Nov. 20, 1951 H. A. DE VALLE-ARIZPE 2,575,866

CALCULATING MACHINE

Filed Nov. 13, 1947 4 Sheets-Sheet 1

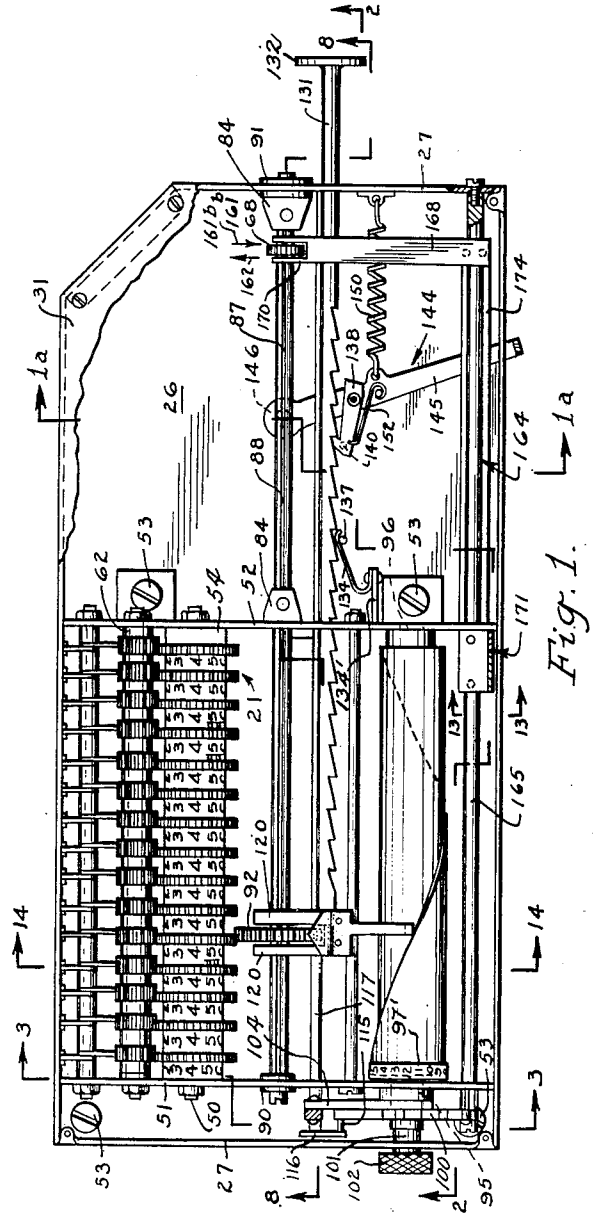


Fig. 1.

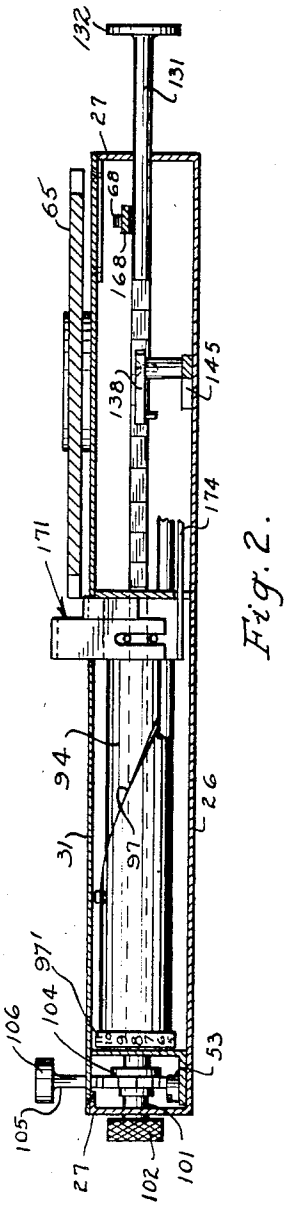


Fig. 2.

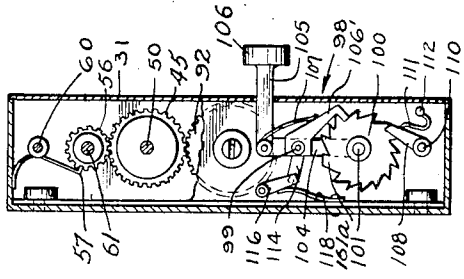


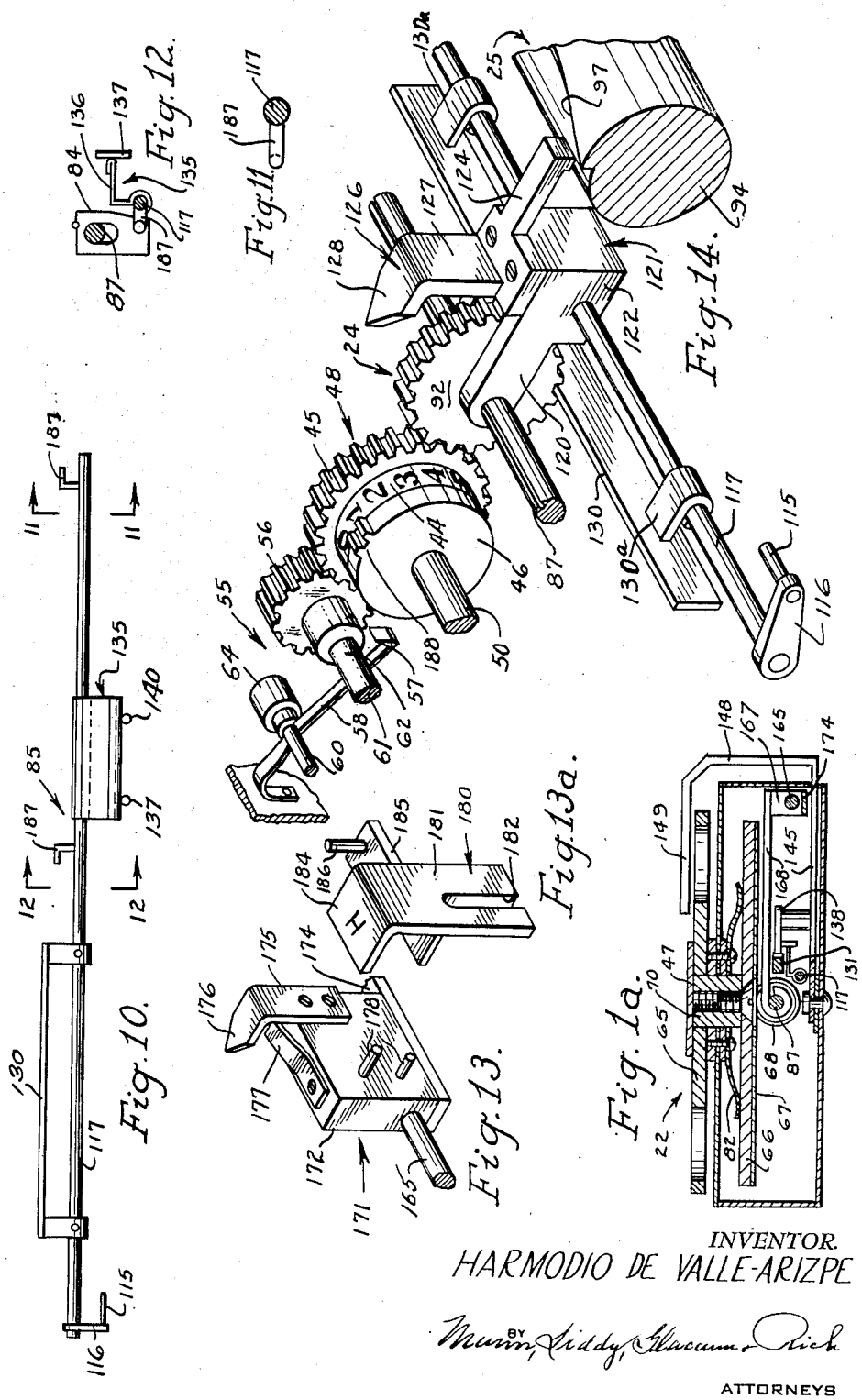
Fig. 3.

