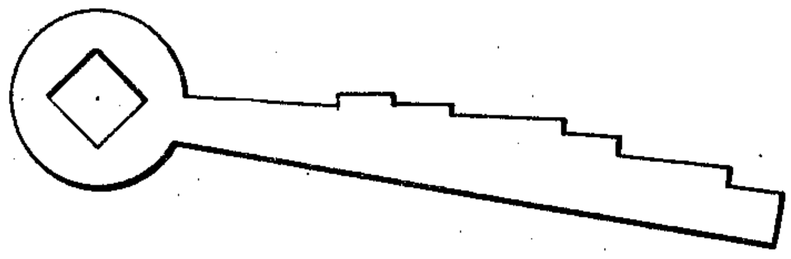
APPLICATION FILED FEB. 25, 1909.

938,550.

Patented Nov. 2, 1909.

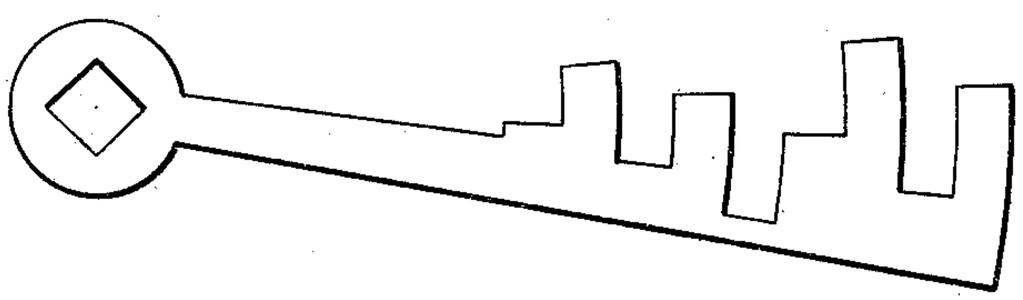
11 SHEETS—SHEET 10.

Fig. 25.



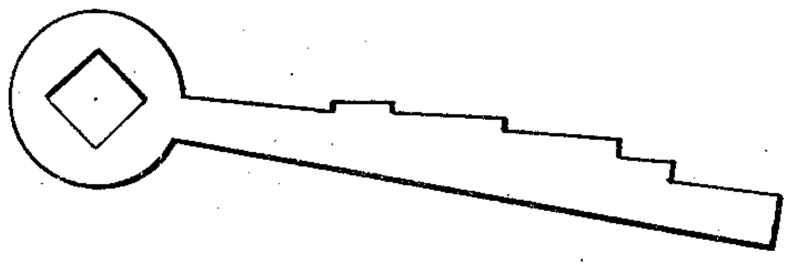
7 TENS.

Fig. 26.



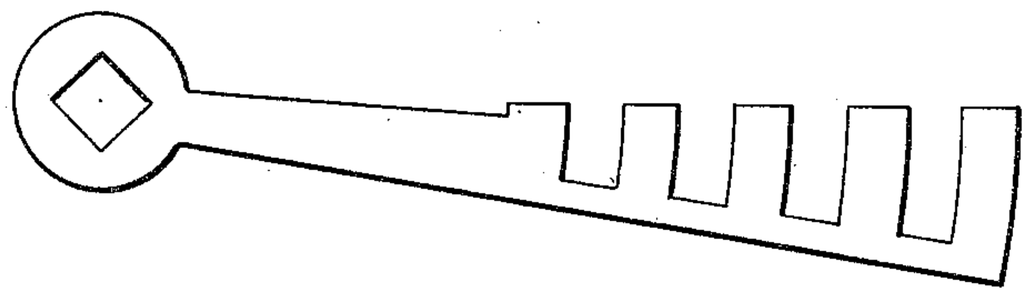
6 UNITS.

Fig. 27.



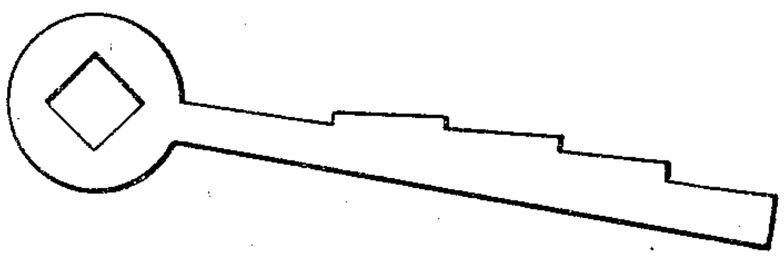
6 TENS.

Fig. 28.



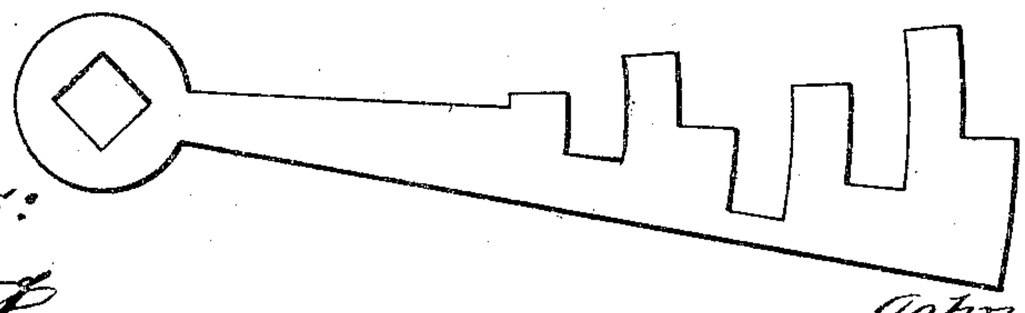
5 UNITS.

