J. GRABER.

CALCULATING MACHINE.

APPLICATION FILED JUNE 30, 1910.

972,360.

Patented Oct. 11, 1910.

5 SHEETS—SHEET 1.

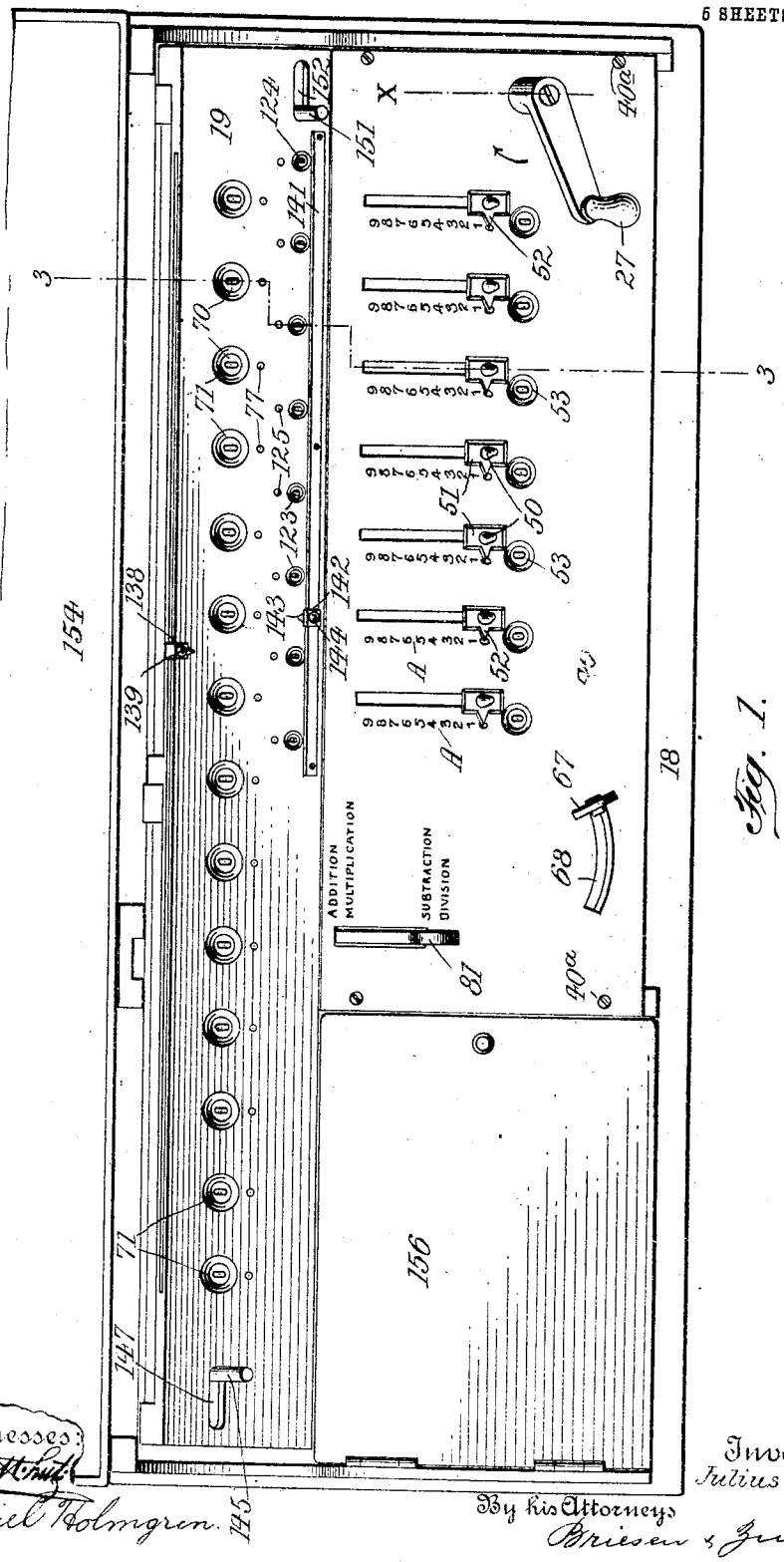

Fig. 1.

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Daniel Holmgren.

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By his Attorneys
Briesen & Knupp.

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5 SHEETS—SHEET 2.