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CALCULATING MACHINE

Filed Nov. 13, 1947 4 Sheets-Sheet 2



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CALCULATING MACHINE

Filed Nov. 13, 1947 4 Sheets-Sheet 3

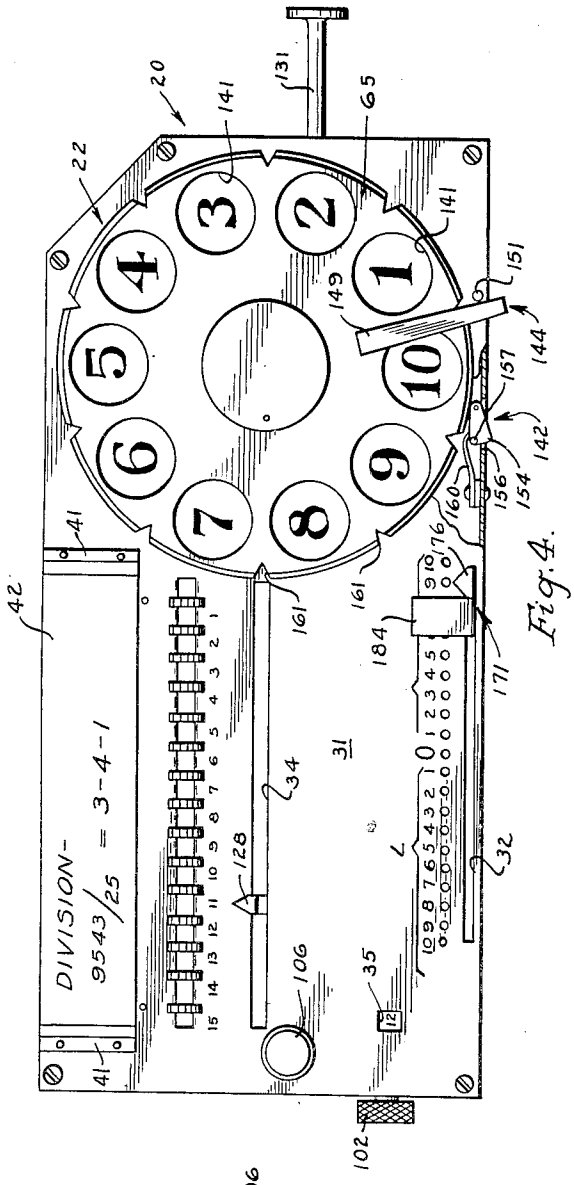


Fig. 4.

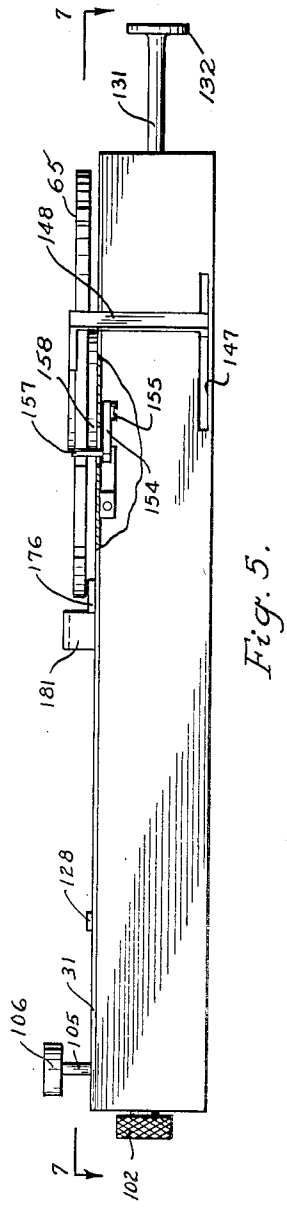


Fig. 5.

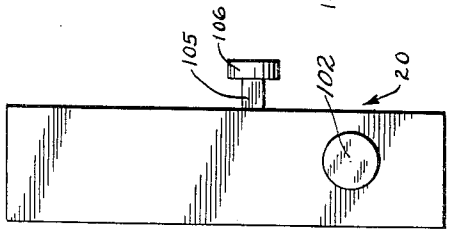


Fig. 6.

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CALCULATING MACHINE

Filed Nov. 13, 1947 4 Sheets-Sheet 4

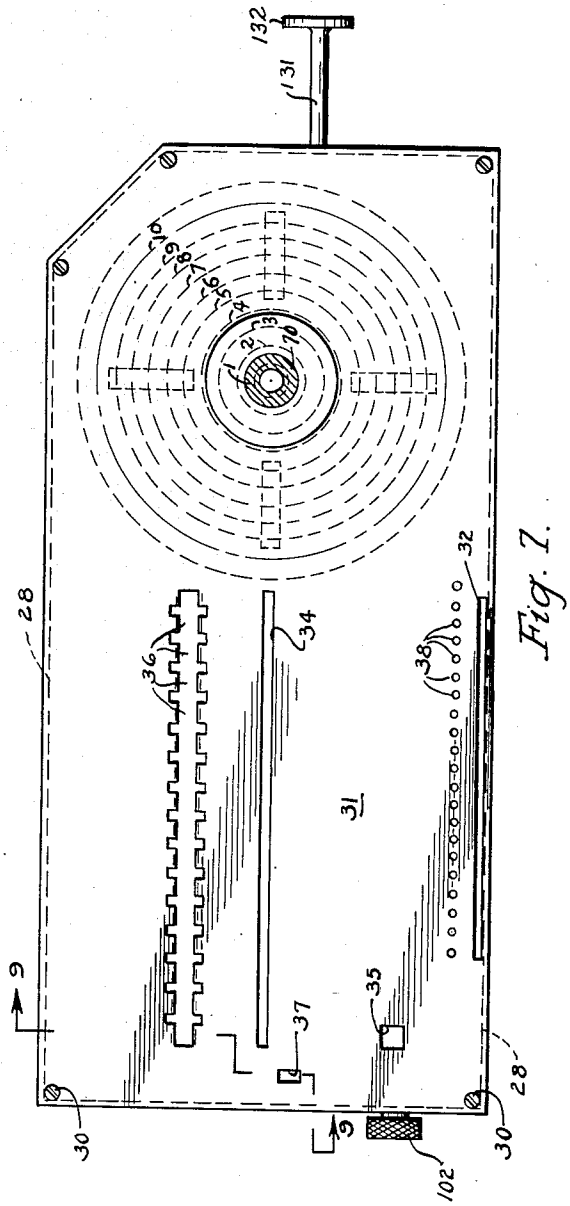


Fig. 7.

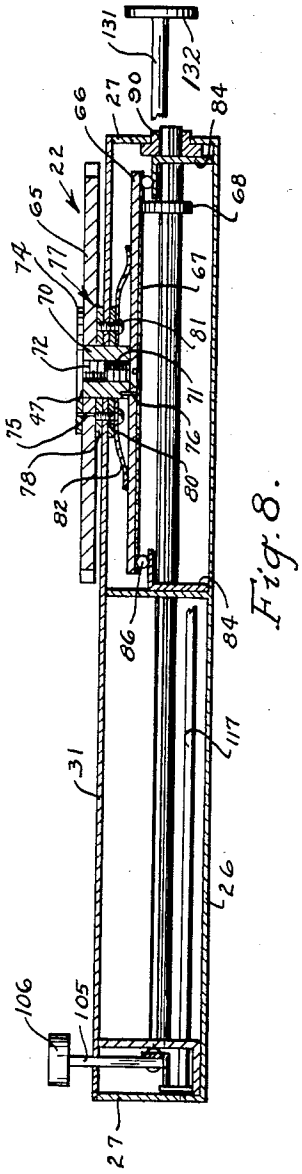


Fig. 8.