Fig. 29.



5 TENS.

Fig. 30.



4 UNITS.

Witnesses:

Wm. D. Cornish

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938,550.

J. BRICKEN.

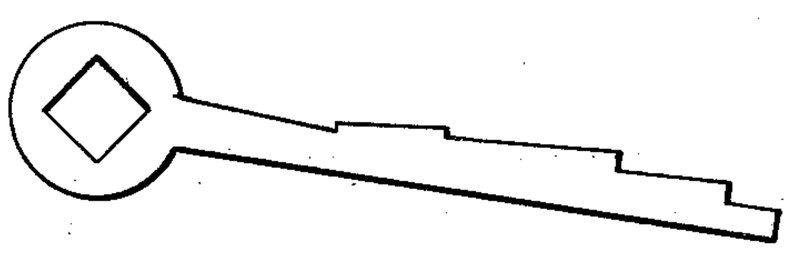
CALCULATING MACHINE.

APPLICATION FILED FEB. 25, 1909.

Patented Nov. 2, 1909.

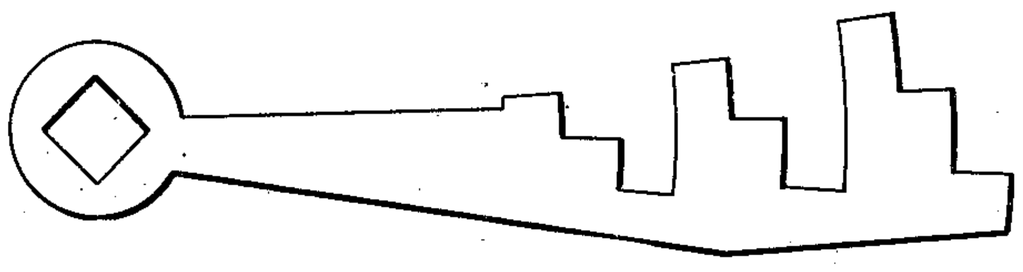
11 SHEETS—SHEET 11.

Fig. 31.



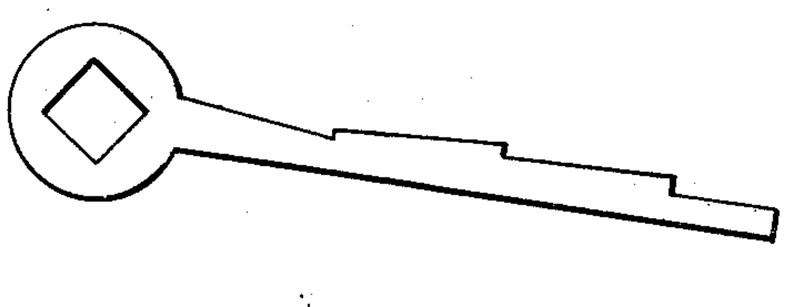
4 TENS.

Fig. 32.



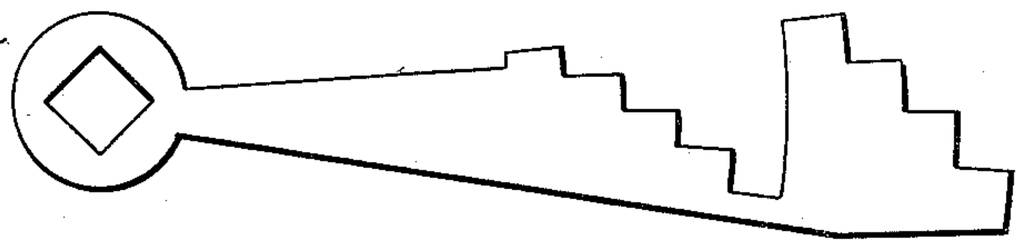
3 UNITS.

Fig. 33.



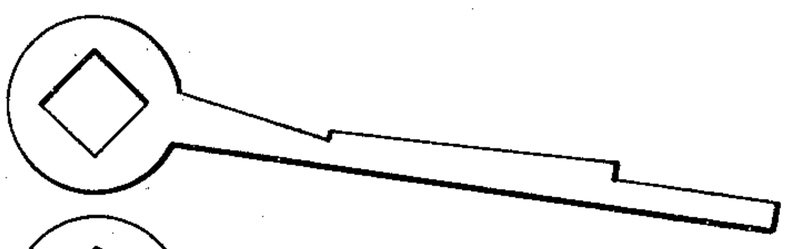
3 TENS.

Fig. 34.



2 UNITS.

Fig. 35.

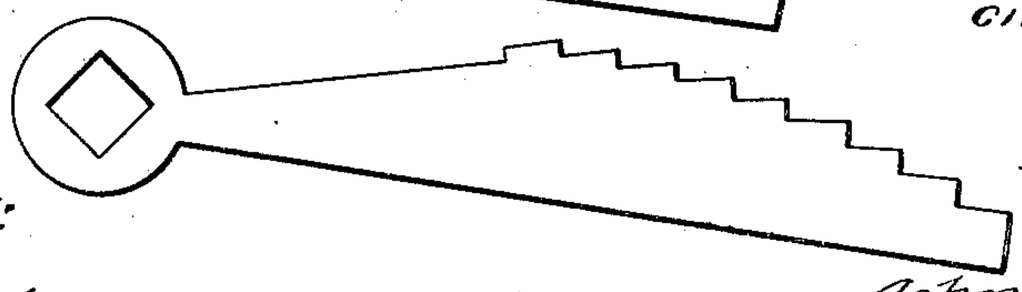


2 TENS.

Fig. 37.