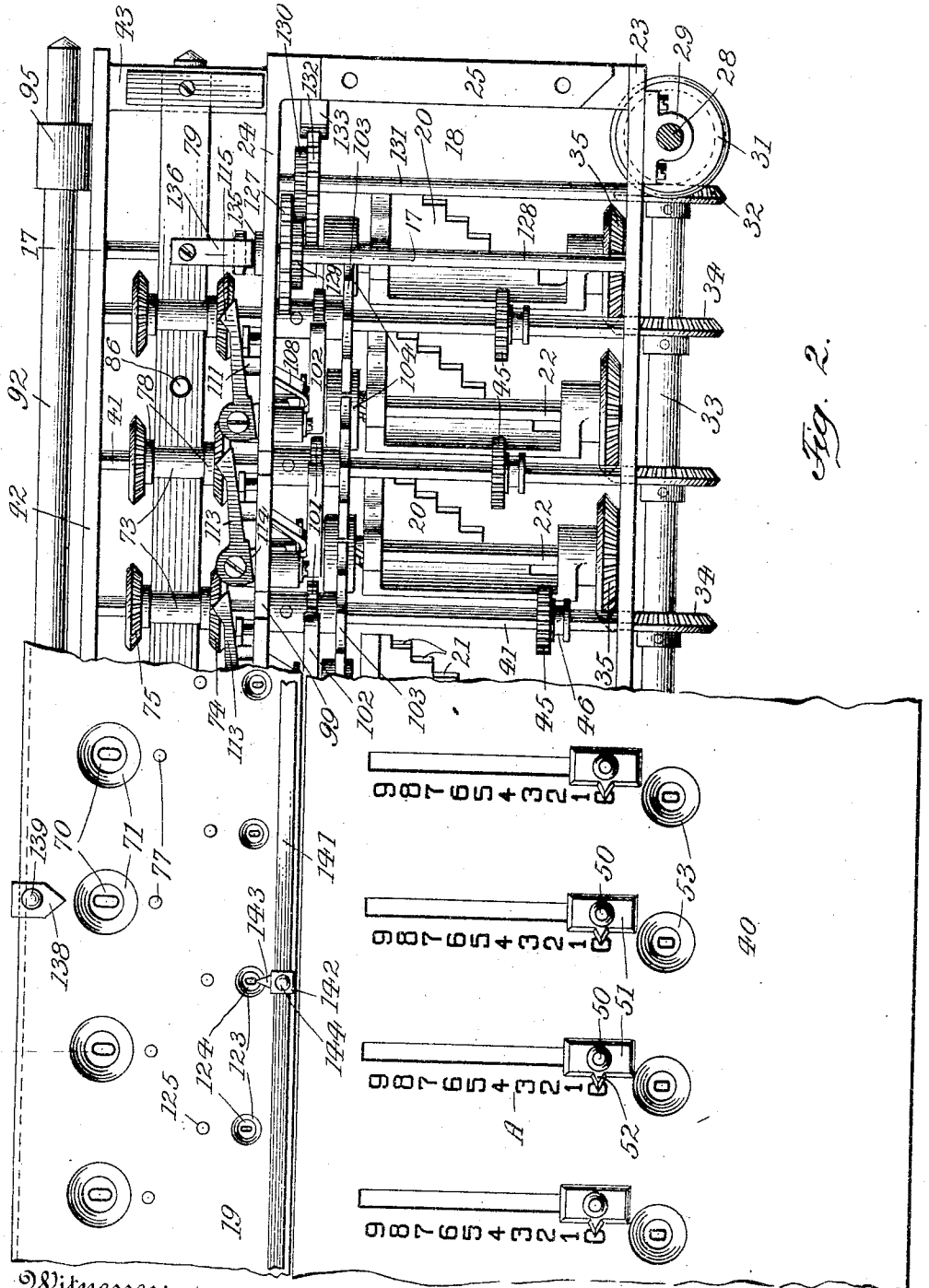

Fig. 2.

Witnesses:
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5 SHEETS—SHEET 3.