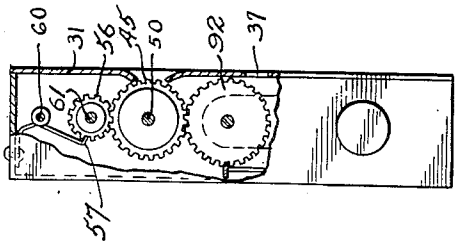


Fig. 9.

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Patented Nov. 20, 1951

2,575,866

UNITED STATES PATENT OFFICE

2,575,866

CALCULATING MACHINE

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Application November 13, 1947, Serial No. 785,774

6 Claims. (Cl. 235—63)

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This invention relates to calculating machines of the type adapted to perform such arithmetical operations as addition, subtraction, multiplication and division.

An important object of the invention is to provide a simple compact and inexpensive machine of the character mentioned by which such arithmetical operations as it is designed to perform may be carried out easily, quickly and accurately without necessitating on the part of the operator any high degree of skill in the attainment of efficient performance.

To the above and other ends the invention contemplates a rotatable dialing unit, a register including a series of rotatable counter disks, register-actuating means by which any selected one of said disks may be operatively connected to said dialing unit for rotation in one direction or the other, as required, in response to uni-directional rotation of said dialing unit and at any one of a plurality of speeds with reference to the speed of rotation of said dialing unit, and control means for automatically effecting operative connection between said dialing unit and successive counter disks as successive dialing operations are completed.

Other objects and advantages of the invention will become apparent from the following description when taken in connection with the accompanying drawings, in which

Figure 1 is a plan view of the machine with the cover plate of its housing broken away and the dialing unit removed.

Figure 1*a* is a fragmental sectional view taken on line 1*a*—1*a* of Fig. 1, certain parts being omitted in the interest of clarity.

Figure 2 is a vertical sectional view taken on line 2—2 of Fig. 1 and showing in section the cover plate together with certain elements of the dialing unit.

Figure 3 is a vertical sectional view taken on line 3—3 of Fig. 1.

Figure 4 is a plan view of the machine, a portion of its housing being broken away for clarity with reference to structural details of dial restraining means adapted to insure the proper extent of rotation of the dial incident to each dialing operation.

Figure 5 is a side elevation of the machine with its housing broken away, as in Fig. 4, and portions of its dialing unit in section.

Figure 6 is an end elevation of the machine as viewed from the left in Fig. 4.

Figure 7 is a sectional view taken on line 7—7 of Fig. 5, various parts and openings being

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omitted in the interest of clarity and in order to emphasize the relation to each other of the gear tracks peculiar to the driving disk of the dialing unit.

Figure 8 is a vertical sectional view taken on line 8—8 of Fig. 1.

Figure 9 is a sectional view taken substantially on the line 9—9 of Fig. 7 and showing the relation of the register observation slot to one of the counter disks.

Figure 10 is a detail plan view of a gear locking and pawl releasing unit.

Figure 11 is a sectional view taken on line 11—11 of Fig. 10.

Figure 12 is a sectional view taken on line 12—12 of Fig. 10 and showing in elevation one of a pair of driving disk declutching arms in operative association with the unit of Fig. 10.

Figure 13 is a perspective view taken on line 13—13 of Fig. 1 and showing a slidable indexing block rigidly connected to one end of a gear-shifting strap.

Figure 13*a* is a perspective view of a latch adapted to be slidably connected to the indexing block, and

Figure 14 is a perspective view showing one of the counter disks in association with its driving mechanism and its restraining means, the driving mechanism being illustrated as including a gear in association with its positioning and locking mechanism.

The mechanism herein illustrated as an embodiment of the present invention includes a housing 20, a registering unit 21, a dialing unit 22, a transmission unit 24 by which the registering unit may be actuated in response to operation of the dialing unit and a transmission control unit 25 by which the denominational orders of the registering unit may be rendered selectively responsive to the operation of the dialing unit.

As will be readily understood, the housing 20 serves as an enclosure for most of the various parts, combinations and subcombinations of elements entering into the machine embodying the present invention, the housing comprising a bottom plate 26, with which are associated end and side walls 27 and 28, respectively, to which is removably connected, as by screws 30, a cover 31. The cover 31 is provided with pointer accommodating slots 32 and 34, an observation window 36, a key-accommodating opening 37, and a series of latch pin receiving apertures 38. At one end of the cover 31 there is inscribed, etched or otherwise affixed to the upper face of the cover in an annular group a series of numerals 1 to 10

inclusive, which function, as will hereinafter more clearly appear, in connection with the dialing unit 22 to aid in the carrying out of arithmetical processes of addition, subtraction, multiplication and division. For the operators convenience, as when for example, the process of division is being executed, there is provided a pair of hold down strips 41 beneath which a suitable cardboard strip 42 is removably held and on which the operator may make any notations that he may deem advisable or helpful in the carrying out of computations.

The registering unit 21 includes a series of counter disks 44, each of which is provided on its peripheral face with a series of numerals 0 to 9 inclusive. To one end of each counter disk 44 there is rigidly connected a spur gear 45 and at the opposite end of such disk there is similarly connected a transfer disk 46, the function of which will hereinafter more clearly appear.

Referring particularly to Figs. 1, 4 and 7, it will be observed that each counter disk 44 of the registering unit 21 is disposed beneath and is visible through its corresponding window 36, there being as many such windows as there are counter disks and the series of windows, together with the respective disks, being identified from right to left by the numerals 1 to 15, inclusive, suitably affixed to the upper face of the cover plate 31 adjacent the respective windows. The numerical order of the windows 36, as identified by the numerals 1 to 15, inclusive, corresponds to the "units," "tens," "hundreds" (and so on) digit positions within a given numerical quantity.

As will be readily understood from an inspection of Fig. 14, each counter disk 44 together with its associated spur gear 45 and transfer disk 46 constitutes a counter-disk assembly indicated as a whole by the numeral 48. Referring particularly to Figs. 1, 3 and 9, it will be observed that the several counter-disk assemblies 48 are journaled for independent rotation on a common shaft 50 fixedly connected at its opposite ends to and supported by a pair of walls 51 and 52, disposed transversely of the housing 20 and rigidly anchored by screws 53 to the bottom 26 of the housing, as shown most clearly in Fig. 1. A suitable spacer 54, carried by the shaft 50 and disposed intermediate the wall 52 and the adjacent counter-disk assembly 48, may be employed to retain the several counter-disk assemblies against undue longitudinal displacement on said shaft.

In order that the counter-disk assemblies 48 may be held against undue rotation, each such assembly is associated with a restraining device 55, which, as will be appreciated from an inspection of Figs. 1, 3, 9 and especially Fig. 14, includes a gear 56, between the teeth of which is yieldably retained a cam-like detent 57, carried by a spring arm 58, looped intermediate its ends about a supporting rod 60 and anchored at its end, nearest such rod, to the adjacent side wall 28 of the housing 20. It will be understood, of course, that while the detent 57, acting under the influence of its associated spring arm 58, is such that it will normally enter between the teeth of the gear 56 and hold that gear against undue rotation it will readily ride over successive teeth and into successive valleys of its cooperatively related gear as such gear is rotated in the normal operation of the machine. The gears 56 of the several restraining devices 55, which correspond in number to the number of counter-disk assemblies 48, are journaled for independent rotation on a common shaft 61, which, like the spring arm supporting rod 60, is fixedly connected at its opposite ends to and supported by the pair of transversely disposed walls 51 and 52. In order that the gears 56 may be held in a properly separated relation to each other, suitable sleeve-like spacers 62 are carried by the shaft 61 and are disposed intermediate adjacent gears and between the end gears and the respectively adjacent walls 51 and 52. Similarly the spring arms 58 of the restraining devices 55 are held against undue displacement by a series of sleeve-like spacers 64 carried by the supporting rod 60.

