P. L. SOBEL.

CALCULATING MACHINE.

APPLICATION FILED APR. 1, 1916.

1,264,701.

Patented Apr. 30, 1918.

6 SHEETS—SHEET 1.

Fig. 1.

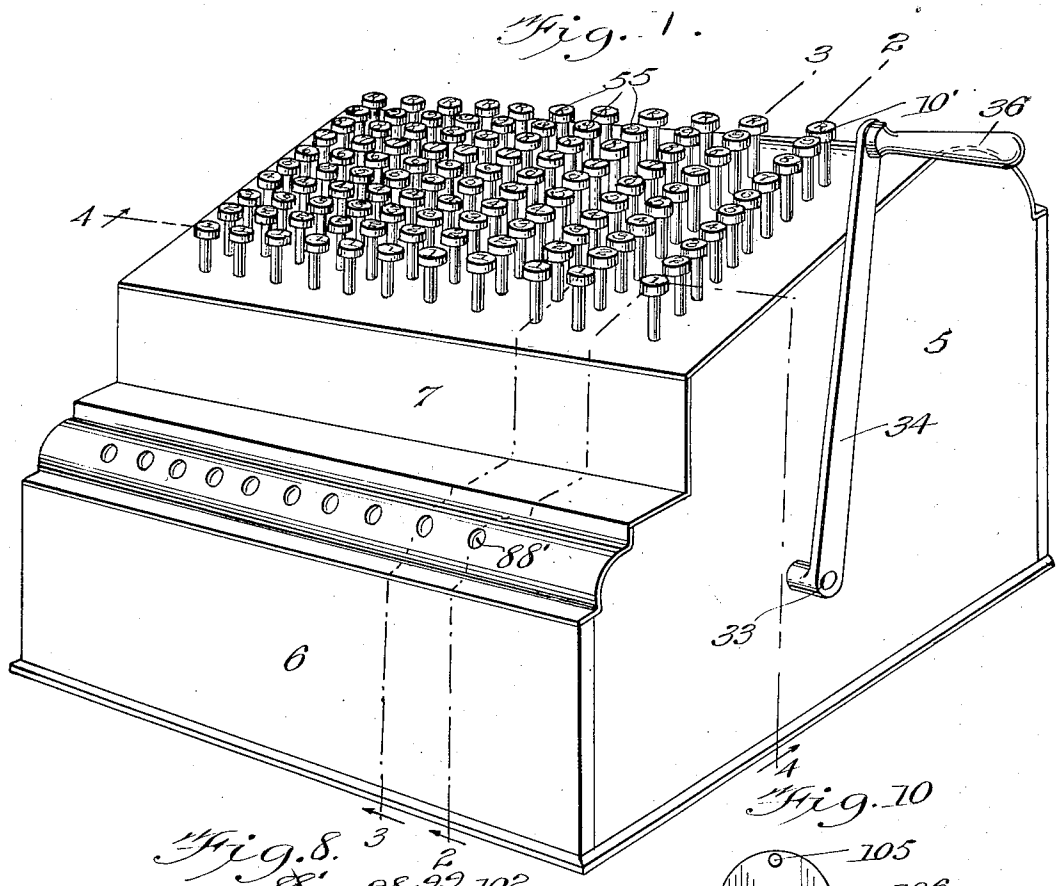


Fig. 8.

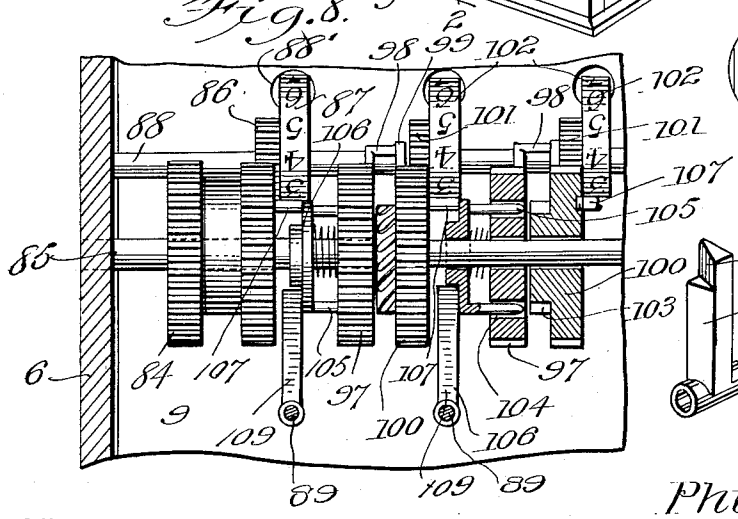


Fig. 10

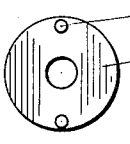
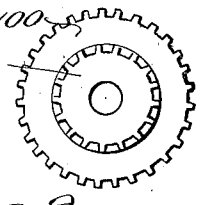


Fig. 11



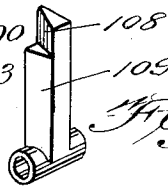


Fig. 9

Witnesses

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A. F. [illegible]

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6 SHEETS—SHEET 2.