CIPHER.

Fig. 36.



1 UNITS.

Witnesses:

Ba L. Perry

Albert J. Sawyer

Inventor:

John Bricken

By Cheever & Cox Attys

UNITED STATES PATENT OFFICE.

JOHN BRICKEN, OF CHICAGO, ILLINOIS, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, OF ONE-THIRD TO HARRY MARKS, OF CHICAGO, ILLINOIS, AND ONE-THIRD TO REUBEN MARKS, OF DES MOINES, IOWA.

CALCULATING-MACHINE.

938,550. Specification of Letters Patent. **Patented Nov. 2, 1909.**

Application filed February 25, 1909. Serial No. 480,062.

To all whom it may concern:

Be it known that I, JOHN BRICKEN, a subject of the Emperor of Russia, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Calculating-Machines, of which the following is a specification.

My invention relates to calculating machines and the general object of the invention is to provide a machine of this character composed of parts which are few in number, simply constructed and reliable in operation.

Another object is to provide a machine having only twenty keys or less, capable of addition, subtraction, multiplication and division.

Another object of my invention is to provide certain advantageous devices which contribute to the general operation of the machine. These will specifically appear in the following detailed description and claims.

I will first describe the machine more particularly with reference to its ability to multiply, after which its functions for the other processes will readily become apparent.

It is true of course that two figures are sufficient to express the product of any two digits. Where the product of two digits requires two figures to express it the product contains a figure in the units place and a figure in the tens place. In harmony with this law of arithmetic I provide in my machine two kinds of figure keys, to wit, a set of units keys and a set of tens keys and a key must be operated both in the tens and in the units set for every figure in the multiplicand. The keys are mounted in a shiftable key board capable of occupying any one of nine positions, depending upon the digit used as a multiplier.

I accomplish my objects by the mechanism illustrated in the accompanying drawings, in which:

Figure 1 is a plan view of the machine. Fig. 2 is a side elevation of the machine with the casing removed. Fig. 3 is a plan view taken on the line 3—3 Fig. 2. Fig. 3ª is a detail of the snap catch for holding the key board in the position to which it may be set. Fig. 4 is a sectional elevation taken on the line 4—4 Fig. 2 showing the controlling cylinder and computing wheels thereon. Fig. 5 is a detail in perspective showing the resetting mechanism for the denomination carriage. Fig. 6 is a side view of the denomination carriage and adjacent parts. Fig. 7 is a front view of the same looking toward the right in Fig. 6. Fig. 8 is a perspective view of the tracker bar. Fig. 9 is a perspective view of a carrying wheel. Fig. 10 is a perspective view of a carrying dog. Fig. 11 is a perspective view of a stop dog, employed in the computing wheels. Fig. 12 is a perspective view of the controlling cylinder upon which the computing wheels rotate. Figs. 13 and 14 are perspective views of the denomination carriage which actuates the computing wheels. Fig. 15 shows the mathematical table illustrating the principle upon which my machine operates. Fig. 16 is a perspective view of the key-board. Fig. 17 is a perspective view of the yoke bar which carries the denomination carriage. Fig. 18 is a detail view chiefly in longitudinal section through the controlling cylinder showing a convenient form of mountings therefor. Fig. 19 is a diagram indicating the method or principle upon which the differential members are formed. Figs. 20 to 37 inclusive are side views of the individual differential bars.

Similar characters refer to similar parts throughout the several views.

Proceeding now to a detailed description of the form and particular construction of machine selected to illustrate the principle of my invention, the stationary main frame 1 serves to support and inclose the operating parts. A key-board 2, best shown in Figs. 2 and 16, is adapted to shift forward and backward or longitudinally in the main frame, having for this purpose flanges 3, 3 which engage the edges of a plate 4 secured to the side walls of said main frame. The key-board is held in any position by means of spring dogs 5 secured to the stationary frame and having teeth adapted to slip into the notches 6 on said key-board. Preferably the teeth and notches are beveled so that when the key-board is pushed with moderate force by the operator it will force the dogs outward and move to the desired position, whereupon the dogs will again take hold.

The position of the key-board, longitudinally in the frame or casing, depends upon the multiplying factor, for example, in mul-

tiplying a number by seven the key-board must occupy a position corresponding to "7" and in multiplying by four the key-board must be moved to a position corresponding to "4". To indicate the proper position I provide a factor indicator which in the present form of machine consists of a series of indicating figures 2^a marked on the carriage 2, in position to be visible through the sight aperture 1^a in the frame or casing, see Fig. 1.

The key stems 9 and 10 belonging respectively to the tens keys 7 and units keys 8 pass through apertures in the top and bottom of the key-board and are thus supported so as to be movable in a vertical direction. The keys are held in raised position by means of springs 1[illegible], as shown in Fig. 2. The key stems pass through slots 12 in the top of the main frame, said slots being arranged longitudinally to permit the movement of the keys and key-board. Beneath the keys are the differential bars 13 which are rigidly secured to the rock shaft 14 and have individual forms, as illustrated in Figs. 20 to 36 inclusive. The form of each bar is determined from the table shown in Fig. 15.

The rock shaft 14 has rigidly secured thereto two toothed segments or racks 15 and is influenced by a spring 16 or other mechanism to remain in raised position. The teeth on said segments are adapted to engage the pinions 17 which are rigidly secured to the yoke bar 18. The arrangement is such that when a key is depressed, the segments will be depressed and will cause the yoke bar to rotate different amounts, depending upon the key struck. When the key is released the spring 16 will cause the yoke bar to be returned to normal position shown in Fig. 2.