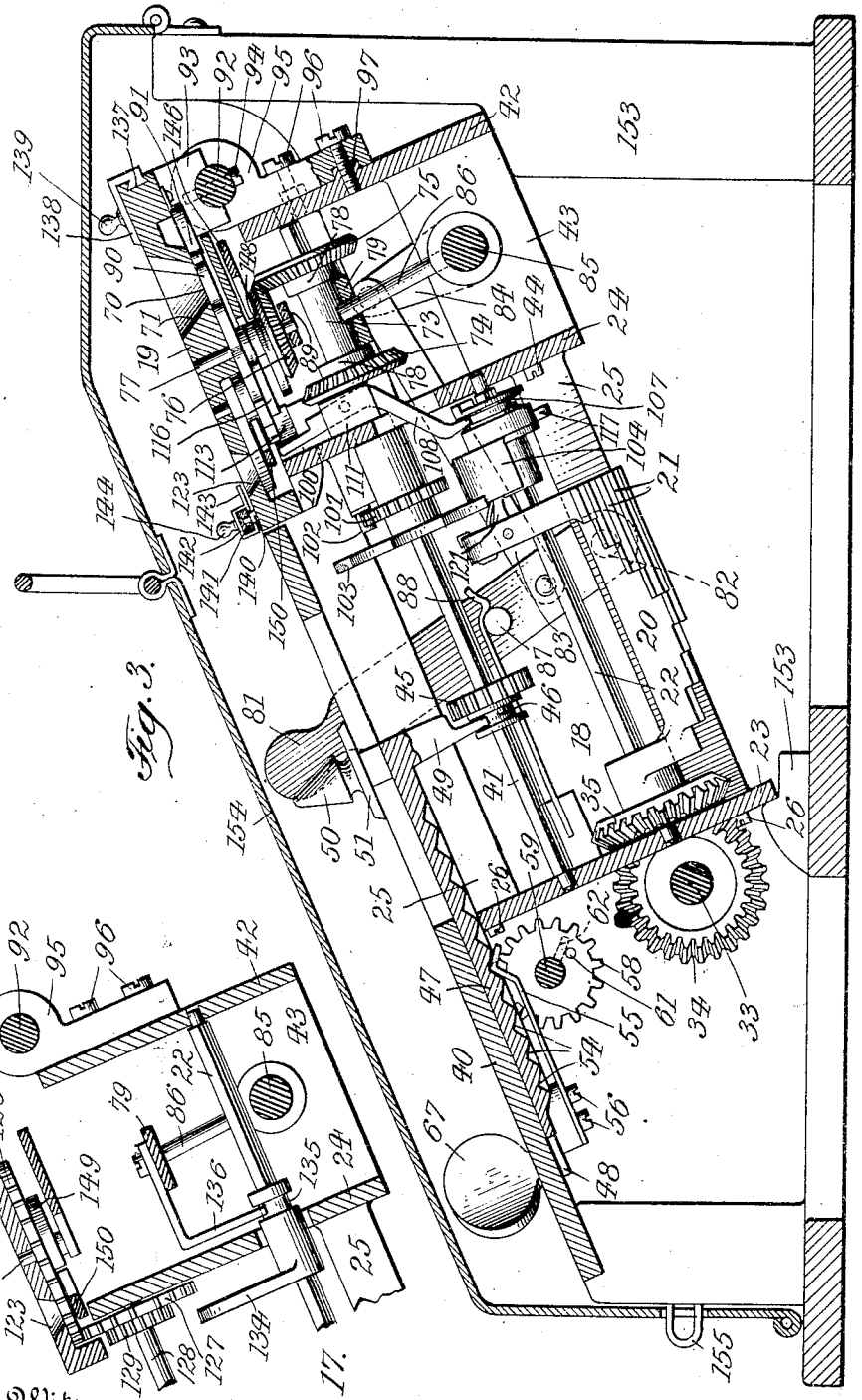

Fig. 3.

Fig. 17.

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5 SHEETS—SHEET 4.

Fig. 4.

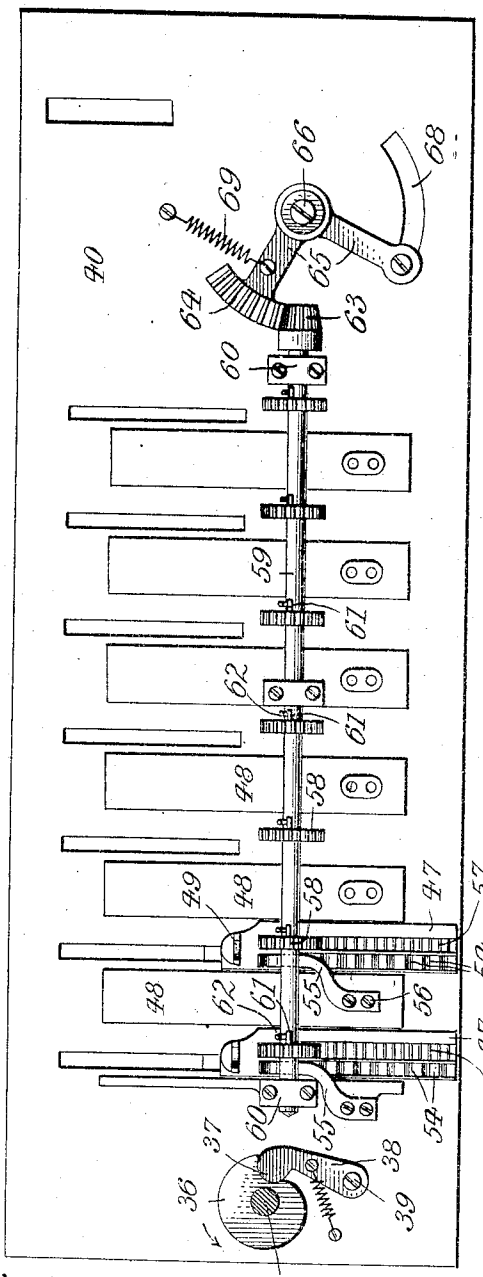


Fig. 8.

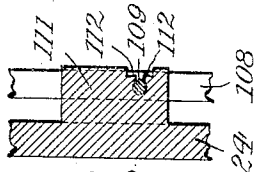


Fig. 7.

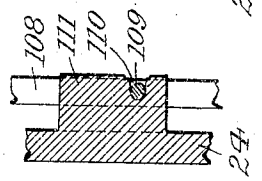


Fig. 6.

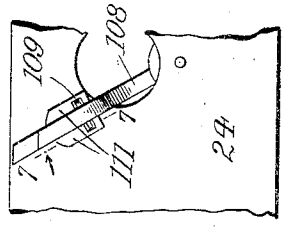
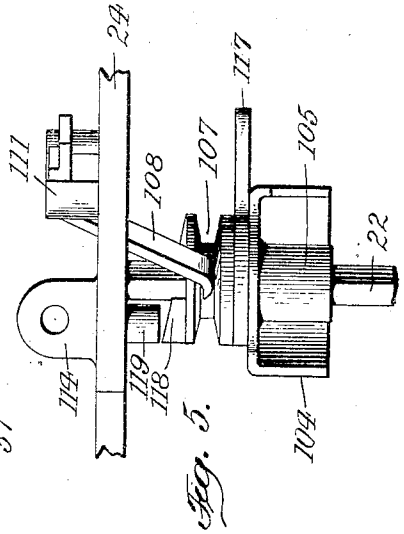


Fig. 5.