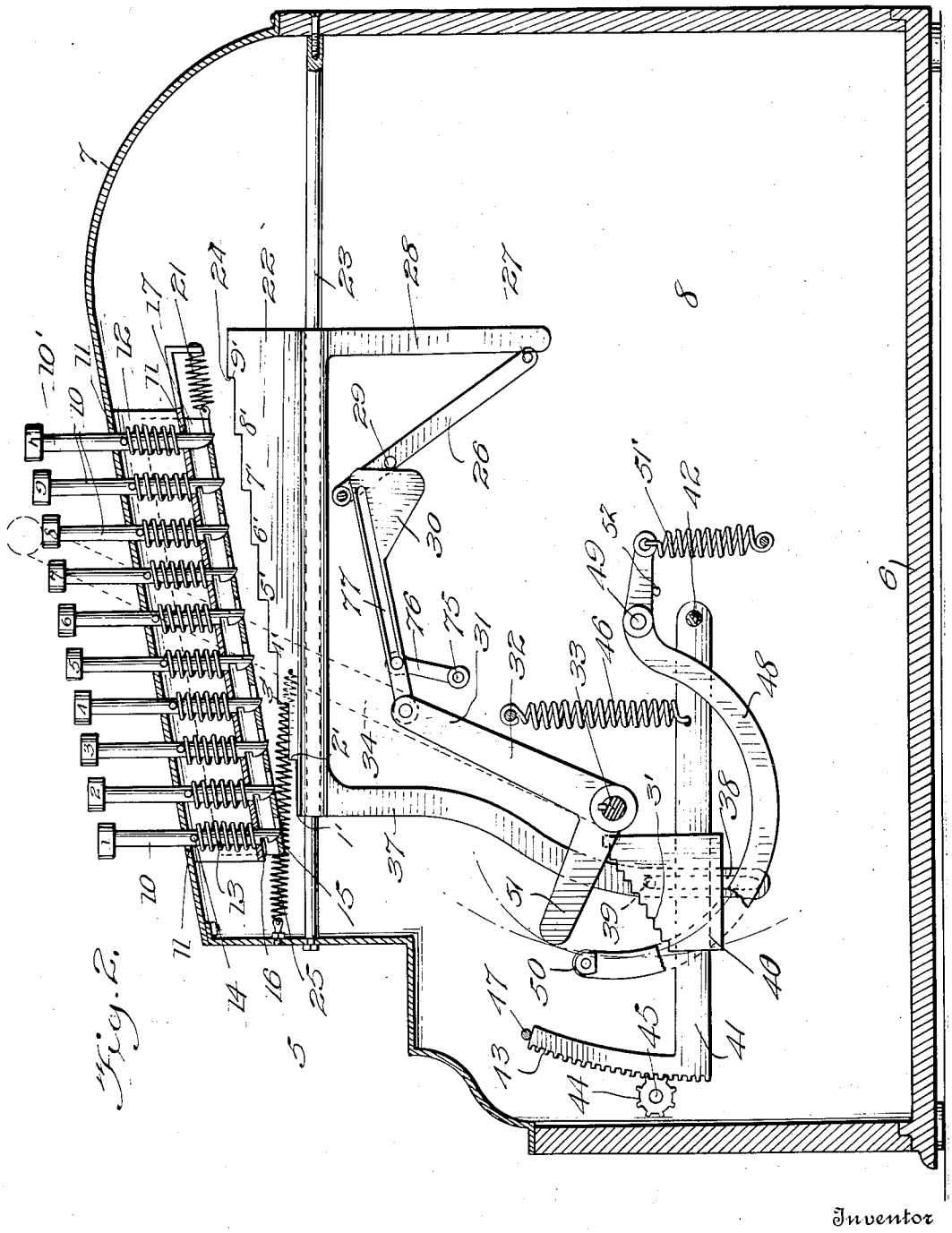


Fig. 2.

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6 SHEETS—SHEET 3.

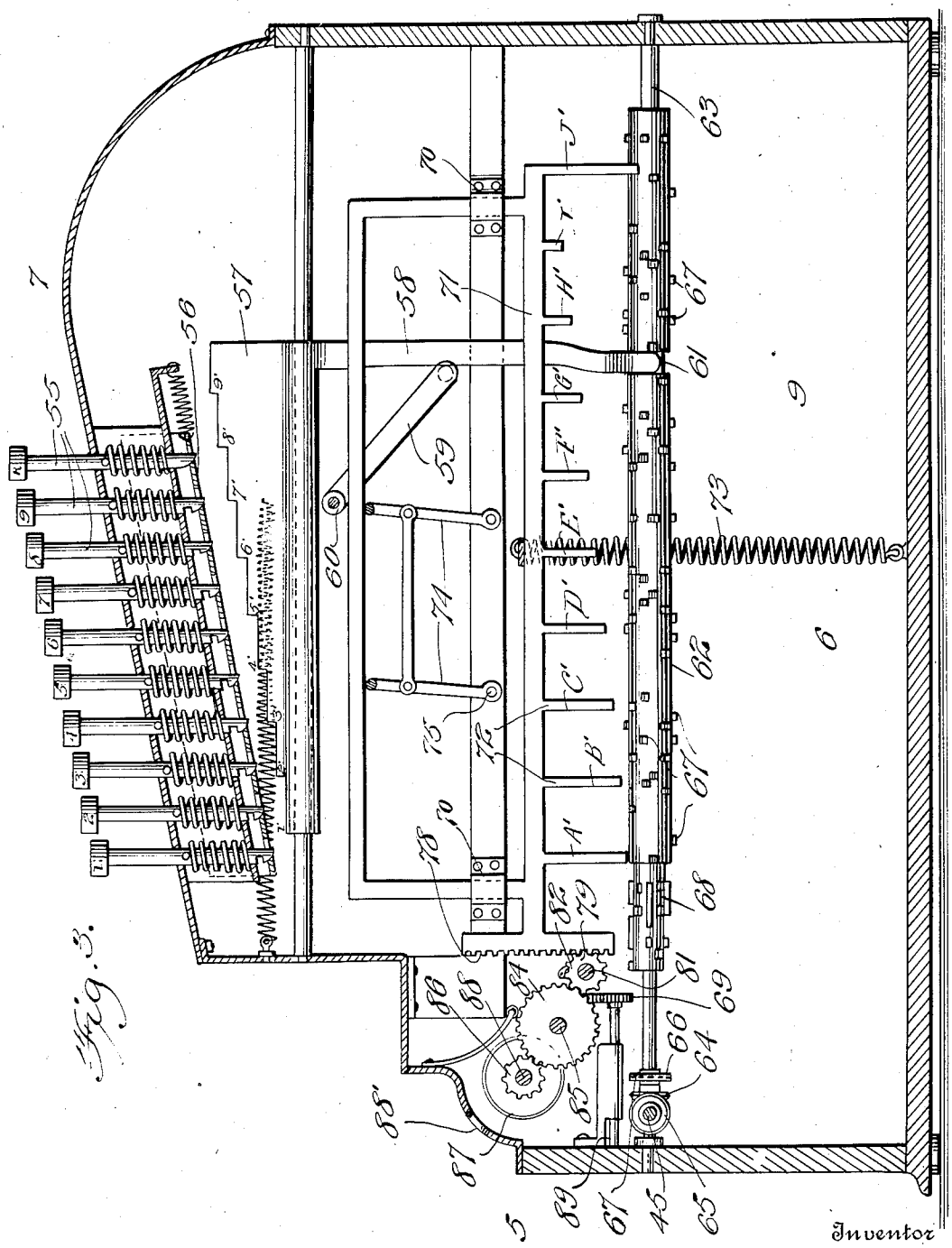


Fig. 3.

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6 SHEETS—SHEET 4.