The dialing unit 22, as shown most clearly in Figs. 2, 4 and 8, comprises two highly important elements, namely, a rotatable dial plate 65 and a driving disk 66 having a facing 67 of suitable material, such as a reasonably soft plastic into which the teeth of a pinion 68, hereinafter more particularly referred to, may be slightly embedded under moderate pressure to provide a series of concentric gear tracks made up of permanently formed tooth indentures, the several tracks being diagrammatically illustrated in Fig. 7 and there identified as tracks numbers 1 to 10, inclusive. Here it may be well to mention that the number of teeth with which the pinion 68 is provided bears a ratio to the number of tooth indentures peculiar to the respective gear tracks (1 to 10) in the order of 1 to 1, 1 to 2, 1 to 3 and so on up to and including 1 to 10. Thus, it will be understood that if, for example, the pinion 68 carries ten teeth and tracks, say 1, 3 and 9, are respectively composed of ten, thirty and ninety tooth indentures, it follows that one complete revolution of the driving disk 66 will effect one, three and nine complete revolutions of the pinion 68 when that pinion is maintained in driven relation to the respective tracks just mentioned. The reason for specific gear ratios between the pinion 68 and the several gear tracks (1 to 10) will become more apparent when considering the hereinafter described operation of the machine.

As shown most clearly in Fig. 8, the dial 65 and the friction disk 66 are connected together for rotation in unison, the means employed to effect such connection being herein illustrated as including a tubular shaft 70 which is internally screw threaded to receive a pair of screws 71 and 72, the former of which passes through the driving disk and the latter of which is provided with a disk-like head 74 seated on the upper face of the dial and anchored thereto by a pin 75. The pin 75 insures the screw 72 against turning with respect to the dial 65, and, likewise, a similar pin 76, passing through the driving disk 66 and into the lower end of the shaft 70 insures such disk and shaft against turning with relation to each other. An adequate bearing 77 is provided for the shaft 70, the bearing being herein illustrated as including a pair of disks 78 and 80 suitably connected, as by screws 81, to the upper and lower faces, respectively, of the cover plate 31 through which the shaft projects. To the lower face of the disk 80 are connected the inner ends of a plurality of flat springs 82, the outer or free ends of which are bent downwardly so as to engage the driving disk 66 and exert a slight pressure on it in order that a positive driving action may be maintained between itself and the pinion 68 during the dialing operation.

In order that the pinion 68 may be conveniently shifted from one gear track to another (reference being had to the tracks, numbers 1 to 10 in Fig. 7), there are provided a pair of disk declutching arms 84 adapted to be moved vertically, as will

hereinafter more clearly appear, through the medium of a gear locking and pawl releasing unit 85 to be described later in detail. It may be well to here mention that the driving disk 66 engages and rides on a pair of bearing balls 86 suitably held against linear displacement on the declutching arms 84, the arms being adapted when raised to correspondingly lift the driving disk free of the pinion 68 and the springs 82 being adapted to insure return movement of the driving disk into engagement with the pinion as the arms are lowered to their normal or lowermost positions. It will be observed, of course, that as the driving disk 66 is raised and lowered, its associated shaft 70 and dial 65 will likewise move due to the fact that such shaft is free to move longitudinally of itself within the bearing 77.

The transmission unit 24, shown most clearly in Figs. 1 and 14 and by which the registering unit 21 may be actuated in response to operation of the dialing unit 22, includes a shaft 87 which is provided with a spline groove 88 and is journaled intermediate its ends in the transverse wall 52. The shaft 87 is journaled at its opposite ends in bearings 90 and 91 carried, respectively, by the transverse wall 51 and one of the end walls 27 of the housing 20. It is on the shaft 87 that the pinion 68, hereinbefore referred to, is so splined that it is held against rotation with respect to the shaft but yet adapted to be shifted longitudinally of the shaft and into registration with any one of the gear tracks (numbers 1 to 10) of the dialing unit 22. Hereinafter, means for facilitating shifting of the pinion 68 and accurate positioning of the same with respect to the gear tracks (1 to 10) will be described. It will be observed in connection with the transmission unit 24, that the shaft 87 carries a driving gear 92, which is so splined to the shaft that it rotates therewith and is adapted to be shifted into meshing engagement with the respective gears 45 of the several counter-disk assemblies 48.

Referring now to the transmission control unit 25 by which predetermined denominational settings of the transmission unit 24 may be facilitated in rendering the counter-disk assemblies 48 of the registering unit 21 selectively responsive to the dialing unit 22, it will be observed that said control unit includes a positioning drum 94, supported for rotation in a pair of bearings 95 and 96 carried, respectively, by the transverse walls 51 and 52. The drum 94 is provided with a uniformly pitched cam-like helical abutment 97, the circular extent of which is 360° and the longitudinal extent of which is substantially that of the drum. Secured to one end of the drum 94 for rotation therewith is an indexing dial 97', provided on its peripheral face with a cypher or "0" marking (not shown) and a series of numbers which may be observed in succession through the window 35, it being understood that the numbers of said series correspond respectively to the counter-disk identifying numbers (1 to 15) appearing, as shown in Figs. 4 and 7, in association with the windows 36 formed in the cover plate 31 of the housing 20.

In order that the drum 94 may be conveniently rotated step-by-step so as to render predetermined points of the abutment 97 effective in the operation of the transmission control unit 25, there is provided, as shown most clearly in Figs. 1 and 3, a manually operated pawl and ratchet mechanism 98. This mechanism includes a ratchet wheel 100 secured to a shaft-like extension 101 of the drum 94, which extension projects

through one of the end walls 27 of the housing 20 and is there provided with a knurled knob 102, by which the drum may be rotated independently of the pawl and ratchet mechanism 98, if such operation is deemed expedient, as when, for example, conditions are such that a quicker initial setting of the drum may be effected by turning the knob than by resorting to the pawl and ratchet mechanism. Mounted for oscillatory movement on the extension 101, is a pawl-actuating lever 104, to the outer end of which is pivoted an operating key 105 which projects upwardly through the opening 37 and is there provided with a finger piece or button 106. Pivotally connected to the lever 104, as by a trunnion pin 99, is a pawl 106', which is held in engagement with the ratchet wheel 100 by a flat spring 107 suitably anchored at its outer end to the outer end of said lever, the pawl serving, as is apparent, to advance the ratchet wheel step-by-step in a counter clockwise direction (reference being had to Fig. 3) as its associated actuating lever 104 is operated. In order to prevent reverse rotation of the ratchet wheel 100, there is provided a restraining pawl 108, pivotally connected to the transverse wall 51 by a trunnion pin 110 and maintained in engagement with the ratchet wheel 100 by a flat spring 111, bent to substantially a U-shape and pivotally supported on a trunnion pin 112 carried by the wall 51. In order that the pawl-actuating lever 104 may be returned to its normal position following each successive operation of the key 105, there is pivotally connected to said lever, as by means of its associated trunnion pin 99, a link 114, which, at its lower end, is pivotally connected to a pin 115 carried at the outer end of a bell-crank arm 116, secured to one end of a shaft 117 extending longitudinally of the housing and constituting an important element of the gear locking and pawl releasing unit 85 shown in Fig. 10 and hereinafter more particularly described. Beneath the arm 116, there is arranged a flat spring 118, one end of which is anchored to the bottom 26 of the housing 20 and the other end of which engages the arm 116 so as to react thereon and thus lift the link 114 causing the pawl-actuating-lever 104 to return to its normal position after having been depressed by the key 105.