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CALCULATING MACHINE.

APPLICATION FILED JUNE 30, 1910.

972,360. **Patented Oct. 11, 1910.**

5 SHEETS—SHEET 5.

Fig. 9.

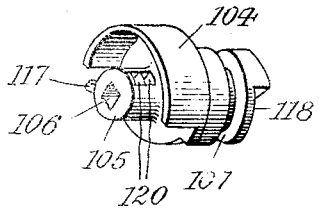
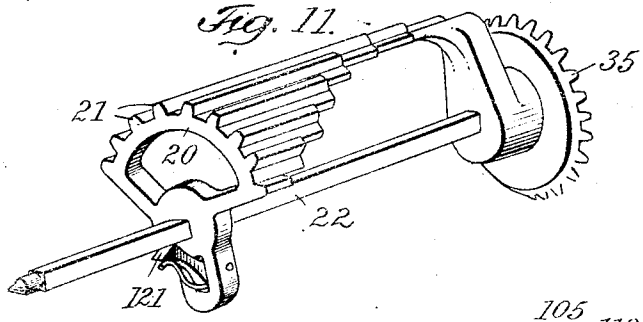


Fig. 11.



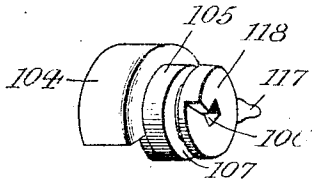
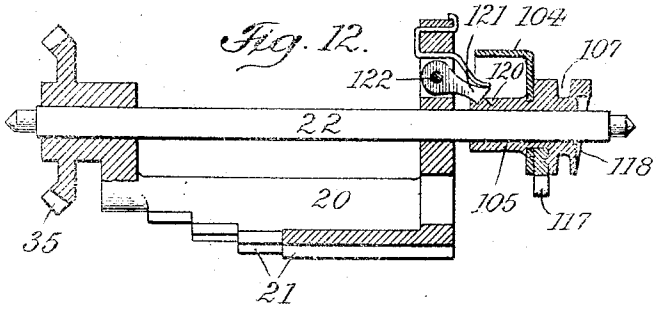


Fig. 10.

Fig. 12.



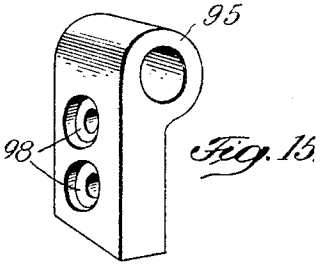


Fig. 15.

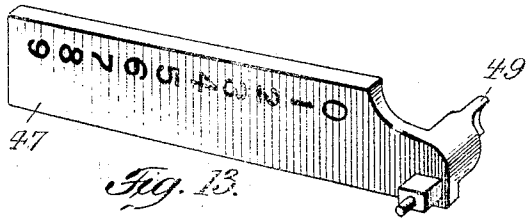


Fig. 13.

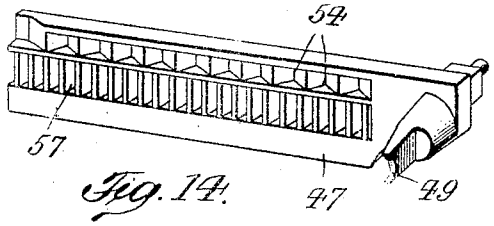


Fig. 14.

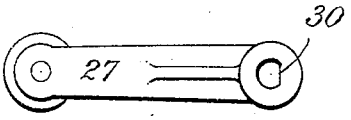


Fig. 16.

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UNITED STATES PATENT OFFICE.

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CALCULATING-MACHINE.

972,360. Specification of Letters Patent. **Patented Oct. 11, 1910.**

Application filed June 30, 1910. Serial No. 569,652.

To all whom it may concern:

Be it known that I, JULIUS GRABER, a citizen of the United States, residing at New York city, county and State of New York, have invented a new and Improved Calculating-Machine, of which the following is a specification.

This invention relates to a calculating machine of novel construction, which is adapted to automatically perform addition, subtraction, multiplication, or division.

The machine is reliable in operation, may be readily manipulated, is compact, and composed of a minimum number of parts.

In the accompanying drawing: Figure 1 is a plan partly broken away of my improved calculating machine, Fig. 2 an enlarged plan, partly in section, of the right hand portion thereof, Fig. 3 a cross section on line 3—3, Fig. 1, showing the casing in position, Fig. 4 a bottom view of the setting plate with some of the parts omitted, Fig. 5 a detail of the barrel and coöperating parts, Fig. 6 a detail of the shipping lever, Fig. 7 an enlarged section on line 7—7, Fig. 6 showing the pintle before being locked, Fig. 8 a similar section showing the pintle locked, Figs. 9 and 10 are perspective views of the barrel, Fig. 11 is a perspective view of the feed sector and adjoining parts, Fig. 12 a longitudinal section through the feed sector and barrel, Figs. 13 and 14 are perspective views of the numbered slide, Fig. 15 is a detail of one of the brackets, Fig. 16 a detail of the crank, and Fig. 17 a cross section on line 17—17, Fig. 2.