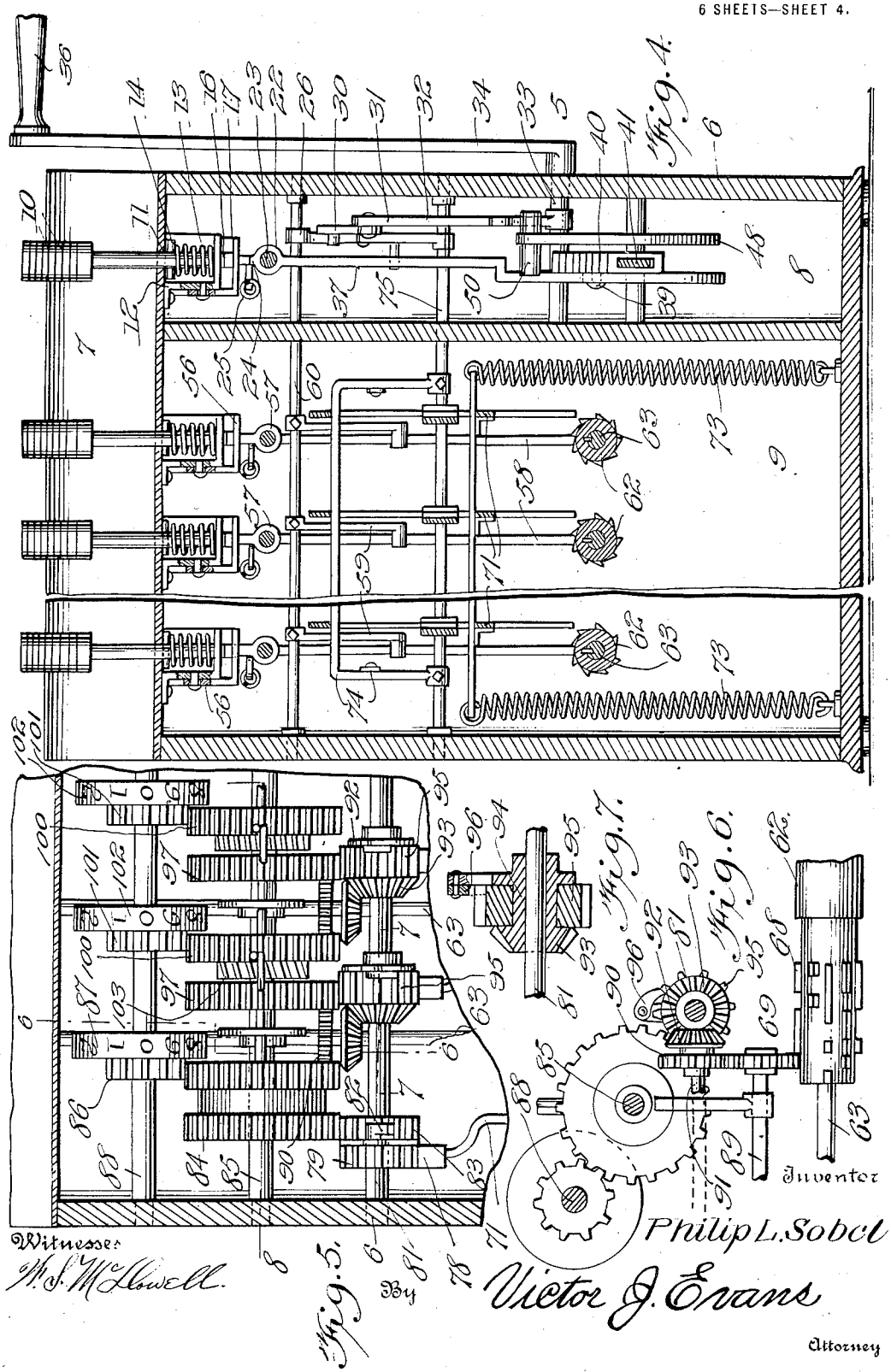


Fig. 4.

Fig. 5.

Fig. 7.

Fig. 6.

Witnesses:

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CALCULATING MACHINE.

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6 SHEETS—SHEET 5.

Fig. 12.

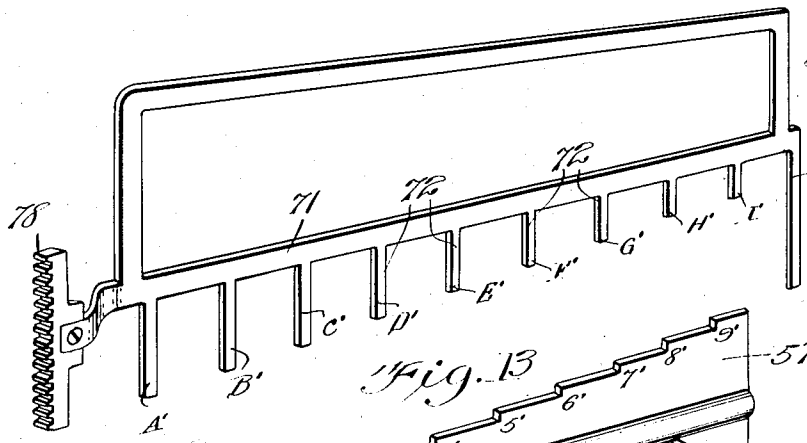


Fig. 13.

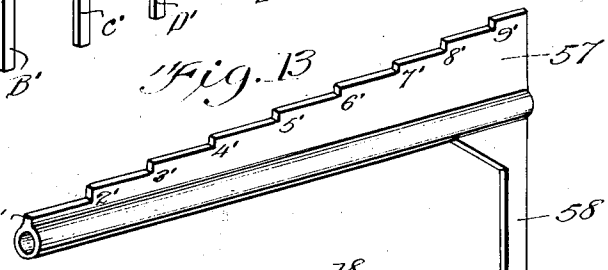


Fig. 14.

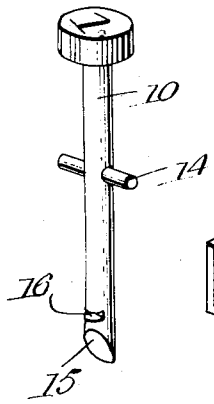


Fig. 15.

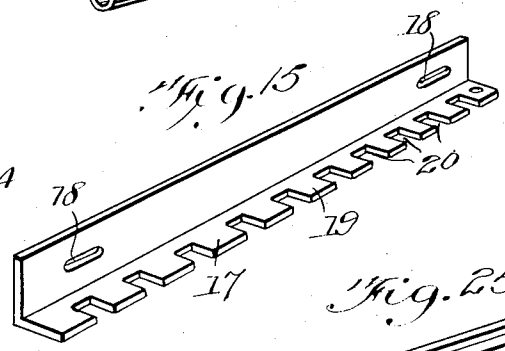


Fig. 17.

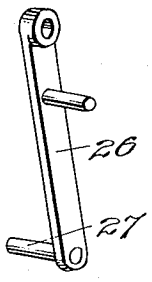


Fig. 25.



Fig. 16.

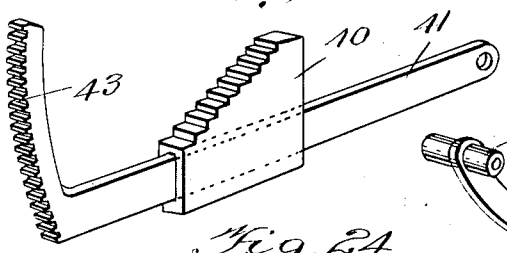


Fig. 24.

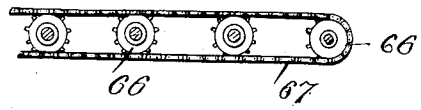
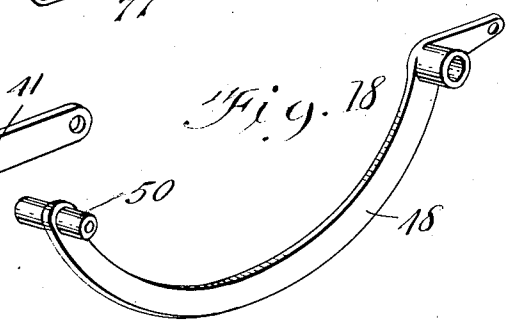


Fig. 18.



Witnesses

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CALCULATING MACHINE.

APPLICATION FILED APR. 1, 1916.

1,264,701.

Patented Apr. 30, 1918.

6 SHEETS—SHEET 6.

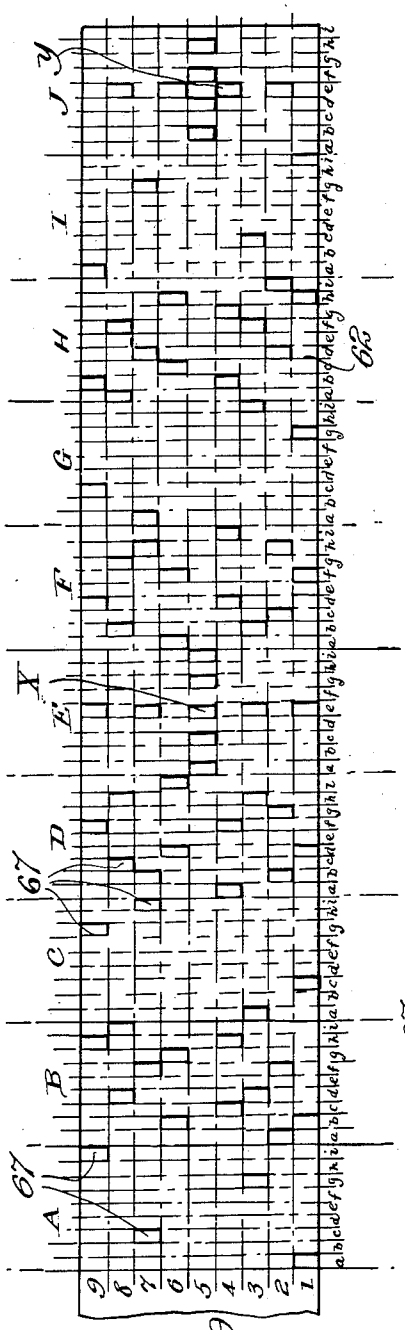


Fig. 19.