Continuing further with the description of the transmission control unit 25 and referring especially to Figs. 1 and 14, it will be noted that the driving gear 92 is confined within the space afforded between a pair of translating arms 120, constituting important elements of a gear yoke indicated as a whole by the numeral 121, which includes a guide block 122, with which said arms are connected. The outer ends of the arms 120 embrace the shaft 87 and are guided by it as the yoke 121 is moved from one position to another along the shaft 117 which passes through the block 122 and is disposed in a parallel relation to the shaft 87. To the upper face of the block 122, there is connected a tail piece 124, the outer end of which overlies the drum 94 and is adapted to engage the helical abutment 97 which functions as a variable stop, as will hereinafter more clearly appear, to facilitate accurate positioning of the gear 92 with respect to the gear 45 of any selected counter-disk assembly 48.

To further facilitate accurate selective positioning of the gear 92, there is provided a pointer 126 which is supported on the block 122 for movement therewith, the pointer comprising a vertically disposed standard 127, which projects up-

wardly through the slot 34 to a point above the cover plate 31 of the housing where it terminates in a horizontally disposed index arm 128, tapering to a point directed towards the line of numbers (1 to 15) which are indicative of the respective counter-disk assemblies 48 of the registering unit 21.

Referring particularly to the gear locking and pawl releasing unit 35, it will be understood that since the shaft 117 is connected to the key 105 by way of the link 114 said shaft is caused to undergo a rocking movement as the key is moved up and down. The rocking movement of the shaft 117 is utilized to move a longitudinally disposed locking bar 130 into and out of locking engagement with the gear 92, the bar being connected to a pair of arms 130a secured to the shaft 117. Locking of the gear 92 serves to hold it against any undue rotation as it is shifted out of engagement with any one of the several gears 45 and into engagement with the next of such gears, thus insuring unobstructed meshing since all of the gears 45 during the gear shifting period are held in tooth alignment with respect to each other and in meshing positions with reference to the gear 92 by the several detents which are associated with the gears 56 that permanently mesh with the respective gears 45. It is apparent that the locking bar 130 is moved into gear locking position as the key 105 is depressed, and it, therefore, follows that said key is of necessity held in its depressed position in order to maintain the gear 92 locked against possible rotation during the gear shifting period.

In order that the gear 92 may be conveniently shifted from right to left, reference being had to Fig. 1, in establishing an initial setting of that gear with reference to a selected counter-disk assembly 48, there is provided a longitudinally disposed rack 131, slidably mounted in the transverse wall 52 and one end wall 27 of the housing 20, the rack being suitably connected at one end to the gear yoke 121 and provided at its opposite end with a button 132 for convenience of manipulation by the operator. Normally the rack 131 is held against movement from right to left, as viewed in Fig. 1, by a spring finger detent 134, mounted on a supporting wing 134', secured to the transverse wall 52. The detent 134 is adapted to engage the teeth of the rack 131 so as to positively lock it against movement from right to left. Although the rack 131 may be readily moved by the operator to the right against the relatively slight braking action offered by the detent, such braking action is of sufficient intensity to reasonably insure against any undue displacement of the arm in that direction.

Taking into account the positive locking action of the detent 134 with respect to the rack 131, it becomes apparent that such detent must be released in order to permit movement of the rack from right to left when it becomes necessary to effect an initial setting of the gear 92. Means for effecting such release of the detent 134 are herein illustrated as including an angle bar 135 secured to the shaft 117 of the gear locking and pawl releasing unit 85, the upper or free arm 136 of the angle bar being normally disposed in a horizontal position, as shown in Fig. 12, and its outer edge being then disposed in close proximity to a depending pin 137 suitably connected to the detent relatively near its outer end as shown in Fig. 1. From the foregoing it will be understood that as the key 105 is depressed and the shaft 117 is thereby rotated in a clockwise direction, reference being had to Fig. 12, the angle plate 135 will engage the pin 137 and so move the detent 134 as to release it from its locking engagement with the rack 131, the release of the detent being coincident with the upward movement of the locking bar 130 into locking engagement with the gear 92. Here it may be well to mention that there is provided a rack-actuating pawl 138, which will be hereinafter more particularly described and which must be released from engagement with the rack 131 incident to the release of the detent 134. To this end, the pawl 138 is provided relatively near its outer end, with a pin 140, which, like the pin 137 carried by the detent 134 and hereinbefore described, projects downwardly in close proximity to the outer edge of the free arm 136 of the angle bar 135, the location of the pins 137 and 140 with reference to each other being indicated in Figs. 1 and 10. Thus, it will become apparent that as the angle plate 135 is moved to release the detent 134, in the manner previously described, the pawl 135 will be similarly and simultaneously released from its engagement with the rack 131.

Referring again to the dialing unit 22, it will be noted that the dial plate 65 is provided with a series of finger-tip receiving openings 141, arranged in an annular group at the peripheral margin of the plate and through which the respective numerals 1 to 10 may be clearly observed when the plate is at rest in any one of its several normal positions. In order that the dial plate 65 may be brought to rest in a normal position following each operation thereof, there is provided a dial plate restraining unit 142 which, as will hereinafter more clearly appear, depends for its operation upon the operation of a pawl-actuating unit 144, with which the rack-actuating pawl 138 is associated.

Before describing the dial plate restraining unit 142, it is deemed advisable to refer in detail to the pawl-actuating unit 144, which, as shown most clearly in Figs. 1, 2, 4 and 5, includes a finger actuated cross bar 145, pivotally supported on a vertically disposed trunnion 146 suitably connected to the bottom wall 26 of the housing 20, the cross bar 145 being disposed so as to allow ample space to permit the gear 68 to move unobstructedly along the shaft 87. In order that the bar 145 may be exposed to finger-tip operation incident to the completion of each dialing operation, it extends outwardly from the housing 20, by way of an elongated opening 147 formed in one of the side walls 28 of said housing, and is bent up and over to provide, respectively, a latch arm engaging gusset 148 and a finger contact arm 149, the latter being disposed in a contiguous relation to the peripheral margin of the dial plate 65 and being there adapted to respond to finger tip engagement incident to completion of successive dialing operations. As a result of such response, the cross bar 145 is moved in a clockwise direction, reference being had to Fig. 1, about its pivot point and in opposition to its associated tension spring 150, which normally retains the cross bar in its retracted position and serves to return it to that position following each dialing operation, the spring being connected at one end to the cross bar and at its opposite end to an end wall 27 of the housing. It will be noted that the retracted position of the cross bar 145 is a definite or predetermined one by reason of the fact that a stop lug 151, provided on the cover plate 31 of the housing 20, is so disposed as to engage the finger contact arm

149 as that arm, together with its associated cross bar 145, is moved in a counterclockwise direction under the action of the tension spring 150. As is obvious, the pawl 138, which is pivotally connected to the cross bar 145 and is normally maintained in operative engagement with the rack 131 by a suitable spring 152 connected to said cross bar and engaging said pawl, is so related to the rack as to cause it to advance step-by-step from left to right incident to successive dialing operations.

Referring again to the dial plate restraining unit 142, shown in detail in Figs. 4 and 5, it will be noted that said unit includes a latch-arm 154, pivotally connected, as by a screw 155, to the under side of the cover 31 of the housing 20. The arm 154 projects outwardly from the housing 20 by way of a slot 156 provided in one of the side walls 28 of said housing thus exposing said arm for engagement by the upwardly extending latch-engaging gusset 148 incident to completion of successive dialing operations. Carried by the outer end of the latch-arm 154, is a detent pin 157, which, as shown in Fig. 5, projects upwardly through the cover plate 31 by way of an opening 158 provided therein, the detent pin terminating substantially flush with the upper face of the dial plate 65 when that plate is in its lowermost position. Normally the latch-arm 154 is held in its retracted position, shown in Fig. 4, by a flat spring 160, one end of which is anchored to one of the side walls 28 of the housing and the other end of which engages the inner edge of said arm. In order that the detent pin 157 may function effectively to limit the rotation of the dial plate 65 incident to completion of successive dialing operations, said plate is provided at its periphery with a series of equi-distantly spaced V-shaped notches 161 adapted for the reception of the detent pin 157 as it is moved inwardly by the latch-arm 154 following the engagement of that arm by the latch-arm engaging gusset 148.