My improved calculating machine comprises essentially a stationary casing 18 that contains the setting and operating mechanism, and a longitudinally movable carriage 19 embodying the counting and registering mechanism.

The operating mechanism has as main elements, a series of toothed sectors 20 each provided with nine teeth 21 that gradually decrease in length. Sectors 20 are firmly secured to, preferably squared transverse parallel shafts 22 engaging suitable perforations in the walls 23, 24 of casing 20. Central wall 24 is made integral with forwardly extending cross arms 25, to which front wall 23 is secured by screws 26 or otherwise. Shafts 22 are adapted to be simultaneously rotated in the same direction by means of a crank 27 secured to a vertical axle 28, turning in bearings 29. At its upper end, axle 28 is partly flattened to be engaged by a corresponding bore 30 of handle 27 as illustrated in Fig. 16, so as to insure of positive rotation of axle 28. The latter carries a miter wheel 31 which engages a similar wheel 32 keyed to a longitudinal shaft 33. The latter carries a series of relatively fixed spaced miter wheels 34 meshing into wheels 35, which are integral with sectors 20. In order to prevent handle 27 from being turned in the wrong direction, axle 28 is provided with a notched disk 36 which is engaged by the bulged head 37 of a spring-influenced detent 38 pivoted at 39 to the setting plate 40 of casing 18. This plate is by screws 40^a secured to the upper arms 25, connecting walls 23, 24. Axle 28 may thus be readily turned in the direction of the arrow (Fig. 4) while movement in the opposite direction is prevented. It will be seen that by imparting to handle 27 one complete rotation in the proper direction, all sectors 20 will also make one complete rotation. This movement of sectors 20 is utilized for rotating a series of counting shafts 41 through a greater or less angle, one shaft 41 being provided for each sector 20. Shafts 41 are preferably squared and are fitted into corresponding perforations of front wall 23 and of a rear wall 42 having forwardly extending flanges 43 which are secured to walls 24 by screws 44. Upon each shaft 41 is slidably mounted a pinion 45 having ten teeth and provided with a grooved collar 46. By properly setting these pinions upon shafts 41, a rotation of handle 27 will impart to said shafts a rotation through an angle that corresponds to the number of teeth 21 coming into engagement with pinions 45. Thus for instance, if a pinion 45 is advanced to be engaged by two teeth 21, it will perform two tenths of a revolution upon one complete rotation of handle 27. These partial rotations of shafts 41 are registered by a counting device hereinafter more fully described.

The means for setting pinions 45 are as follows: Above each shaft 41 is arranged a slide 47 playing in a suitable guide way which is formed between rails or bosses 48 integral with and depending from plate 40. Each slide 47 has a downwardly extending arm 49 that engages the grooved collar 46 of one of the pinions 45. At its upper side,

slide 47 has a knob 50 extending through a corresponding slot of plate 40 and provided with a flange 51 that prevents a disengagement of said slide from plate 40. Flange 51 has a pointer 52 which plays along a scale A embracing the numbers 0 to 9. At its upper face, slide 47 carries the numbers 0 to 9 which are adapted to travel below a window 53 formed in plate 40. The correlation of the parts is such that when any one of the slides 47 is set to one of the numbers of its scale A, the like number on the slide will be displayed through window 53 below said scale, so that in this way the proper position of the slide may be checked. In order to temporarily lock the slides 47 in any position to which they have been set, each slide is provided at its bottom with ten notches 54 the distance between which equals that between the numbers of scale A. Notches 54 are adapted to be engaged by a resilient detent 55 secured to plate 40 as at 56, and holding the slide against accidental movement.

After the desired computation has been made in manner hereinafter described, all slides 44 may be simultaneously returned to their zero-position in the following manner: In addition to notches 54, each slide 47 is provided at its lower side with a countersunk rack 57 which is engaged by a pinion 58. Pinions 58 are loosely mounted on a longitudinal shaft 59 hung in suitable bearings 60 of plate 40, an axial displacement of pinions 58 being prevented by their engagement with countersunk rack 57. Each pinion 58 is provided with a laterally extending pin 61 arranged in the path of a pin 62 projecting radially from shaft 59. The latter is provided at one end with a beveled gear wheel 63 meshing into a toothed sector 64 formed on one arm of a bell crank lever 65 pivoted at 66. The other arm of the lever carries a finger piece 67 projecting upward through a curved slot 68 of plate 40. A spring 69 secured to lever 65 tends to return finger piece 67 to its normal position.

Each counting shaft 41 is operatively connected in manner hereinafter described to a rotary dial 70 carrying the numerals 0 to 9. Dials 70 are mounted in carriage 19 and have their uppermost numbers displayed through windows 71 of said carriage. The operative connection between shafts 41 and their dials 70 is such that the latter may be turned either to the left in case the machine is used for the purpose of addition and multiplication, or to the right for subtracting and dividing purposes. Means are further provided for advancing any one dial for the distance of one number when the preceding dial has completed one revolution, thus carrying or transferring a unit or ten or hundred as the case may be, to the dial situated at the immediate left of the dial in question. The correlation between the parts should be such that when any one dial, while performing an addition or multiplication passes from 9 to 0, it will automatically cause the dial to the left thereof to register the ten, hundred, thousand etc. which must be transferred. In like manner, any one dial, while performing a subtraction or division and passing from 0 to 9, should automatically cause the dial to the left thereof to register the ten, hundred, thousand etc. which must be borrowed.