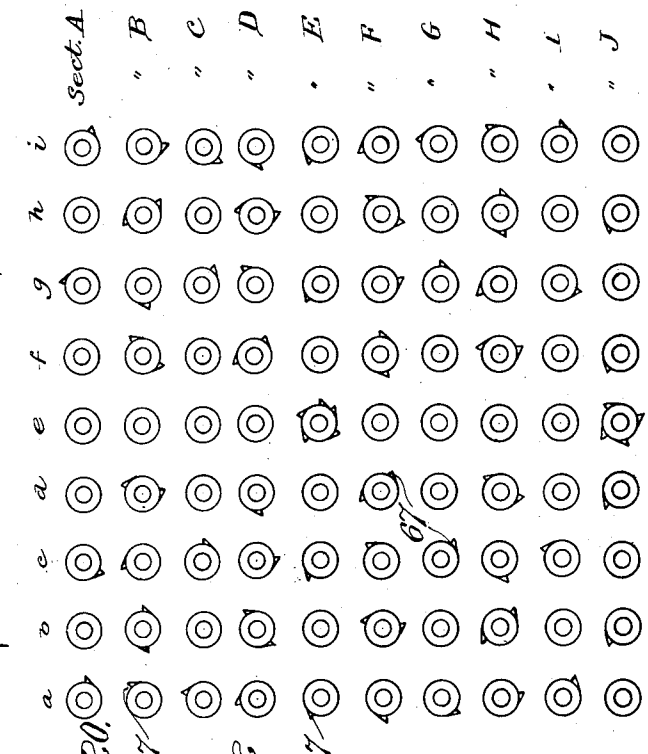


Fig. 20.

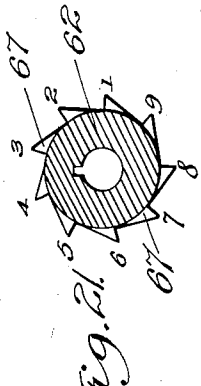


Fig. 21.

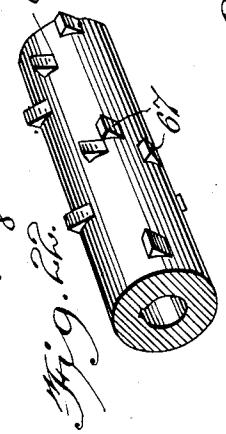


Fig. 22.

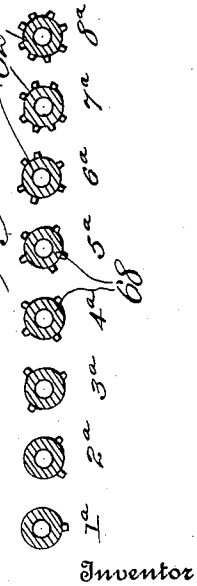


Fig. 23.

Witnesses

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UNITED STATES PATENT OFFICE.

PHILIP L. SOBEL, OF PHILADELPHIA, PENNSYLVANIA.

CALCULATING-MACHINE.

1,264,701. Specification of Letters Patent. Patented Apr. 30, 1918.

Application filed April 1, 1916. Serial No. 88,281.

To all whom it may concern:

Be it known that I, PHILIP L. SOBEL, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented new and useful Improvements in Calculating-Machines, of which the following is a specification.

This invention relates to calculating machines, and has for its object to provide a machine for automatically registering numbers or figures.

Another object of the invention is to provide a machine for automatically performing multiplication and other arithmetical problems.

A further object resides in a machine of the above character wherein the mechanism for performing the various functions assigned to the device, is thrown into operation by a single movement of an operating lever, thus eliminating the necessity of using spring or electrical motors and rendering the machine capable of operation under all conditions.

A still further object is to provide a calculating machine with a plurality of plunger keys, which operate in conjunction with a series of controlling cylinders and coacting finger bars, number recording mechanism being associated with said cylinders and finger bars and adapted for operation upon movement of the latter.

A further object is to construct a calculating machine of mechanism characterized by compact and durable construction and of positive and efficient operating qualities.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction herein described and the scope of the application of which will be indicated in the claims hereunto appended.

In the drawing,

Figure 1 is a perspective view of the calculating machine comprising the present invention,

Fig. 2 is a vertical transverse sectional view taken approximately on the line 2—2 of Fig. 1, illustrating the mechanism of the multiplier selective means,

Fig. 3 is a similar view on the line 3—3 of Fig. 1, disclosing the selective mechanism of the multiplicand,

Fig. 4 is a vertical longitudinal sectional view on the line 4—4 of Fig. 1,

Fig. 5 is a detail horizontal sectional view, illustrating a portion of the number registering mechanism,

Fig. 6 is a detail vertical section taken through the registering mechanism on the line 6—6 of Fig. 5,

Fig. 7 is a detail sectional view on the line 7—7 of Fig. 5,

Fig. 8 is a detail vertical sectional view taken on the line 8—8 of Fig. 5,

Fig. 9 is a perspective view of the shifting lever utilized in the number recording mechanism and forming a part of the "carrying over" device,

Fig. 10 is an elevation of the shifting disks,

Fig. 11 is an elevation of a dial actuating gear,

Fig. 12 is a detail perspective view of a finger bar and the coöperating toothed rack thereon,

Fig. 13 is a similar view of a similar shifting carriage or bar,

Fig. 14 is a perspective view of one of the actuating keys,

Fig. 15 is a similar view of the key locking plate,

Fig. 16 is a detail view of the lever actuating segment, and the stepped operating slide thereon,

Fig. 17 is a detail view of the releasing lever,

Fig. 18 is a detail view of the lever controlling element,

Fig. 19 is a diagrammatic blank view of the toothed cylinder, illustrating the relative positions of the stop lugs or teeth formed thereon,

Fig. 20 represents a plurality of transverse sectional views, taken through one of the toothed cylinders and illustrating, in section, the relative position of the entire number of stop teeth formed thereon,

Fig. 21 is an enlarged transverse section of the toothed cylinders, further disclosing the relative positions of the stop teeth,

Fig. 22 is a fragmentary perspective view of the toothed cylinder,

Fig. 23 illustrates a series of transverse sectional views disclosing the respective positions and construction of the recorder operating gears formed on the toothed cylinders,

Fig. 24 is a detail vertical sectional view of the means for synchronously rotating the tooth cylinders, and Fig. 25 is a detail perspective view of the locking lever controlling link.

Similar characters of reference denote corresponding parts throughout all the views of the drawings.

Referring to the details of construction of the present invention, the numeral 5 indicates a suitable form of casing for inclosing and supporting the actuating mechanism of the device. This casing preferably consists of the relatively solid base 6, and a lighter metallic top 7, the base being provided with supporting buffer members, designed to prevent the casing from marring or scratching a support upon which the machine is positioned. The interior of the casing is preferably divided into compartments 8 and 9 for the reception of, what will be termed for purposes of description, a selective multiplier and multiplicand mechanism, respectively.