The yoke bar (shown separately in Fig. 17) supports a denomination carriage (shown separately in Figs. 13 and 14) which serve to transmit rotary motion from the yoke bar to the computing wheels 20, mounted upon the controlling cylinder 21. Said cylinder is intended to be rotated only for resetting the computing wheels to zero, or to correct the units wheel to show the proper result in subtraction or division, and the preferred manner of mounting it is shown in detail in Fig. 18. A handle 22 is mounted on a crank arm 23 which has at its inner end a cylindrical portion 24 journaled in the frame work 1. Inside of said cylindrical portion 24 is a cylindrical portion 25 whereon the yoke bar 18 is loosely mounted so as to be independently rotatable. Inside of the portion 25 is a portion 26 which is threaded or otherwise rigidly secured to the ends of said controlling cylinder. A plate 27 is secured to each end of the controlling cylinder for holding the computing wheels thereon. The crank 23 of the resetting handle 22 is flexible to a certain extent to permit the button 28 thereon to spring into the pockets 29 and 30 provided for it in the side of the framework (see Figs. 2, 3 and 18). As a result of this construction when the button is in one of said pockets the crank 23 and cylinder 21 will be prevented from rotating, but said cylinder may be rotated by withdrawing the button from its pocket and then turning said crank. The computing wheels 20, one of which is shown in perspective in Fig. 9, are independently rotatable on said cylinder 21, and in the present instance constitute figure wheels also, being provided on their peripheries with figures running from 0 to 9. Said wheels are each provided with a carrying dog 31 which is radially movable and is provided with a lateral extension 32, as clearly shown in Figs. 9 and 10. Said wheels are each provided with ten ratchet teeth 33 adapted to be engaged by the extension 32 of the carrying dog on the computing wheel of next lower order. The construction is such that when a carrying dog is in projected position, farthest from the center of the computing wheel, the extension thereon will clear the teeth 33 of the computing wheel of higher order, but when the dog is in retracted position, nearest the center of the computing wheel, said extension 32 will engage the teeth on said higher computing wheel. These carrying dogs are urged to retracted position by means of a wire spring 34 lying within an annular groove 20^a in the body of the computing wheel as shown in Fig. 9. This spring passes through an aperture 35 in the center of the dog and presses it radially inward toward the center of the wheel.

The position of the carrying dogs is controlled by the exterior surface of the controlling cylinder 21, said cylinder being provided with a longitudinal recess 37 into which said dogs may descend when they have rotated to a position in register therewith. At all other points on the surface of said cylinder the dogs will be held in projected position. On one side said recess is beveled as at 38 and on the other side is flanked by a radial wall 39 as best shown in Fig. 12. Furthermore, the inner end of the dog is cut off square as best shown in Fig. 10. As a result, when moved toward the beveled side 38 the dog will be projected and its extension 32 will thus clear the teeth 33 on the adjacent computing wheel. By rotating the controlling cylinder in the direction indicated by the arrow in Fig. 12, the dog will first be caused to drop into slot 37, after which the continued rotation of said cylinder by the handle 22 will cause the wall 39 to engage it to reset the computing wheel to zero.

In order to prevent the computing wheels from rotating accidentally and to hold them accurately in alinement, one or more spring stop dogs 40 are mounted in the computing wheels so as to be ra-

lially movable therein, and are provided with wedge shaped or round inner ends (Fig. 1), adapted to enter the longitudinal grooves 41 in the controlling cylinder. There are nine of these grooves 41 located one tenth of a circumference apart and these, together with the groove 37 are so placed that they will arrest the computing wheels with their figures at the proper reading line. The stop dogs 40 have apertures 42 (see Fig. 11) adapted to receive the wire spring 33 in a similar manner to the dogs 30.

The grooves 41 are V shaped or beveled in such manner as to receive the inner ends of the stop dogs 40 but prevent the entrance of the carrying dogs 31. As a result, the carrying dogs will drop at only one point on the cylinder, to wit, the carrying point, whereas the stop dogs will tend to arrest the computing wheels at each of the digital points. The recess 37 will have no effect upon the stop dogs, for the latter will be traveling in a direction indicated by the arrow in Fig. 12. As a result of the above described construction the computing wheels may be rotated independently and the carrying dogs will clear the carrying teeth thereof except at the carrying point where the dog springs inward and becomes operative upon the computing wheel of next higher order.

The computing wheels are adapted to be rotated by the pawl 45 pivotally supported from the arms 46 extending from the frame 47 of the denomination carriage as best shown in Figs. 2, 6, 7 and 14. In the form here selected for illustration the denomination carriage consists of a U shaped frame adapted to travel along the yoke bar 18 past the computing wheels 20. The pawl 45 is normally pressed toward the computing wheels by a spring 48 so that said pawl will engage the carrying teeth 33 when the yoke bar is rotated in the forward direction but will slip over them when the yoke bar is returned to normal position.