The means for transmitting motion from shafts 41 to dials 70 are as follows: Between walls 24, 42 of casing 18, there is slidably mounted upon each shaft 41 a sleeve 73 having a squared bore so as to participate in the rotation of said shaft. At its ends, each sleeve 73 carries a pair of integral beveled gear wheels 74, 75, either one of which is adapted to engage a similar wheel 76, said wheels 76 being keyed to the spindles 77 of dials 70. Wheels 74, 75 are provided with inner integral hubs or collars 78 that straddle a longitudinal shipping bar 79 guided upon the upper edges of flanges 43. Bar 79 is actuated by a hand lever 81 pivoted to casing 18 at 82 and connected through link 83 with a lever 84. The latter is fast on a longitudinal rock shaft 85 mounted in suitable bearings of casing 18 and arranged below bar 79. To shaft 85 are rigidly secured a pair of fingers 86 that engage corresponding apertures of bar 79. It will thus be seen that in the position illustrated in Fig. 3, all of the wheels 75 are in engagement with wheels 76 so that when crank 27 is turned to the right, dials 70 will also be turned to the right. If lever 81 is swung backward, wheels 74 will be brought into engagement with wheels 76 so that upon the rotation of crank 27 to the right, dials 70 will be turned to the left. In order to maintain lever 81 in its end positions, it is provided with a pin 87 which is engaged by a bulged spring 88 secured to casing 18 (Fig. 3). Spindles 77 of dials 70 are mounted in suitable perforations of the carriage top plate and of a longitudinal bar 89 fastened to the carriage at a distance below said top plate. In order to prevent an accidental displacement of the dials and to insure a proper centering of the dial numerals below windows 71 of carriage 19, each dial 70 is scalloped as at 90 to be engaged by a retaining spring 91.

It may here be stated, that for the purposes of addition and subtraction, carriage 19 might be dispensed with, and that the spindles 77 carrying wheels 76 and dials 70 could be mounted in casing 18. For multiplication and division, however, wheels 76 must successively be brought into operative engagement with different wheels 74 or 75 as will be hereinafter more fully described. In order to permit this displacement of carriage 19, the latter is provided along and be-

low its rear edge with a cylindrical rod 92 clamped to suitable bearings 93 of said carriage by screws 94. Rod 92 is rotatably and slidably mounted in a pair of bearings 95, secured to wall 24 of casing 18 by screws 96. For expediting the assemblage of the parts, wall 24 is provided for each bearing 95 with a pair of integral bosses 97 which are adapted to be received within corresponding recesses 98 of the bearings, as illustrated in Figs. 3 and 15. It will be seen from Fig. 1, that the number of dials 70 provided in carriage 19 exceeds considerably the number of sectors 22. This is due to the fact that in multiplying the multiplicand and multiplier appear successively on casing 18 while the product appears on carriage 19, and that the digit number of the product naturally exceeds the digit number of multiplicand and multiplier. If a transfer of the carriage is necessary, the latter is slightly swung up, until beveled wheels 76 clear wheels 74 or 75, whereupon it is longitudinally shifted to the position desired. The carriage is thus again lowered so that all wheels 76 will come into engagement with another set of wheels 74 or 75. In order to readily ascertain the position for a proper engagement between the wheels and to lock the carriage in position, wall 24 is provided with a series of upper notches 99 which are adapted to be engaged by a lug 100 depending from carriage 19 (Figs. 2 and 3).

As thus far described, it will be seen that if pointers 52 are set to any numbers of scale A, these numbers will appear below the corresponding windows 71 of carriage 19 by turning crank 27 once completely around in the direction of the arrow (Fig. 1, the crank occupying normally the position marked X). This is due to the fact that by setting any one pointer 52 to a number say 4, pinion 45 will be taken along by arm 49 to be brought opposite that section of sector 20 which has four alined teeth 21. Through the subsequent rotation of crank 27, the pinion 45 will be advanced for four teeth, which movement will be transmitted to dial 70. The latter will thus be turned for four numerals, the direction of rotation depending upon the position of hand lever 81. If the latter is set for addition, the numeral "4" will appear below window 71, while if set for subtraction, the numeral "6" will be displayed below said window.

In order to lock dials 70 in position while they are inoperative, shafts 41 are provided with toothed wheels 101 having ten teeth which are engaged by retaining springs 102. In addition thereto each shaft carries a scalloped disk 103 made integral with wheel 101. The several concave teeth of disk 103 are adapted to be engaged by the solid section of a mutilated barrel 104, the parts 103 and 104 constituting a Geneva movement.