The multiplier mechanism in its preferred form consists of a plurality of spring pressed plunger keys 10, consisting of nine keys each of which being plainly marked in numerical succession, by numerals ranging from 1 to 9. A tenth key 10′ is utilized to restore the numeral keys to a normally elevated position, when the latter have been depressed, for a purpose to be presently disclosed. The keys are mounted for vertical movement in alining openings 11 formed in the top 7 and in a supporting bracket 12, secured to and depending from said top, the keys being normally maintained in an elevated position by the action of coiled helical springs 13, which are confined between the brackets 12 and the stop pins 14, formed with the keys, the springs normally surrounding the keys 10. By this construction the keys will be held elevated and the upward movement thereof will be limited by the engagement of pins 14 with the under surface of the top 7. The lower extremities of the keys, below the bracket 12 are formed with beveled faces 15, and with notches 16, the latter being adapted to coöperate with a sliding angular plate 17 mounted on the bracket 12. The plate 17 is provided with elongated slots 18, for the reception of studs projecting from the bracket 12, the studs being used to support the plate and the slots 18 permit the latter to move longitudinally with respect to the stationary bracket 12. The lower portion 19 of the plate 17 is provided with a series of recesses 20 formed in alinement with the keys 10, and in which are normally positioned beveled extremities 15, of each of the latter. One edge of each recess 20 is normally pressed against the beveled face 15 of each of the keys 10 by the action of a coiled spring 21, the latter being secured to the bracket 12 and to the movable plate 17. By this construction the keys 10 may be locked in a lowered or active position, as when a key is depressed the plate 17 will be moved forwardly by the action of the beveled faces 15, until the key has a notch 16 therein in a position alining with the plate 17. When the key reaches its lowered position the plate 17 will be forced into engagement with the walls of said notch, due to the action of the spring 21, thereby locking the key against possible further movement in either direction.

In order to release the locked key, so that it may assume an elevated position, the key 10′ is merely provided with a beveled face, the notch 16 as formed in the keys 10, having been eliminated so that when the same is depressed the plate 17 will be moved to a position clear of the notch 16 of the lowered key, thereby permitting the latter to regain an elevated position by the action of the coiled spring 13. The object in depressing the keys 10 will be disclosed in the immediate following description.

Positioned in vertical alinement with the keys 10, at a point beneath the same, is a sliding bar 22, which is movably positioned upon the horizontally extending rod 23, secured to and extending transversely of the casing 5. The upper edge of the bar or carriage is formed with angular stop projections 24, which are, in number, equal to the aggregate number of the numeral keys 10 and one of said projections is adapted to engage with the lowered extremity of a particular coöperating key 10 when the latter is depressed. A coiled spring 25 is connected with the sliding bar and with the top 7, the normal tendency of which resides in exerting a tension to hold the bar forwardly into engagement with a depressed key 10. This movement is normally arrested by means of a pivoted locking lever 26 which is formed with a stud 27 adapted to contact with a finger 23 depending from the sliding bar 22.

In order to release the sliding bars, to permit the same to move forwardly, the lever 26 is provided with a lug 29, which normally coöperates with a link 30 pivotally connected with an arm 31 of a bell-crank lever 32, keyed upon a main operating shaft 33. One end of the shaft 33 extends exteriorly of the casing 5 and has rotatably secured thereto a manually operated lever 34, provided with a handle 36 on the outer end thereof. Upon revolving the shaft 33 the bell-crank lever 32 will be oscillated to permit the locking member 26 to gravitate out of engagement with the finger bar 28 of the sliding carriage 22, and will thereby permit the latter to move forwardly until the movement thereof is arrested by a depressed key 10.

A second finger 37 is formed on the sliding bar, at the extremity opposite the finger 28, and said finger or extension protrudes downwardly toward the base 6 and is formed with a slot 38, adjacent its lower extremity, for the reception of a stud 39 secured to a stepped plate 40. The plate 40 is slidably mounted upon a lever 41 pivoted as at 42 upon the casing 5 and located within the compartment 8. This construction permits the plate 40 to be moved laterally in synchronism with the sliding bar 22, but the pivotal movement of said plate will not be transmitted to the bar on account of the formation of the slot 38 in the member 37. The extremity of the lever 41, opposite its pivotal point 42, is formed with a curved rack bar or segment 43 which intermeshes with the pinion 44, secured to a horizontally extending shaft 45, the latter being connected with a recording mechanism, to be presently described. A coiled spring 46 is fastened to the lever 41, and to the casing 5, thus maintaining the lever in a normal elevated position, the upward movement thereof being limited by a stop pin 47. Secured to the casing 5 in juxtaposition to the lever 41, is a pivoted, curvilineal, lever actuating element 48 which is pivoted as at 49 to the casing 5 at one extremity thereof and has the opposite extremity provided with a stud 50. A spring 51 maintains the element 48 in an elevated position and its upper movement is curtailed by a stop pin 52.

Summarizing the operation of the above described parts, that is the mechanism positioned with the compartment 8, a key indicating the number of the multiplier is depressed, bringing the lower end of the same into the path of the stop projections formed on the sliding bar 22, the key being held in a lowered position by the locking action of the plate 17. The manually operated lever 34 is then oscillated to revolve the shaft 33 and its coöperating bell-crank lever 32, in order that the bar 22 may be released from its relatively retarded position accomplished by the lever 26. This operation is performed by a slight movement of the main lever 34. If the key 10 indicating a multiplier 3 has been depressed, the bar 22 will move forwardly a predetermined distance until the stop projection indicated by the numeral 3′, contacts with the multiplier key 3. This forward movement of the lever 22 results in moving the plate 40 a corresponding lateral distance upon the lever 41. It might be well to state at this point, that the limited movement of the bar 22 upon the rod 23 is varied in accordance with which of the multiplier keys have been depressed. As will be observed, this movement gradually increases in direct ratio with the numerical order of the keys 10, that is, if the key 10 bearing a multiplier numeral 1 is depressed, the movement of the bar 22 is relatively short as the stop projection 1′ is but slightly spaced from the key 1, when the latter is lowered. However, when the key 9 is depressed, the movement of the bar 22 reaches its maximum length, due to the distance between said key and the projection 9′ of the sliding bar. In other words the movement of the bar 22 increases by steps from the key 1 to the key 9 for a purpose to be presently set forth.

The regulated movement of the sliding bar 22, as stated above, is directly transmitted to the stepped plate 40, which is also moved a regulated distance toward a stud 50 of the element 48. The continued forward movement of the lever 34 results in the arm 51 of the bell-crank lever 32 in striking the stud 50 and pressing the latter into one of the shoulders 3′ of the plate 40. The shoulder engaged by the stud is regulated in accordance with the multiplier key depressed, in this instance, the key 3. However, if the key 9 has been depressed the stud will engage with the shoulder 9^a of the plate 40, due to the fact that the bar will move a greater distance when the key 9 is actuated than it will when the key 3 has been lowered.