From the description thus far of the registering unit 21, the dialing unit 22, the transmission unit 24, the control unit 25, and the gear locking and pawl releasing unit 85, it will be understood that any desired number, such, for example, as 9876, entering into the process of a mathematical computation to be carried out by the machine herein illustrated as an embodiment of the present invention, may be readily set up on the registering unit by the following procedure: First, assuming that the gear 92 is located at the extreme right hand limit of its path of movement (reference being had to Fig. 1), the drum 94 of the transmission control unit 25 is rotated by the pawl and ratchet mechanism 98 until the numeral "4" appears through the observation window 35, the numeral "4" being selected because of the fact that the number "9876" is represented by four digits; second, the rack 131 is then moved manually from right to left while holding down the key 105 and thereby maintaining the detent 134 and the pawl 138 disengaged from said rack, movement of the rack being continued until the tail piece 124 engages the abutment 97 at a point which will of necessity correspond to the fourth counter-disk-assembly 48 from the right in Fig. 4 and there identified by the numeral "4." When the tail piece 124 engages the abutment 97, the pointer 128 will then register with said numeral and the gear 92 will then mesh with the gear 45 of said fourth counter-disk-assembly, whereupon the key 105 may be released, thus retracting the locking bar 130 from engagement with the gear

92 and simultaneously permitting the detent 134 and the pawl 138 to move into engagement with the rack 131. Following the preliminary measures as above described, the operator inserts his finger tip in the dial-plate opening 141, corresponding to the numeral "9" appearing through such opening, and rotates the dial plate 65 in a clockwise direction, reference being had to Fig. 4, until it is arrested by the restraining unit 142.

As a result of the dial-plate operation just described, the fourth counter-disk assembly 48 is so actuated (assuming the pinion 68 is positioned to follow the gear track number 1) as to expose the numeral "9" of said assembly 48 to view through the window 36 corresponding to that assembly. Incident to completion of the dialing operation just described, the pawl actuating unit 144 is so actuated as to cause the pawl 138 to engage the next succeeding tooth of the rack 131, with the result that as the operator releases his finger from the dial plate 65 said unit will be returned to its normal position, thus causing said pawl to move said rack a step to the right, thereby establishing a meshing engagement of the gear 92 with the gear 45 of the third counter-disk-assembly 48. The next dialing and succeeding operations are carried out according to the foregoing description, thereby setting up on the registering unit 21 the remaining digits, namely "8," "7" and "6" of the number "9876."

In the foregoing description of operation it is assumed that the gear 92, before being moved into meshing engagement with the gear 45 of the fourth counter-disk-assembly 48, is located at the extreme right hand limit of its path of movement. The assumed position of the gear 92 may be termed its "zero" position, from which the gear 92 may be unobstructedly moved into successive engagement with the gears 45 of the entire series of counter-disk-assemblies 48, provided, of course, the setting of the drum 94 is such that its associated abutment 97 does not intercept the path of movement of the tail piece 124. Such non-interception may be insured by rotating the drum 94, through the medium of the pawl and ratchet mechanism 98, to its "zero" position, which position will be assumed when the cypher "0," not shown but hereinbefore referred to as provided on the dial 97', appears through the window 35. Here it may be well to mention that the cypher "0" is, of course, located between the numerals "1" and "15" in the present instance, its position there corresponding to the position of a throw-out segment 161*a* provided on the periphery of the ratchet wheel 100 intermediate the first and last teeth thereof. It is to be noted that, as the drum 94 assumes its "zero" position, the throw-out segment 161*a* moves into such position with reference to the pawl 106 that, as the key 105 returns to its normal position, the pawl is cammed to the outer face of said segment where it remains ineffective until such time as the drum is rotated by the operator through the medium of the knob 102 in order to allow the pawl to engage the teeth of the ratchet wheel 100.

The ratchet wheel must contain in its periphery as many teeth as there are counter disks 44 in the registering unit 21, besides one space for a throw-out segment 161*a*. As the ratchet wheel 100 is rigidly connected to the helix drum 94, one revolution of said element 100 equals to one revolution of drum 94. Therefore, each tooth of the ratchet wheel represents a fraction of the revolution of the helix drum, that is, if we have a machine with 15 counter disks 44 the periphery

of the ratchet wheel must be divided by 16 spaces, corresponding 15 to the counter disks and one for the throw-out segment 161, each space will have, then an angular measure of 22° 30′ therefore the helix 97 would have an angular extent of 360°. Such helix is shown in Fig. 1 with one half with full lines and other with dotted lines.

In order that the arithmetical processes of addition, subtraction, multiplication and division may be carried out, it is necessary, in certain cases, that the pinion 68 be rotated in the direction of the arrow 161*b* appearing in Fig. 1, the direction of rotation thus indicated being hereinafter referred to as a "positive" direction. In other cases it is necessary that the pinion 68 be rotated in the direction of the arrow 162 appearing along side the arrow 161*b*, the direction of rotation thus indicated being hereinafter referred to as a "negative" rotation. Moreover, it is necessary that provisions be made not only for effecting positive and negative rotation of the gear 68, but also for establishing various gear ratios between that gear and its associated driving disk 66 in order that said gear may be rotated both positively and negatively in the order of from one to ten revolutions for each revolution of the driving disk. To these ends, a gear shift unit 164 is provided for conveniently shifting the gear 68 from any of its operating positions, corresponding to the gear tracks 1 to 10, at the right of the center line of the driving disk 66 (reference being had to Fig. 8) to any of its corresponding operating positions at the left of said center line, the operating positions at the right of said center line being hereinafter referred to as "positive" positions and the operating positions at the left of said center line being hereinafter referred to as "negative" positions.

The above mentioned gear shaft unit 146 includes a guide rod 165 which passes through the transverse wall 52 and is secured at one of its ends to the transverse wall 51 and at its opposite end to the end wall 27 of the housing 20. On the rod 165, there is slidably carried a translating block 167, to the upper end of which is connected a horizontally disposed gear shift fork 168, between the fingers 170 of which the gear 68 is disposed for longitudinal movement along the shaft 87 as the translating block 167 and its associated fork 168 are moved longitudinally of the guide rod 165 by a manually operated indexing unit 171, shown, in part in Fig. 13 and illustrated more generally in Figs. 1, 2 and 4.

Referring to the indexing unit 171, it will be noted that it includes an index block 172, slidably mounted on the guide rod 165 and secured at its lower end to a strip-like connector link 174 which in turn is secured to the lower end of the translating block 167 so as to effect movement of the gear 68, through the medium of the gear shifting fork 168, to any predetermined setting with relation to the several gear tracks 1 to 10. In order that the gear 68 may be conveniently and accurately set with relation to any selected one of the several gear tracks 1 to 10, and positioned with reference to the center line of the driving disk 66, for either positive or negative rotation, the indexing block 172 is equipped with a pointer 175 which projects up through the slot 32 provided in the cover plate 31 of the housing 20, the pointer being bent at its upper end to provide an index tab 176 which terminates relatively near the common center line of the several apertures 38, as shown in Fig. 4. Of these apertures 38, the central one is indicative of the central or neutral position of the gear 68 with reference to the driving disk 66 and is identified by the cypher "0," the remainder of them being respectively, indicated by the reference characters R and L in two groups, one of which group is located at the right of the central aperture and the other of which is located at the left of that aperture. The apertures 38 of the R and L groups are identified by the numbers 1 to 10, reading to the right in the R group and to the left in the L group, the numbers just mentioned being permanently affixed to the cover plate 31, as by etching or otherwise. Adjacent the R group of apertures 38, may be provided, as by etching or otherwise, the indicia "ADD" and "MULT," indicative of the mathematical processes of addition and multiplication, respectively, and adjacent the L group of apertures may be likewise provided to indicia "SUB" and "DIV," indicative of the mathematical processes of subtraction and division, respectively.