In multiplying, the travel of the denomination carriage from columns of lower to columns of higher order is automatic, being caused by the tracker bar 50 shown separately in Fig. 8. Said tracker bar is rigidly secured to the sides of the main frame preferably by means of the end frames 50^a (see Figs. 6, 7 and 8) and has oblique slots 51 which are arranged parallel to each other and adapted to receive the roller 52 carried at the end of the tracker arm 53. Said arm is pivoted to the denomination carriage at the point 54 so as to swing laterally, and is urged to the left (Figs. 7 and 13) by means of the spring 55, which is limited in such movement by the arm striking against one of the parts of the denomination carriage. It will be seen that when the yoke bar is depressed the roller 52 will enter the slot beneath it and will be caused to move toward the right (Fig. 7). This will cause the compression of spring 48 because the carriage is held by a dog 58 engaging the ratchet teeth 59 of the yoke bar 18 (see Figs. 5, 7 and 17). Said dog is pivotally secured to the carriage and is spring pressed to hold its lower end in engagement with said yoke bar. After the roller 52 has passed out from the lower end of the slot which it has entered, the spring 48 immediately swings said roller 52 to the left (Fig. 7) so that at the end of the return stroke the roller will enter the next slot to the left and pull the denomination carriage one step toward the left where the pawl 45 will be in position to operate upon the wheel of next higher order. The carriage will be held in this next higher position by the dog 58 which will then be in engagement with another ratchet tooth on the yoke bar 18. This traveling action of the denomination carriage due to the interaction of the tracker bar and tracker arm takes place only when one of the units keys is operated. No such traveling action is required when one of the tens keys is operated for the reason that, as previously mentioned, two figures are always sufficient to express the product of any two digits. I will now describe the present construction by which traveling movement of the denomination carriage is prevented when the yoke bar is moved by the tens keys.

Lying adjacent to the underside of the tracker bar is a stop bar 61, mounted so as to slide horizontally (see Figs. 2, 6 and 7) to cover and uncover the lower ends of the slots 51 of the tracker bar. The purpose is to prevent the roller 52 from entering the tracker bar from beneath on the return movement following operation by the tens keys. This locking bar is spring pressed to occupy a forward position covering the lower ends of the slots 51. Said bar is forced to retracted position by means of the cams 63 on the lower end of the controlling arms 64 as best shown in Figs. 2 and 6. Said arms are pivoted on the stationary rod 65 and are urged to raised position by means of the spring 66 shown in Fig. 2. The arrangement is such that when said controlling arm 64 is down the stop bar 61 will be in retracted, a nonactive position, and when said controlling arms are up said stop bar will be in projected acting position. Said arms 64 are adapted to be held down by means of the locking bar 68 which crosses them and is pivotally mounted upon the stationary rod 69. The parts are so arranged that when bar 68 is in one position it will hold the arm 64 down in locked position and when said locking bar is rotated to a second position it will release said controlling arms and permit the stop bar 61 to move to active position. Said locking bar 68 is adapted to be rotated from active to nonactive position by means of a pin 70 secured to the stem of each of the

tens keys as shown in Fig. 2. Said locking bar is adapted to be rotated from nonactive to active position by a pin 71 mounted on the stem of each of the units keys 8. Thus the depression of any one of the units keys will cause the stop bar 61 to be moved to a position where it will not interfere with the cross travel of the denomination carriage but the operation of any one of the tens keys will cause said stop bar to be moved to a point where it will interfere and thus prevent such travel. By thus constructing the machine so that the denomination carriage or computing-wheel actuator travels only once in multiplying two digits together the actuator dog 45 will be in position to actuate the proper computing wheel in multiplying by the next digit.

As previously explained the production of any two digits may be expressed by a number having two figures. The product of some digits may be expressed by a single figure, for example, a single figure is sufficient to represent the product of any digit multiplied by 0 or 1. Consequently there is no need of a tens key for the "0" units key or the "1" units key. Hence while there are ten units keys in my machine, eight tens keys are sufficient.

In the present design the roller 52 normally occupies a position above the upper edge of the tracker bar so that the carriage may be free to be returned to units position for fresh calculations.

I will now describe the resetting mechanism for returning the denomination carriage to units position after a computation has been completed. A guide bar 75 is supported in the framework parallel to and preferably somewhere near the main ratchet portion of the yoke bar 18, as best shown in Fig. 2. Rotatably and slidably mounted upon said guide bar is a resetter 76 shown in perspective in Fig. 5. In the preferred form here shown said resetter is supported upon said guide bar by means of apertured ears 77 and is provided with a lug 78 adapted to slide along the top of the tracker bar 50 whereby said tracker bar coöperates with the bar 75 to guide the resetter. Said resetter is provided with a dog 80 adapted to engage the upper end of the dog 58 to push it and the denomination carriage back to units position. In order that the dog 58 may be released from the teeth 59 of the yoke bar during the resetting operation a cam 81 is formed on the resetter as clearly shown in Fig. 5.

The resetter is operated by means of a handle 82 and when the resetter is moved in a direction to reset the denomination carriage the cam 81 will first come into engagement with the dog 58 and raise the lower end thereof free from the teeth 58 of the yoke bar 18. A slot 84 (see Fig. 1) is formed in the top of the casing parallel with said yoke bar and guide bar to permit the travel of the resetting mechanism. Connecting with the left end of said slot 84 is another slot 85 at right angles thereto which permits the resetter to be thrown back clear of the denomination carriage. A spring 86 interposed between the sliding collar 87 and the head 88 on the handle 82 tends to hold said handle and resetter in non active position.

In the particular form of machine here shown, the figures on the computing wheels are viewed through an aperture 90 in the plate 91 hinged to the main frame at the point 92 and resting at its other edge upon a spring 93 as shown in Fig. 2. Said plate is provided with a retarding device 94 consisting of a plate of rubber, felt or other suitable material which, when the plate is depressed, will retard the carrying wheels during the action of resetting the latter to zero.