When the shoulder 9^a of the plate 40 is in position for coöperation with the stud 50 the arms 51 of the bell-crank lever 32 will force the lever 41 downwardly through the agency of the stepped plate 40, and the interposed stud 50. The downward movement of the lever 40 is controlled by the relative positions of the stepped plate 40 thereon, as it is evident, that if the shoulder 9^a is coöperating with the stud 50, the downward movement of the lever 40 will exceed the downward movement of the latter when said stud is contacting with the shoulder 3^a. When the plate 40 is in its normal position the rotation of the operating lever 34 will have no effect upon the lever 41 as the arm 51 of the bell-crank lever 32 is out of the path of the stud 50 when the latter reaches a lowered position, this being due to the difference in radii of the arcs upon which the arm 51 and the lever 48 revolve about. The varied lowered positions of the lever 41 are obtained in order that the rack bar will revolve the pinion 44 in various degrees of a complete revolution. Briefly stated, by depressing any one of the keys 10, and upon actuating the lever 34, the pinion 44 may be rotated in a regulated manner from one ninth of a complete revolution to any other ninth up to a complete revolution, all of which being accomplished in accordance with the key depressed. The controlled and regulated rotation of the pinion 44 is the object of the mechanism located in the compartment 8, as the pinion 44 rotates the shaft 45 which forms a salient feature of the recording mechanism to be hereinafter described.

The compartment 9 has a mechanism com-

prising the multiplicand structure located therein and the latter consists principally of a number of parallel rows of numerically differing keys 55, the latter being similar in every respect to the keys 10, and therefore, a detailed description of their construction will be omitted. The lowered extremities of the keys 55 are beveled, as are the keys 10, and are also formed with locking notches to coöperate with sliding plates 56, designed to perform exactly the same functions as the plate 17. The sliding bars or carriages 57 are vertically positioned beneath the keys 55 and correspond in general construction and operation to the sliding bar 22. The carriages 57 are provided with depending arms 58, which extend downwardly and engage with a crank arm 59 of a retarding element 60, the latter being keyed to the same shaft as the lever 26, so that when the lever rotates, to release the sliding bar 22 of the multiplier mechanism, the sliding bars 57 of the multiplicand structure will be released simultaneously therewith.

The lower extremities of the arms 58 are formed with yoke members, which are adapted to engage within angular grooves 61 formed in toothed cylinders 62, the latter being keyed to horizontally extending shafts 63. The cylinders are free to move laterally upon the shafts 63 in synchronism with the bars 57, by means of the connecting arms 58, the rotation of the shafts 63 will revolve the cylinders 62 in unison therewith but the rotary movement of said cylinders will not be transmitted to the arms 57. The shafts 63 are revolved by means of a beveled gear 64 secured to one extremity thereof, the latter meshing with a similar gear 65 mounted on the shaft 45. It is evident that the regulated movement of the pinion 44 will revolve the cylinders 62 in precise synchronism therewith, as the gears 64 and 65 and the pinion 44 are exactly the same in dimension. Sprocket wheels 66 are keyed to the shaft 63 and chains 67 are trained thereover, in order that the shafts 63 may revolve simultaneously in uniform relation.

One of the most important features of the invention resides in the construction and method of operation of the toothed cylinders 62. In Figs. 21, 22, 23, and 24 of the drawings, the details of construction of the cylinders have been clearly illustrated, and it will be noted, upon an examination of these figures, that the cylinders have been divided longitudinally into ten imaginary sections, which have been designated by the characters A, B, C, D, E, F, G, H, I, and J. Each section is further divided, longitudinally, into nine sub divisions, also suitably designated by the characters *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, and *i*, and in cross section the cylinder is further divided into nine circumferential sections 1, 2, 3, 4, 5, 6, 7, 8, and 9. Formed at predetermined points upon the cylinders 62 and occupying the sub divisions above mentioned, are teeth or stop lugs 67 which protrude outwardly from the surfaces of said cylinders. The lugs are in width equal to the width of a particular sub division *a*, *b*, *c*, etc., and in circumference equal to the length of any one of the sections 1, 2, 3, etc., as will be apparent upon an examination of the views of the drawings. The object in placing the stop lugs 67 upon certain portions of the cylinders 62 will appear as the description proceeds.

The forward ends of the cylinders 62 are provided with a series of gear elements 68, particularly illustrated in Figs. 6 and 23 of the drawings, in the latter figure it will be noted that the teeth form separate or independent gear members 1^a, 2^a, 3^a, 4^a, 5^a, 6^a, 7^a, and 8^a, each gear being provided with a different number of teeth ranging from one to nine, the above gears being adapted to mesh with gears 69 on the recording mechanism. Mounted for vertical movement in guide brackets 70 secured to the casing 5, are sliding finger bars 71, and the latter being provided with a plurality of depending finger members 72, which are designated by the characters A′, B′, C′, D′, E′, F′, G′, H′, I′, and J′. It will be noted that the fingers gradually decrease in length from the finger A′ to the finger J′, and said fingers are arranged and designed to coöperate with the stop lugs or teeth 67 of the cylinders 62 in a manner to be set forth. The finger A′ coöperates with the teeth 67 of the section A, and the finger B′ with the teeth of the section B, and so on.

Secured to the bars 71 and to the base 6 are springs 73 which exert sufficient tension upon the bars 71 to force the fingers 72 thereof toward the stop teeth 67. The bars are maintained normally elevated through the agency of pivoted elevating links 74, keyed to a horizontal shaft 75, the latter extending into the compartment 8 and is provided at this point with a keyed crank arm 76, coöperating with the slot 77 formed in the link member 30. Also, formed on the finger bars 71 are rack teeth 78 which control the rotation of other recording gears 79 on the number registering mechanism.

In the form of registering mechanism illustrated in the drawings, which is a preferred form at the present time, there is provided a main shaft 81, upon which is mounted for rotation the gears 79 above mentioned. This gear, as stated before, is operated by the rack teeth 78 on the finger bars 71, positioned immediately adjacent the compartment 8 and it will be evident that the lowering of the rack 78 will cause the rotation of the gear 79. Rigidly secured to the gear 79 is a pivoted pawl 82 which is designed

to engage with a gear 83, rotatable about the shaft 81, in order that the gear 83 will be revolved upon the movement of the gears 79 in one direction, a reverse movement of the latter gear permits the gear 83 to remain idle, due to the formation of the pawl 82. Intermeshing with the gear 83 is a compound gear 84, loosely mounted on a second shaft 85, the latter gear meshing with a cog 86 secured to the numeral dial 87 of the unit recording column of the registering apparatus, said gear or cog being mounted on a dial supporting shaft 88. The cog 86 is of exactly the same size as the gears 79 and 83, so that an equal movement will be imparted to said numeral dial upon the rotation of the gears 79. It will now be obvious that the lowering of the rack teeth of the finger bar adjacent the compartment 8, will revolve the numeral dial 87 in direct proportion to the descent of said rack teeth, thereby regulating the numeral on the dial 87 which will appear at the sight opening 88′ therefore, this mechanism being utilized only in the unit column of the registering mechanism.

The remaining dials of the registering mechanism, that is to say, those above and including the tens recording dials, are operated by three different methods, firstly, by the gears 68 of the cylinders 62, secondly, by the rack teeth 78 of the finger bar 71, and thirdly, by an automatic carry over mechanism. The first operation of the latter dials are performed by the meshing of the gear 68 with the cog gears 69, loosely journaled on stud shafts 89 extending from the casing 5. The gears 69 intermesh with similar gears 90, secured to countershafts 91, so that the latter will revolve in unison with the gears 69. The shafts 91 have secured thereto beveled gears 92 which engage with like gears 93 loosely journaled on a shaft 81. The gears 93 are provided with extended hubs 94, about which are loosely journaled cog gears 95 and the hubs 94 have pivotally secured thereto pawl members 96, which are adapted to engage with the teeth of the gears 95 when the hubs 94 are rotated in one direction, a reverse movement of the gears 93 will permit the gears 95 to remain idle.