The means for carrying and borrowing tens, hundreds, thousands, etc., during the calculating operation, are as follows: Let it be assumed that to the number "4" registered as described, the number "7" should be added. The "4" displayed below window 71 had thus to be changed to a "1" while below the window to the left the number "1" will appear, to display jointly the result 11. To this effect the hubs 105 of barrels 104 are slidably mounted on shafts 22 and are provided with squared bores 106 to be taken along by the shafts during the rotation thereof. Each hub 105 is provided with a circumferential groove 107 which is permanently engaged by the lower arm of a shipping lever 108. This lever is provided with a transverse pintle 109 constituting its fulcrum and received within a corresponding groove 110 of a divided boss 111 formed on wall 24. To prevent a disengagement of pintles 109, the edges of grooves 110 are slightly upset at 112 after the insertion of the pintles, as illustrated in Fig. 8. The upper arms of levers 108 engage triggers 113 pivoted to lugs 114 of wall 24. The heads 115 of triggers 113 are arranged in the paths of tappets 116 secured to the spindles 77 of dials 70. Barrels 104 carry fingers 117 which are adapted to engage wheels 101 but are normally out of alinement therewith. At their rear ends, hubs 105 are provided with helical cam surfaces 118 adapted to engage corresponding abutments 119 made integral with wall 24.

I prefer to make barrels 104 and fingers 117 of steel cast into the hubs 105, the latter being preferably made of composition metal (Figs. 9, 10 and 12).

Normally the parts occupy the position illustrated in Fig. 2. If one of the dials 70 completes one revolution, its tappet 116 engages trigger 113, whereby tilting the same together with the upper arm of lever 108 toward wall 24. The lower arm of this lever will thus shift the barrel 104 located to the immediate left of the dial 70 in question backward to bring its finger 117 into the path of the coöperating wheel 101. During the last half of the rotation of crank 27, wheel 101 will thus be advanced for one tooth, to cause a corresponding advance of its coöperating dial 70 for one numeral, as will be readily understood. As soon as this movement has taken place, the helical cam 118 will engage abutment 119 so that hub 105, barrel 104 and finger 117 are returned to their normal position. In order to prevent any accidental displacement of hub 105, the latter is provided with a pair of notches 120 adapted to be engaged by a spring-influenced detent 121 pivoted to sector 20 at 122.

The operation is briefly stated as follows: If an addition is to be performed, the fig-

ures of the first number to be added are marked by pointers 52 whereupon crank 27 is given a full turn. The figures indicated by pointers 52 will thus appear below windows 71, whereupon finger piece 67 is moved toward the left to return all pointers to their zero-position. The figures of the second number are now marked by pointers 52, whereupon the operations are repeated. The sums of the several numbers added will appear below windows 71, the carrying or transferring of the tens, hundreds, thousands, etc., being effected in the manner described. If a subtraction is to be performed, the minuend is marked by pointers 52, and crank 27 is given a full turn to transfer the figures of the minuend to carriage 19, whereupon lever 81 is swung forward. The subtrahend is now marked by pointers 52, and crank 27 is again turned in the same direction, the remainder thus appearing below windows 71. Multiplication is reduced to a series of additions, while division is reduced to a series of subtractions. In multiplying by a multiplier containing but one figure, the multiplicand is marked by pointers 52, whereupon crank 27 is rotated as often as corresponds to the figure of the multiplier. Thus if the multiplicand is to be multiplied by 6, crank 27 receives six successive turns. If the multiplier contains two or more digits, the crank 27 is first turned as often as indicated by the figure of the units, whereupon carriage 19 is slightly lifted and shifted to the right until lug 100 enters the next notch 99. Crank 27 now receives such a number of turns as corresponds to the figure of the tenths. This manipulation of carriage 19 and crank 27 is repeated until the figures of the multiplier are exhausted, the final product appearing below windows 71. In dividing, the dividend is marked by pointers 52 and crank 27 is turned to transfer the figures of the dividend to carriage 19, whereupon lever 81 is swung forward. The divisor is now set up by pointers 52, and carriage 19 is so shifted, that the divisor is properly located below the dividend to start the division. The divisor is now subtracted from the dividend as often as it is contained therein by correspondingly rotating crank 27. Carriage 19 is then slightly lifted and shifted to the left until lug 100 enters the next notch 99. Crank 27 is now again rotated as often as the divisor is contained within the dividend, these manipulations being repeated until the division is completed. Means are provided which audibly announce if the right number of subtractions is overpassed, to permit of correction, such means however being omitted in the drawings as they do not form part of the present invention.

The numbers of the successive revolutions performed by crank 27 and constituting the digits of the divisor are visibly registered in the following manner: Below each window 71 and staggering therewith, there are provided in carriage 19 a series of windows 123 adapted to display one of the numbers 0—9 of auxiliary dials 124. Each dial 124 is secured to a spindle 125 and is serrated at its periphery as at 126. Dials 125 are adapted to engage a toothed wheel 127 mounted on a transverse shaft 128 of casing 18. Shaft 128 carries a pinion 129 meshing into a similar wheel 130 fast on a shaft 131, said shaft also carrying a fixed gear wheel 132 engaged by a retaining spring 133 and equaling in all respects wheel 127. Wheels 127, 132 are adapted to be alternately engaged by a tappet 134 slidably mounted on the right hand end shaft 22, which is for this purpose prolonged as illustrated in Fig. 2. The hub of tappet 134 is provided with a circumferential groove 135 which is engaged by an arm 136 secured to shipping bar 79. When the machine is set for multiplication, tappet 134 engages gear wheel 127 once during each rotation of crank 27, to advance the dial 124 engaged by wheel 127 for one numeral, and thus register the number of multiplications. When the machine is set for division, tappet 134 engages wheel 132 once during each rotation of crank 27 to turn dial 124 in the opposite direction and thus register the number of divisions.