The resetting of the computing wheels is accomplished in the following manner: After a computation is complete and the computing wheels occupy various positions they may be reset by first releasing the resetting handle 23 and rotating it and the controlling cylinder 21 one complete rotation in a forward direction. This rotation of the controlling cylinder will cause the resetting wall 39 thereon to pick up the different computing wheels by engaging the inner ends of the various carrying dogs thereon as it comes to them. When the revolution of the controlling cylinder is complete the figures will all exhibit "zero" at the reading line.

Operation: Let it be supposed that it is desired to multiply the number 83 by 4. The key board will first be shifted by the operator to such position that the index numeral 4 will appear through the sight aperture 1^a in the top of the casing. The operator will then depress the units key 3, then the tens key 3, then the units key 8 and the tens key 8, whereupon the product 332 will appear upon the computing wheels. After this calculation is complete the machine may be reset again to zero by rotating the handle 23 one complete revolution in a forward direction to reset the computing wheels, and by moving the resetting handle 82 to the right along slot 84 to return the denomination carriage to units place. Handle 82 is then returned to its normal position in the slot 85 as shown in Fig. 1 and in full lines in Fig. 2.

In order that the manner of forming the differential bars may be understood attention is called to the arithmetical table shown in Fig. 15 and the diagram Fig. 19; to facilitate description the horizontal lines in Fig. 15 will be indicated by the small letters *a* to *i* inclusive commencing at the right or units column; and the vertical columns will

be lettered from A to I inclusive commencing at the top. The contents of the table itself is clearly shown in Fig. 15 and it is sufficient to say that the product of any two digits may be obtained by reading the number appearing at the intersection of the rows containing the digits to be multiplied; for example, the product of 3 by 3 is obtained by reading at the intersection of line C and column *c*. Again the product of 7 by 8 may be obtained by reading the number appearing in line G and column *h*. In the table the large type indicates the units of the product and the small type the tens thereof.

We may now analyze the calculating above given which will appear as follows:

83
4
—
12
32
—
332

The keys are so constructed that when the key board is moved to a point corresponding to the multiplier 4 (which comes in line D of the table) the computing wheel farthest to the right will show 2 as soon as the 3 units key has been depressed. This corresponds to the units figure shown in column *c* (the third column of the table). The 3 tens key is so formed that its depression will cause the second computing wheel from the right to show "1". This is in compliance with the tens figure appearing at the same intersection of the table. The fact that the key last depressed actuates the second computing wheel instead of the lowest computing wheel is due to the travel of the denomination carriage which has occurred between the action of the two keys. The operator must now depress the 8 units key, and said key is so constructed that it will rotate the second computing wheel from the right two more spaces to show "3". He then depresses the 8 tens key whereupon the third figure wheel from the right end shows "3". This is in compliance with the figure appearing at the intersection of line D and column *h*. The computing wheels will now show the complete product 332.

As it is necessary in multiplication (after the key board has been shifted to proper position) to press primarily a units key and secondarily the corresponding tens key (except on the occasions when the digit in the multiplicand happens to be "0" or "1") the keys may be said to occur in two sets, a primary set and a secondary set. Referring to the above example, it will be seen that "12" in the line below the multiplier "4" is a true product, being the product of 3 multiplied by 4 but, considering the example as a whole, said product is only a "partial product" and not the grand or total product which is "332". It will be seen that a partial product is obtained every time a units key and its companion tens key are struck.

I have now described the construction and operation of the machine with special reference to multiplication. In an analogous manner it will perform simple addition by moving the key-board to the point corresponding to the index or indicator numeral 1.

In order that the machine may be employed for subtraction I have marked co digits upon the figure keys in consonance with the well known theory of complements, the co digits having a value one less than the actual complement. In my machine the operator does not have to make the usual correction of unity in the resulting number, this being taken care of by rotating the handle to pocket 30 (see Fig. 2).

My machine may be also employed to divide upon the theory that division is the inverse of multiplication. In order to properly perform division the controlling cylinder is rotated one space forward to pocket 30 as in subtraction. The operator then proceeds as in multiplication.

The term "factor digits" may conveniently be employed to designate any two digits intended to be multiplied together.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is:

1. In a multiplying machine, a totalizer, differential bars for operating the same, said bars having different points of actuation, and figure keys, one for each of said bars, said figure keys being shiftable to nine different positions relatively to said bars to actuate them at different points depending upon the multiplier to be used.

2. In a multiplying machine, a totalizer, differential bars for operating the same, said bars having a plurality of points of actuation for producing different effects upon the totalizer, according to the multiplier to be used, and figure keys, one for each of said bars, said figure keys being shiftable to act upon said bars at the different points of actuation thereof.

3. A multiplying machine comprising a totalizer, and differential mechanism for operating the same, said differential mechanism including a stationary axle, differential members pivoted thereon and each having a plurality of points of actuation for producing different amounts of movement in the totalizer, keys for operating said differential members and a key board wherein said keys are mounted, said key board being shiftable relatively to said differential members for causing said keys to contact them at the different points of actuation thereof.

4. A calculating machine adapted to multiply and comprising totalizing mechanism

and differential mechanism for actuating the same, said differential mechanism including a single set of units keys running from 0 to 9 and a single set of tens keys running from 2 to 9, and differential members operated by said keys, there being a differential member for each and every one of said keys except the "0" key, said keys and differential members being relatively shiftable to cause the keys to act upon different portions of the differential members depending upon the multiplying factor to be employed.