Considering Figs 13 and 13*a*, it is to be noted that the index block 172 is provided on its upper face with a flat spring 177, which is bent upwardly so that its free end is normally spaced only a slight distance from the under face of the index tab 176. Carried by the index block 172 and extending from one side thereof are a pair of guide pins 178 disposed one above the other. On the pins 178 is slidably carried a vertically movable latch 180, comprising a latch plate 181, which is provided with a notch 182 adapted to accommodate said guide pins. The latch plate 181, as shown in Fig. 4, projects upwardly through the slot 32 and terminates at its upper end in a horizontally disposed thumb tab 184, by which said plate may be conveniently depressed against the action of the spring 177, it being noted in this connection that the spring engages the under face of an abutment plate 185, which is rigidly connected to the latch plate at right angles thereto. The abutment plate 185 projects well beyond the latch plate 181 and is provided at its outer end with an indexing pin 186, which is adapted to enter any selected aperture 38, according to whatever setting of the gear 68 may be desired. From the relationship of the various elements entering into the indexing unit 171, it will be understood that the operator, by depressing the latch plate 181, may readily release the indexing pin 186 from such one of the apertures 38 as the pin may then occupy, thus freeing the unit for movement to any other selected position. After the indexing unit 171 is moved to its newly selected position it may be again locked by releasing the latch plate 181 so as to permit the spring 177 to lift the abutment plate 185, thus causing the indexing pin 186 to enter such one of the apertures 38 as may correspond to the desired setting of the indexing unit. Here it is to be noted that at such time as the indexing unit 171 is being shifted from one position to another, the driving disk 66 of the dialing unit 22 is maintained in its elevated position to permit the gear 68 to be unobstructedly shifted in accordance with the shifting movement of the indexing unit 171. In order to maintain the driving disk 66 elevated during such time as the gear 68 is being shifted from one position to another, the declutching arms 84, hereinbefore described, are pivotally connected, as will be understood from Figs. 10, 11 and 12, to a pair of crank arms 187, which are secured to and are adapted to so move with the shaft 117 that, as the shaft is rotated in response to depression of the key 105, the arms 84 are

lifted and they, in turn, move the driving disk 66 upwardly out of engagement with the gear 68, it being understood, of course, that when the key 105 is released, the shaft 117 will return to its normal position thus lowering the arms 84 and thereby permitting the driving disk to return to its lower or gear-engaging position under the action of its associated springs 82.

Referring again to the registering unit 21, it is to be noted that, in carrying out certain mathematical computations by the machine embodying the present invention, the relationship of any one of the counter-disk-assemblies 48 to the next such assembly at the left, reference being had to Fig. 1, must be such that as the counter disk 44 of a given assembly completes one revolution, thus presenting its cypher, zero, to view through one of the windows 36, the counter disk of the next assembly will be so rotated as to present an appropriate one of its numerals. For example assuming the counter disks 44 are set at their zero positions and the counter disk at the extreme right in Fig. 1 is rotated in a positive direction to the extent of one complete revolution, the counter disk at the left must undergo transfer rotation to the extent of one-tenth of one revolution so as to expose its numeral "1" in conjunction with the zero marking of the first counter disk. Another complete rotation of the first counter disk 44 in a positive direction must result in a further one-tenth revolution of the next counter disk so as to expose the numeral 20 to view as must be true also of the numerals 30, 40 and so on upon completion of successive revolutions of the first disk in a positive direction. In accordance with the present invention, the transfer rotation is effected in a positive direction incident to the carrying out of addition and multiplication operations, whereas, in the carrying out of subtraction and division procedures, transfer rotation in a negative direction and for the purpose hereinafter described is imparted to such of the counter disks as may be involved. In order that transfer rotation of the counter disks 44 may be effected in either a positive or a negative direction, according to whether the gear 68 is set positively or negatively with reference to its associated driving disk 66, each transfer disk 46 to the right of the last of the counter disk assemblies 48 appearing in Fig. 1 carries a segmental gear 188 which includes a pair of teeth so located with relation to the numerical markings of their associated counter disk 44 that they will engage the gear 56 next adjacent said associated disk at the left thereof (reference being had to Fig. 1) and rotate that gear to such an extent, as the zero marking of said associated disk moves into view through one of the windows 36, that the companion gear 45, meshing with said gear 56, will be rotated to the extent of one-tenth revolution, thus causing the counter disk 46, which is associated with said companion gear 45, to move a sufficient distance to expose its numeral "1." Repetition of the operations just described will, of course, effect successive transfer operations so as to expose the numerals 20, 30, 40 and so on in consecutive order.

From the description of the invention thus far given, it is believed necessary now to describe only generally the procedures to be followed in carrying out the processes of addition, subtraction, multiplication and division, in connection with which procedures specific examples will be considered.

As to addition, let it be assumed that the numbers 754320, 8329 and 56075 are to be added. First, the pinion 68 is set to register with track number 1 of the driving disk 66 and as positioned for rotation in a positive direction as the dialing unit 22 is actuated. Next, the gear 92 of the transmission unit 24 is meshed with the gear 45 of the sixth counter-disk-assembly 48 since there are six digits in the first of the above given numbers. The dialing unit 22 is then actuated to register the numeral 7 on the sixth counter-disk-assembly 48, whereupon the gear 92 is automatically moved into engagement with the gear 45 of the fifth counter-disk-assembly, pursuant to which engagement the dialing operation is carried out to register the numeral 5 on said fifth counter-disk-assembly. The procedure is continued in the manner just described until all of the numerals entering into the number 754320 are registered by the registering unit 21. Following such registration of that number, the gear 45 is moved into position to cooperate with the fourth counter-disk-assembly 48, since there are four digits in the next of the above numbers, namely, 8329. The dialing procedure is again carried out; and finally the number 56075 is dialed, whereupon the summation, 818724, is presented to view through the windows 36 corresponding to various counter-disk-assemblies responsible for the presentation of said summation. It should here be pointed out that in dialing any number containing a cypher, the counter-disk-assembly 48 corresponding to the digit position of the cypher is permitted to remain undisturbed as will be readily understood, in connection with the dialing of the third of the above mentioned numbers, when it is taken into account that the cypher occupies the hundredths-digit position and that the counter-disk-assembly corresponding to that digit position is passed by the gear 92 which is permitted to remain inactive until it assumes a cooperative relation to the next counter-disk-assembly destined to be operated, such assembly being in the present instance that assembly which correponds to the tenths-digit position occupied by the numeral 7.

To carry out the process of subtraction, as for example where the minuend is, say, 8329 and the subtrahend is 127, the larger of these numbers is dialed as above explained in carrying out the process of addition. The gear 68 is then shifted to its negative one track position and the subtrahend is dialed, with the result that the remainder, 8202, will be presented to view by the four counter-disk-assemblies 48 corresponding to units, tens, hundreds and thousands digit positions, the effect on the minuend initially recorded by the registering unit 21 being accounted for by reason of the fact that the counter disks 44 entering into the dialing of the subtrahend are rotated in a direction opposite to that employed in recording the minuend, the reversal in rotation of the counter disks being due to the negative setting of the gear 68 during the second dialing operation.

In considering the procedure concerning multiplication, it may be well to first discuss a simple example such as 3 times 5, wherein the numeral 5 is the multiplicand and the numeral 3 is the multiplier. In this instance, the gear 92 is set to engage the gear 44 of the counter-dial-assembly 48 occupying units position in the registering unit 21, and the gear 68 is shifted to its positive number 3 position for cooperation with gear track number 3. Since the gear ratio as between the gear 68 and the driving disk 66 is in the order of

3 to 1 when said gear is set for engagement with gear track number 3, it follows that by simply dialing the numeral 5 the first and second of the dial assemblies 43 will collectively present the number 15 to view through the first and second of the series of windows 36.