Meshing with the gears 95 are cogs 97, the latter being loosely mounted on the shaft 85 and are formed with arms 98 which engage with pins 99 on gears 100, the latter also being loosely mounted to rotate about the shafts 85. The arms 98 are formed on the gears 97 in order that the same will be driven in a single specified direction. The gears 100, when rotated, drive gears 101 rotatably mounted on the dial shaft 88, the gears 101 being secured to the remaining registering dials 102 of the said shaft 88. It will be noted that, in operation, the cylinders 62 are moved forwardly to permit one of the gears 68 thereof to mesh with the gear 69 of the registering mechanism. When one or more of the cylinders 62 are revolved, by previously described mechanism, the gears 95 will be rotated thereby operating recording dials 102 in direct proportion to the rotary movement of the cylinders 62.

The gears 95 are also operated by the rack teeth 78 on the finger bars 71, when the multiplicand of a problem contains two or more units. Fig. 8 of the drawings has disclosed one method of transferring a number, which exceeds the number or numbers that can be registered on a single dial, over to an adjacent dial in order that the product may be correctly given or read. For instance, for automatically registering the number 10 when only the dial 87 has been operated, as the latter dial can only record a number under 10. This mechanism, in its preferred form, consists of a gear 103 connected with the compound gears upon the shaft 85 and will be noted that the teeth of the gears 103 are angularly cut or formed. The compound gears are provided with alining openings 104 to receive projecting pin members 105 on shifting disks 106. The compound gears are formed with projecting lugs 107 which are adapted to contact with beveled faces 108, provided on rocking levers 109, mounted for rocking movement upon the stud shafts 89. It will be noted, that when the compound gears make a complete revolution the projections 107 thereon will contact once with the beveled faces 108 of the rocking levers 109 and partially rotate the latter about its axis 89. This movement on part of the lever 109 will force the shifting disks 106 and their coöperating pin members 104 into the angular grooves of the gears 103. This action results in rotating the numeral dials, controlled by the compound gears, one tenth of the complete revolution and thereby automatically registering a number containing two or more units, by carrying over the said number to a coöperating numeral dial which will necessarily have to be operated to properly register the number. After having described the mechanism comprising the operating parts of the present invention, a brief description covering the actual method of operating the machine will be given to facilitate a clear understanding relative thereto. If it is desired to multiply the number 69 by multiplier of 5, the product may be obtained by depressing keys 6 and 9 of the multiplicand, keys 55 in the tens and units column, respectively thereof, and then by lowering the key 5 of the multiplier key 10. The above keys will be retained in a lowered position by the locking action of the plates 17 and 56. The next step, in operation, is to oscillate the manually controlled lever 34, which will rotate the shaft 33 and the bell-crank lever 32,

thereby operating or releasing the retarding elements 26 and 60, thereby permitting the sliding bars or carriages 22 and 57 to move forwardly, by the influence of the springs controlling their movement. It will be noted that the initial movement of the lever 34 results in moving the stepped plate 40 into a proper position upon the lever 41, the movement thereof being regulated by the depressed key, or the multiplier keys 10. The cylinders 62, controlled by the units and tens keys of the multiplicand, also move forwardly in conjunction with the stepped plate 40, to permit the gears 68 to mesh with the recording gears 69. The gears 68, in this instance, formed on the cylinder of the units column, will be the gear 8^a and on the tens cylinder the gear 5^a. The forward movement of the cylinders is regulated by the lowered keys 6 and 9 of the multiplicand. The remainder of the cylinders 62 also move forwardly, toward the registering mechanism, in synchronism with the units and tens controlling cylinders above mentioned, but said remaining cylinders move forwardly to such an extent that the gears 68 thereof will not mesh with the gears of the registering mechanism. This is due to the fact that none of the keys 55 controlling their movements have been depressed, so as to arrest their forward movement to inactive positions. The movement of the controlling cylinders and their coöperating stepped plates 57 takes place immediately when the lever 34 is initially operated.

The continued movement of the operating lever results in rocking the toothed segment lever 41 a predetermined distance, regulated by the length of contact or engagement of the stud 50 with the bell crank arm 51. The movement, in this instance, is equal to the distance of five teeth of the rack bar 43, thereby revolving the pinion 44 five ninths of a complete revolution, said cylinder being provided with nine radial teeth. The movement of the pinion 44 revolves the shaft 45, which, in turn, rotates the toothed cylinders 62. As above stated, when the lever 34 is first operated, the units and tens controlling cylinders 62 will assume positions permitting the gears 8^a and 5^a, respectively, to engage with the registering mechanism, so that when the cylinders are revolved by the motion imparted to the shaft 45, said gears 8^a and 5^a will effect the actuation of the registering mechanism. The units dial is operated by the rack teeth on the unit controlling finger bar 71. The cylinders 62 will revolve the tens dial to record the numeral 4, as the gear 8^a, while moving five spaces only brings into action 4 teeth thereon with the registering gears 69 of the registering apparatus, and the hundreds dial to register the number 3, as the gear 5^a, while rotating five ninths of the revolution only brings in action three teeth. The operation above described having moved the gear 69 of the hundreds column three spaces, will indicate in the hundreds registering mechanism the numeral 3, and as the gear 69 of the tens column has moved four spaces, the latter movement will be indicated by the numeral 4 on the tens column; thus showing "3" in the hundreds, "4" in the tens and "0" in the units, or a combined product of 340. Thus it will be apparent that the first operation is to obtain the tens of each problem involved, for instance, when the problem is 9×5 the tens of 9 and 5 is obtained which is 4, likewise the tens of 6×5 will be 3. The succeeding operation discloses how the units are obtained and automatically added to the tens, giving the complete problem. It will be noted that the active cylinders 62 have been moved forwardly and their movement has been controlled by the depressed keys of the multiplicand. The cylinder controlled by the units keys will be positioned for engagement with the finger bars 71 and then direct vertical alinement with the fingers E′ thereof. The finger E′ is in alinement with the sub division E and the remaining fingers are in alinement with the other sub divisions I of each of the various sections A to J of the cylinders. Thus, if the multiplicand key 7 is depressed, the cylinders will move into alinement which positions the sub divisions G of said sections A to J under the fingers of the finger bars 71. Upon revolving the cylinders their gear elements will actuate the number registering apparatus as previously described, and said cylinders, after having been revolved are locked against further rotary movement. The forward movement of the lever 34, will, in next step of operation, actuate the crank arm 76, thus lowering the elevating links 74 and permitting the finger bars 71 to move downwardly. The lowering of the finger bars 71 results in the engagement of the rack 78, of the unit mechanism, with a pinion 79 of the registering device and the rack 78 of the remaining inactive finger bars 71 will contact with the lugs of the stationary inactive cylinders. The movement of the unit controlling finger bars 71 continues until the finger E′ on said bar contacts with the offset lug 67 on the section E, sub division I, whereupon the downward movement thereof is arrested by said lug, (see Fig. 19, lug X).