5. A calculating machine adapted to multiply and comprising totalizing mechanism, differential mechanism for actuating the same, said differential mechanism having two sets of keys, one set for obtaining the units figure in a partial product and the other set for obtaining the tens figure in said partial product, and means whereby the relation of parts of the differential mechanism may be altered with respect to each other in accordance with the multiplying factor desired.

6. A calculating machine adapted to multiply and comprising totalizing mechanism, differential mechanism for actuating the same, said differential mechanism having two sets of keys, one set for obtaining the units figure in a partial product and the other set for obtaining the tens figure in said partial product, the first set consisting of ten keys and the second set of less than ten keys, and means whereby the relation of parts of the differential mechanism may be altered with respect to each other in accordance with the multiplying factor desired.

7. A calculating machine adapted to multiply and comprising totalizing mechanism, differential mechanism for actuating the same, said differential mechanism having two sets of keys, one set for obtaining the units figure in a partial product and the other set for obtaining the tens figure in said partial product, the first consisting of ten keys running from 0 to 9 and the second set consisting of eight keys running from 2 to 9, and means whereby the relation of parts of the differential mechanism may be altered with respect to each other in accordance with the multiplying factor desired.

8. In a calculating machine a carrying mechanism, and actuating mechanism therefor, said actuating mechanism including differential members, and keys shiftable relatively thereto to any one of nine different positions for actuating them at different points depending upon the factor to be used as a multiplier.

9. In a calculating machine, a carrying mechanism and actuating means therefor, said actuating means including two sets of differential members, one set for the units figure and the other set for the tens figure in a partial product, a rock bar common to all of said differential members, connections from said rock bar to the carrying mechanism and key mechanism for operating said differential members.

10. In a calculating machine, a carrying mechanism and actuating means therefor, said actuating means including two sets of differential members, one set for the units figure and the other set for the tens figure in a partial product, a rock bar common to all of said differential members, connections from said rock bar to the carrying mechanism and key mechanism for operating said differential members, said key mechanism and differential members being relatively movable to alter the multiplying factor.

11. In a calculating machine, carrying mechanism including carrying wheels and actuating means therefor, said actuating means comprising a bar parallel to and rotatable about the axis of said carrying wheels, means for rotating said bar, and means traveling on said bar for transmitting the rotary movement of said bar to said carrying wheels.

12. In a calculating machine, carrying mechanism including carrying wheels and actuating means therefor, said actuating means comprising a yoke bar parallel to and rotatable about the axis of said carrying wheels, a denomination carriage for transmitting rotary movement from said bar to said wheels, and means for rotating said bar and causing the travel of said carriage thereon.

13. In a calculating machine, carrying wheels, an actuator therefor adapted to move in the plane of rotation of said wheels and to travel in a direction transverse thereto, means for moving said actuator in the plane of rotation of said wheels, and a stationary member having inclined surfaces operative upon said actuator to cause the same to travel.

14. In a calculating machine, carrying wheels, an actuator therefor adapted to move in the plane of rotation of said wheels and to travel in a direction transverse thereto, means for moving said actuator in the plane of rotation of said wheels, and a tracker bar for causing said actuator to travel transversely to the plane of rotation of the carrying wheels.

15. In a calculating machine, carrying mechanism and actuating means therefor, said carrying mechanism comprising carrying wheels, a supporting member whereon said carrying wheels are independently rotatable, and means controlled by the configuration of said supporting member for transmitting movement from one carrying wheel to the next.

16. In a calculating machine, carrying mechanism and actuating means therefor, said carrying mechanism comprising carry-

ing wheels, a controlling cylinder whereon said wheels are independently rotatable, and carrying dogs controlled by said cylinder.

17. In a calculating machine, carrying mechanism and actuating means therefor, said carrying mechanism comprising carrying wheels rotatable about a common axis, carrying teeth on said wheels, and members radially movable upon said carrying wheels for engaging and disengaging the carrying teeth on the carrying wheel of next higher order.

18. In a calculating machine, carrying mechanism and actuating means therefor, said carrying mechanism comprising carrying wheels, a supporting member whereon said wheels are independently rotatable, and a yieldable stop dog on each carrying wheel adapted to coöperate with said supporting member to yieldingly hold the carrying wheels in proper alinement.

19. In a calculating machine, carrying mechanism and actuating means therefor, said carrying mechanism comprising carrying wheels, a supporting member whereon said wheels are independently rotatable, said supporting member having notches running lengthwise thereof, parallel to the axis of the carrying wheels, there being a notch for each figure on a carrying wheel, and a stop dog yieldingly mounted upon each carrying wheel and adapted to enter said notches for preventing accidental rotation of the wheel whereon it is mounted.

20. In a calculating machine, carrying mechanism and actuating means therefor, said carrying mechanism comprising carrying wheels, a rotatable supporting member whereon said carrying wheels are independently rotatable, a carrying dog on each carrying wheel controlled by the configuration of said supporting member and means on said supporting member for engaging the carrying dogs to reset the carrying wheels to zero.

21. In a calculating machine, carrying mechanism and actuating means therefor, said carrying mechanism comprising carrying wheels, a rotatable supporting member whereon said carrying wheels are independently rotatable, a carrying dog on each carrying wheel controlled by the configuration of said supporting member, means on said supporting member for engaging the carrying dogs to reset the carrying wheels to zero, and a hand operable friction device for preventing accidental rotation of the carrying wheels during the resetting operation.

22. In a calculating machine, carrying mechanism and actuating means therefor, said carrying mechanism comprising carrying wheels, a supporting member whereon said carrying wheels are independently rotatable, means controlled by the configuration of said supporting member for transmitting movement from one carrying wheel to the next, and figures running in a series from 0 to 9 on the peripheral surface of said carrying wheels.