Means are further provided for subdividing or separating the digits of the number exposed through windows 71 and 123. For this purpose, carriage 19 is provided along its rear edge with a dovetailed groove 137 in which is slidably mounted a finger 138 having knob 139. In front of windows 123 there is secured to carriage 19 by pins 140 a spaced rail 141 which is straddled by a U-shaped frame 142 of a finger 143 having knob 144.

Means are further provided for simultaneously returning dials 70 to their zero-positions. For this purpose a knob or pin 145 is provided which projects upwardly from a shipping bar 146 through a slot 147 of carriage 19. This bar is in operative engagement with cams 148 secured to spindles 77. In like manner, spindles 125 of dials 124 carry cams 149 which are engaged by a shipping bar 150. The latter is provided with a pin or knob 151 extending upwardly through a slot 152 of carriage 119. By properly manipulating knobs 145 and 151, dials 70 and 124 may be returned to their zero-position whenever desired.

In order to permit a convenient reading of the numbers, casing 18 is so mounted upon a triangular frame 153 that the casing has a slight forward dip as illustrated in Fig. 3. The machine has a hinged curved cover 154 adapted to engage an eye 155 projecting forwardly from frame 153. The space in front

of carriage 19 and to the left of casing 18 may be used as a chamber for storing lubricating oil etc., said chamber being closed by a hinged lid 156 that may serve as a support for taking notes and similar purposes.

It will be seen that the above described calculating machine is simple in construction and that the number of parts that go to make it up is greatly reduced.

The machine may be readily manipulated and is absolutely reliable in operation.

I claim:

1. In a calculating machine, a slotted setting plate, a numbered slide engaging the same, a countersunk rack formed in the slide, a pinion engaging the rack, and means for detaining the slide.

2. In a calculating machine, a slotted setting plate having downwardly extending integral rails, numbered slides reciprocally mounted between said rails, countersunk racks formed in the slides, pinions engaging the racks, and means for detaining the slides.

3. In a calculating machine, a slotted setting plate, a plurality of numbered slides engaging the same and having countersunk racks, a shaft extending across all of said slides, pinions on said shaft that engage the racks, means for operating the shaft, and means for detaining the slides.

4. In a calculating machine, a slotted setting plate, a plurality of notched slides engaging the same and having countersunk racks, a shaft extending across all of said slides, pinions on said shaft that engage the racks, means for operating the shaft, and detents engaging the slide-notches.

5. In a calculating machine, a slotted setting plate, a plurality of notched slides engaging the same and having countersunk racks, a shaft extending across all of said slides, pinions on said shaft that engage the racks, a beveled gear wheel at one end of the shaft, a spring-influenced toothed sector engaging said gear wheel, a crank for operating the toothed sector, and detents engaging the slide-notches.

6. In a calculating machine, a slotted setting plate, a plurality of notched slides engaging the same and having countersunk racks, a shaft extending across all of said slides, first pinions on said shaft that engage the racks, means for operating the shaft, arms depending from the slides, and second pinions having grooved collars that are engaged by the arms.

7. In a calculating machine, a counting shaft, a scalloped disk and an integral pinion fast on said shaft, a mutilated barrel adapted to engage the disk, and a finger adapted to engage the pinion.

8. In a calculating machine, a counting shaft, a scalloped disk and an integral pinion fast on said shaft, a mutilated barrel adapted to engage the disk, a finger adapted to engage the pinion, and a retaining spring engaging the pinion.

9. In a calculating machine, a squared shaft, a grooved cast metal hub slidably engaging the shaft, a mutilated barrel and a finger cast into the hub, a scalloped wheel adapted to be engaged by the barrel, and a pinion adapted to be engaged by the finger.

10. In a calculating machine, a squared shaft, a toothed sector fast thereon, a grooved cast metal hub slidably engaging the shaft and having a pair of notches, a mutilated barrel and a finger cast into the hub, a scalloped wheel adapted to be engaged by the barrel, a pinion adapted to be engaged by the finger, and a spring-influenced detent pivoted to the sector and adapted to engage either of the hub-notches.

11. In a calculating machine, a casing comprising a front wall and a central wall, a squared shaft hung therein, a grooved hub slidably engaging said shaft, a shipping lever engaging the hub-groove, a helical cam formed on said hub, and a boss integral with the central wall that is adapted to be engaged by said cam.

12. In a calculating machine, a casing comprising a front wall and a central wall, a squared shaft hung therein, a grooved hub slidably engaging said shaft, a divided grooved boss integral with the central wall, a pintle rotatably seated within the boss-groove, and a shipping lever fast on the pintle and engaging the hub-groove.

13. In a calculating machine, a casing comprising a front wall and a central wall, a squared shaft hung therein, a grooved hub slidably engaging said shaft, a divided grooved boss integral with the central wall, a pintle rotatably seated within the boss-groove, means integral with the boss for locking the pintle to the groove, and a shipping lever fast on the pintle and engaging the hub-groove.

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Witnesses:
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