The downward movement of the finger bar results in actuating the unit dial to record the numeral 5 thereon a movement being imparted by the rack 78 which moves downwardly the distance of five spaces in the unit column, and this is transferred to the total already obtained through the operations of the registering device, above described. The rack on the finger bar 71 of the tens controlling mechanism is prevented from meshing

with the pinion 95 by reason of the elongated finger J′ formed thereon, contacting with the lug Y on sub division I, section J on the tens cylinder, which has been brought into direct alinement with the finger J′ by the rotation of said cylinder five spaces. It will be noted that there are no other lugs on said sub division of any section on said cylinder, that are similarly positioned with the lug *y*, Fig. 19, and therefore no other lugs on said cylinders will act as a stop to any other finger bar. The tens dial has been previously actuated by the gear 8ª of the cylinders 62 so that it will have reached a position indicating 4. The rack 78 of the finger bar 71 of the tens column will be unable to move downwardly as the elongated finger J′, engaging with the cylinder, effectively prevents such action on part thereof. The gears 68 of the tens cylinder rotate the hundreds recording dial until the numeral 3 appears at the sight opening therefor, as previously described, thus the result recorded, in its entirety will read 345, the product of 69 by 5.

After the product has been obtained the return keys 10′ are actuated to permit the mechanism controlled thereby to return to normal position.

It will be understood that the machine can be employed in adding figures by simply using the multiplier 1, successively, with each multiplicand or line of figures.

While the registering mechanism has been shown and described as applied to the front side of the machine, it is evident that by slightly modifying various parts of the device said recording mechanism may be placed rearwardly of the operating keys, as it might prove to be advantageous to place the said mechanism in the latter position.

Having described the invention, what is claimed as new is:—

1. In a calculating machine, the combination with multiplier and multiplicand selective mechanisms, of a plurality of controlling cylinders coöperating with said selective mechanisms, stop lugs formed at intervals upon the surfaces of said cylinders, gears carried by said cylinders and movable in unison therewith, means controlled by said selective mechanisms to actuate said cylinders whereby the stop lugs will be positioned at predetermined points, movable means operable upon the actuation of a manually controlled lever, and having the extent of movement thereof regulated by contacting with said stop lugs, racks carried by said movable means, and a registering mechanism adapted to be operated by the movements of said racks and gears.

2. In a calculating machine, the combination with a plurality of controlling cylinders, stop lugs and gears carried by said cylinders and rotatable in unison therewith, of means for actuating said cylinders to effect predetermined operating positions of said lugs and gears, means coöperating with said gears to register numerical values, and means controlled by said stop lugs to complete the operation of said numeral registering means.

3. In a calculating machine, the combination with a multiplier and multiplicand selective mechanisms, of a plurality of controlling cylinders having stop lugs formed at intervals upon the periphery thereof, a plurality of gears operable to be rotated by the movements of said cylinders, means controlled by said selective mechanisms to actuate said cylinders whereby the gears and stop lugs will be rotated predetermined degrees, a number registering mechanism operable upon the rotation of said gears, and movable means coöperating with said stop lugs to further effect the actuation of said registering mechanism.

4. In a calculating machine, the combination with a plurality of rotatable controlling cylinders, said cylinders being divided into ten longitudinal divisions, said divisions being further divided into nine subdivisions, stop lugs formed at predetermined intervals upon the peripheries of said sub-divisions, of eight gear elements, carried by each of said cylinders, said elements having from one to eight teeth upon each cylinder, of multiplier and multiplicand selective mechanisms, means controlled by said selective mechanisms to adjust the stop lugs and gears carried by said cylinders to predetermined positions, a registering mechanism operable upon the rotation of said gear elements, and movable rack bars having the movement thereof limited by contacting with said stop lugs, said rack bars being operable to further actuate the registering mechanism.

5. In a calculating machine, the combination with a series of rotatably mounted cylinders, of multiplicand and multiplier selective mechanisms coöperating with said cylinders, cylinder operating mechanism operable subsequent to the actuation of the selective mechanisms in order to govern the rotation of said cylinders, a registering mechanism operable upon the rotation of one or more of said cylinders, and rack mechanism having the movement thereof governed by said cylinders to complete the operation of the registering mechanism.

6. In a calculating machine, the combination with numeral selective mechanisms, of a series of controlling cylinders coöperating with said selective mechanism, of cylinder operating means operable subsequent to the actuation of the selective mechanism, stop lugs and graduated gear elements movable with said cylinders, and adapted to be revolved and shifted upon the actuation of the cylinder operating means, a registering

mechanism adapted to be initially actuated by the gear elements, and vertically movable rack bars, adapted to complete the actuation of the registering mechanism and having the downward registering movement thereof regulated by the position of the stop lugs.

7. In a calculating machine, the combination with multiplier and multiplicand selective mechanisms, of a plurality of controlling cylinders coöperating with said selective mechanisms, stop lugs and graduated gear elements formed at intervals upon the surfaces of said cylinders, cylinder operating means releasable after the actuation of the selective mechanisms in order to rotate said cylinders, shifting devices actuated by selective mechanism to laterally position said cylinders with respect to their normal position, a registering mechanism operable upon the rotation of said gear elements, vertically movable finger bars having the movement thereof controlled by the positions of said stop lugs and toothed rack elements carried by said finger bars in order to further effect the actuation of the registering mechanism.

8. In a calculating machine, the combination with a multiplier selective mechanism, comprising resilient numeral indicater keys, locking means for retaining said keys in lowered positions, a slidable stepped bar adapted to have the movement thereof arrested by engaging with a depresed key, each of said keys permitting said bar to slide at different distance, a notched plate movable in unison with said sliding bar, an oscillating tooth segment operable with said plate, a lever adapted to contact with the plate in order to depress the same, whereby various degrees of movement will be imparted to the segment, a shaft carried pinion meshing with said segment, whereby the movement of the latter will be transmitted in a regulated manner to a shaft keyed to said pinion, means for imparting synchronous motion from said shaft to a plurality of cylinder-carrying shafts, controlling cylinders rotatable with said latter shafts, stop lugs and graduated gear elements formed at intervals upon the surfaces of said cylinders, whereby the actuation of the multiplier mechanism will effect different operative positions of said lugs and gear elements, a number registering mechanism adapted to be initially operated by engaging with one of said gear elements of each cylinder, a multiplicand selective mechanism, including vertically movable finger bars adapted to have the lowering movement thereof arrested at predetermined points by contacting with said stop lugs, and rack bars movable with said finger bars and operable to complete the actuation of the registering mechanism.

9. In a calculating machine, the combination with a plurality of controlling cylinders, stop projections and gear elements carried by said cylinders and rotatable in unison therewith, of means for actuating said cylinders to effect different operating positions of said projections and gears, a registering mechanism vertically movable, means coöperating with the projections of the cylinder to actuate said registering mechanism, and rack mechanism operable after the rotation of said gears to complete the actuation of the registering mechanism.

10. In a calculating machine, comprising, in combination, a plurality of rotatable controlling cylinders, stop lugs projecting at intervals from the surfaces of said cylinders, multiplicand and multiplier selective mechanisms, a product registering mechanism cooperating with the selective mechanisms, releasing means forming a part of the selective mechanisms to move one or more of said cylinders to predetermined longitudinal points, whereby certain of said lugs forming gear elements will move from inoperative to operative positions, a registering mechanism adapted to mesh with said gear elements when the latter are in an operative position, means adapted upon the actuation of the multiplier selective mechanism to revolve said cylinders predetermined degrees from their normal positions, in order to effect the operation of the registering mechanism and to adjust the positions of said stop lugs, finger bars operable subsequent to the actuation of the multiplicand selective mechanism and adapted to engage with certain of the stop lugs, whereby the lowering movement of the finger bars will be arrested, and rack elements movable in uinson with the finger bars and adapted to further actuate the registering mechanism, and the rotation of said cylinders being limited to not more than a complete revolution.

In testimony whereof I affix my signature.

PHILIP L. SOBEL.