23. In a calculating machine, the combination of differential mechanism, a denomination carriage operated thereby, carrying wheels operated by said carriage, a bar for supporting said carriage, a carrying cylinder for supporting said carriage, a controlling cylinder for supporting said carrying wheels and carrying dogs controlled by said cylinder, said bar, cylinder and wheels all being rotatable about a common axis.

24. In a calculating machine, differential mechanism, carrying mechanism including carrying wheels, a bar parallel to and rotatable about the axis of said carrying wheels and operated by said differential mechanism, a denomination carriage traveling upon said bar to rotate said carrying wheels, means for causing said carriage to travel in one direction along said bar, and hand releasable means for preventing said carriage from traveling in the opposite direction along said bar.

25. In a calculating machine, differential mechanism, carrying mechanism including carrying wheels, a bar parallel to and rotatable about the axis of said carrying wheels and operated by said differential mechanism, a denomination carriage traveling upon said bar to rotate said carrying wheels, means for causing said carriage to travel in one direction along said bar, and resetting mechanism for causing said carriage to travel in the opposite direction along said bar.

26. In a calculating machine, computing wheels, independently rotatable about a common axis, and actuating means therefor, said actuating means including a denomination carriage adapted to travel in a direction parallel to said axis and to rotate in a plane perpendicular thereto for operating said carrying wheels, and a set of tracks operative upon said carriage to cause travel thereof when the same is rotated.

27. In a calculating machine, computing wheels, independently rotatable about a common axis, and actuating means therefor, said actuating means including a denomination carriage adapted to travel in a direction parallel to said axis and to rotate in a plane perpendicular thereto for operating said carrying wheels, a set of stationary tracks and means on said carriage adapted to cooperate with said tracks for causing the travel of said carriage.

28. In a calculating machine, computing wheels, actuating mechanism therefor including keys and a key actuated carriage having a rotary movement for rotating the computing wheel and a cross travel perpendicular thereto, a tracker member adapted to be engaged by said carriage to cause said

cross travel, and means controlled by the keys for controlling the coaction of said tracker member and carriage.

29. In a calculating machine, computing wheels, actuating mechanism therefor including keys and a key actuated carriage having a rotary movement for rotating the computing wheel and a cross travel perpendicular thereto, a tracker member adapted to be engaged by said carriage to cause said cross travel, and a stop bar controlled by said keys for rendering said tracker member ineffective.

30. In a multiplying machine, computing wheels, actuating mechanism therefor, including two sets of keys and a key actuated carriage having a rotary movement for rotating the computing wheels and a cross travel perpendicular thereto, a tracker member adapted to be engaged by said carriage to cause said cross travel, and means controlled by one of said sets of keys for rendering said tracker member ineffective.

31. A calculating machine adapted to multiply and comprising totalizing mechanism and differential mechanism for actuating the same, said differential mechanism having a units set of keys and a tens set of keys, each tens key being a companion to the corresponding units key, a given tens key being adapted to set up the digit having the higher ordinal value in the product of two factor digits, and the companion units key being adapted to set up the digit having the lower ordinal value in the said product, and means whereby the relation of parts of the differential mechanism may be altered with reference to each other in correspondence with one of said factor digits, in consequence whereof the said units keys and tens keys are sufficient for setting up the product resulting from the multiplication of any digit by any digit.

32. A multiplying machine comprising a totalizer and differential mechanism for actuating the same, said differential mechanism including a primary and a secondary differential member for each of the digits 2, 3, 4, 5, 6, 7, 8 and 9, and only a primary differential member for each of the digits 0, and 1, a figure key for each differential member; and means for moving the keys relatively to their differential members, said differential members being adapted to produce different amounts of movement of the totalizer depending upon the point at which said differential members are actuated by the keys.

33. In combination, a totalizer, a primary and a secondary set of figure keys, differential members one for each of said keys, said differential members having a plurality of points of actuation for producing different amounts of motion in the totalizer, means for shifting said keys relatively to the differential members to actuate them at any one of their points of actuation, and means for transmitting the movement of the differential members to the totalizer.

34. In combination, a totalizer, a primary and a secondary set of figure keys, differential members one for each of said keys, said differential members having a plurality of points of actuation for producing different amounts of motion in the totalizer, a key board wherein said keys are mounted, said key board being movable to move the keys simultaneously and relatively to the differential member for causing the keys to actuate the differential members at any one of the different points of actuation thereon, a shiftable denomination carriage for transmitting movement from the differential members to the totalizer, and means operative by the primary keys for causing the travel of the denomination carriage.

35. In combination, a totalizer including wheels having figures thereon, a traveling denomination carriage adapted to operate said totalizer in the different denominations thereof, differential members adapted to move said denomination carriage to rotate the totalizer wheels various amounts, a primary and a secondary set of figure keys, each key being operative upon one of said differential members to produce rotation of said wheels, and means operable only by the primary keys for causing the travel of said carriage.

36. In combination, a totalizer including wheels having figures thereon, a traveling denomination carriage adapted to operate said totalizer in the different denominations thereof, differential members adapted to move said denomination carriage to rotate the totalizer wheels various amounts, a primary set of the figure keys, a secondary set of eight figure keys, said keys being adapted to operate said differential members, and there being a differential member for each of said keys, and means operated by the primary keys and non operable by the secondary keys for causing the travel of said carriage.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

JOHN BRICKEN.

Witnesses:
DWIGHT B. CHEEVER,
C. J. CHRISTOFFEL.