Considering now a more complex problem of multiplication, for example where 9876 is to be multiplied by 543, the procedure is as follows: Shift the gear 92 into meshing engagement with the gear 45 of a selected counter-disk-assembly 48 that is well removed from the assembly corresponding to window number 1, the selected assembly, being for example, the seventh from the one at the extreme right of the register-unit 21. The gear 68 is then shifted into a cooperative relation to gear track number 5, whereupon the number 9876 is dialed with the result that the number 49380 is registered by the counter-disk-assembly 48 corresponding to the windows 36 which are numbered 8, 7, 6, 5, 4. Having thus multiplied the number 9876 by 5, the gear 92 is moved into meshing engagement with the gear 45 of the counter-disk-assembly 48 occupying the sixth position, as indicated by the numeral 6 adjacent one of the windows 36. Since the next numeral to be considered in the multiplier is the numeral 4, the gear 68 is shifted into a cooperative relation to the gear track number 4, pursuant to which the multiplicand is again dialed with the result that the counter-disk-assemblies correspond to the windows 36 which are identified by the numerals 8, 7, 6, 5, 4, 3 collectively register the number 533304. The gear 92 is now shifted into engagement with the gear 45 of the counter-disk-assembly 48 occupying the fifth position in the registering unit 21 as identified by the numeral 5 adjacent one of the windows 36. Inasmuch as the multiplicand is now to be multiplied by the numeral 3, the gear 68 is shifted into position to cooperate with gear track number 3, whereupon the multiplicand is again dialed with the result that the number 5362668 is registered collectively by the counter-disk-assemblies 48 which correspond to the windows 36 and are identified by the numerals 8, 7, 6, 5, 4, 3, 2. In order to further clarify the mathematical process entailed in the foregoing example, it might be well to point out that the result obtained is in accord with the following arrangement of partial products.

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 9876
 543x
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49380
 39504
  29628
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5362668
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It is to be noted that, in arriving at the above product, the counter disk assembly 48, corresponding to the window 36 which is identified by the numeral 1, remains unaffected in the process of carrying out the multiplication procedure; and since that assembly remains inactive, its reading, appearing through the window 36 which is indicated by the numeral 1, is disregarded as it constitutes no part of the computed product.

In now considering the procedure to be followed in the process of division, let it be assumed that the number 46233 is to be divided by 9. First, the dividend 46233 is recorded on the registering unit 21 according to the manner described heretofore in recording the first number given in the example stated in connection with the description of the procedure to be followed in carrying out the process of addition. After recording the dividend 46233, the gear 68 is shifted to its negative nine track position since the divisor, as given in the present example, is nine. Inasmuch as the divisor nine is not contained in the numeral 4 of the dividend 46233 but is contained in the partial dividend 46, the gear 92 is shifted into engagement with the gear 45 of the counter-disk-assembly 48 by which the numeral 6 is exhibited. The operator then determines by mental arithmetic that the divisor 9 is contained in the partial dividend 5 times, and accordingly makes a notation of the numeral 5 on the cardboard strip 42. Thereafter the operator dials the numeral 5 with the result that the partial dividend 46 disappears leaving a remainder of 1 appearing on the counter-disk-assembly 48 that previously registered the numeral 6. Next the operator moves the gear 92 into meshing engagement with the gear 45 of the counter-dial-assembly 43 by which the numeral 2 is exposed. The previously mentioned remainder of 1 together with the numeral 2 just mentioned represent a new dividend of 12 that is mentally divided by 9 thus giving a quotient of 1 which is noted on the cardboard strip 42. The numeral 1 is then dialed with the result that the dividend 12 disappears leaving a remainder of 3 registered on the counter-dial-assembly 43 that previously registered the numeral 2. The new dividend, therefore, becomes 33, in which the divisor 9 is contained 3 times, the quotient 3 being determined by mental arithmetic and noted on the cardboard strip 42. The numeral 3, as a quotient, is dialed with the result that the dividend 33 disappears leaving a remainder of 6 registered on the counter-dial-assembly 43 that previously registered the unit digit 3 of the dividend 33. The remainder of 6 together with the unit digit 3 of the original dividend 46233 compose the new dividend of 63 in which, as may be determined by mental arithmetic, the divisor is contained exactly 7 times. The operator may then note this result on the cardboard strip 42 by inscribing the numeral 7 as a part of the quotient 5137. It is to be noted that if any new dividend that may be presented during the process of carrying out a problem of division does not contain the divisor, a cypher is written in the quotient, whereupon the gear 92 is moved to its next position of operation in the process.

It is believed that the process of division, as carried out by the present invention, needs no further description, but it may be well to describe the process in connection with a more complex problem, as for example, where 30375 is to be divided by 375. In this instance the dividend 30375 is recorded on the registering unit 21, then, after observing that the divisor 375 is contained 8 times in the dividend 30375, the gear 68 is shifted to its negative eight track position. Inasmuch as the divisor 375 is not contained in the numeral 303 of the dividend 30375 but is contained in the partial dividend 3073, the gear 92 is shifted into engagement with the gear 45 of counter disk assembly 48 by which the numeral "0" is exhibited, then the operator dials the divisor 375, and after this operation is performed the registering unit 21 will show a remainder of 375. Then again the gear 68 is shifted to its negative "one" track position (since the remainder 375 divided by the divisor 375 equals "one") and the divisor 375 is dialed with the

result that the remainder 375 will disappear from view from the unit 21.

In order to make the description given more clear the following explanation is deemed advisable. Dialing the number 375, when the gear 68 is placed in the eight negative track, is the same as multiplying 375 by minus 8, then the negative product 3000 is rested or diminished from the dividend 3037, leaving on the record unit 21 a remainder of 37, as 37 is not divisible by 375 the element 98 is automatically moved one space to the right and then the remainder 37 becomes 375, the operator knows that 375/375 equal one, he shifts the element 68 to the negative one track, dialing afterwards the divisor 375, he obtains a quotient of 81. Therefore, the quotient is given by shifting the gear 68 to obtain each numeral of the quotient.

From the foregoing description of the procedure employed in carrying out the process of division, it becomes apparent that where the divisor and dividend are so numerically related that a remainder exists upon the completion of any given process such remainder will appear through one or more, as the case may be, of the windows 36 beneath which the registering unit 21 is located.

Although only one form of the invention is herein shown and described, it will be understood that various changes may be resorted to in the present embodiment without departing from the scope of the invention or the scope of the following claims.

What is claimed is:

1. A calculating machine comprising a registering unit including a denominational series of rotatable and cooperatively related counter-disk-assemblies; a dialing unit including a rotatable finger-actuated dial plate and a driving disk connected to said plate for rotation therewith; a transmission unit including a shaft, the axis of said assemblies being parallel to the axis of the transmission unit and the axis of the driving disk being perpendicular to the axis of the transmission unit, a driving element carried by said shaft and adapted to be moved longitudinally thereon into driving relation to any selected one of said counter-disk-assemblies and a driven element carried by said shaft for longitudinal movement thereon and adapted to be rotated by said driving disk for effecting rotation of said shaft, said driving element and any selected one of said counter-disk-assemblies in response to rotation of said driving disk; and means for shifting said driven element lengthwise of said shaft to various positions for engagement with said driving disk along its diameter and at opposite sides of its center of rotation, whereby said shaft and consequently any selected one of said counter-disk-assemblies may be rotated in either a positive or a negative direction as desired and at various ratios of angular rotation with reference to that of said driving disk.

2. A calculating machine comprising a registering unit including a denominational series of rotatable and cooperatively related counter-disk-assemblies; a dialing unit including a rotatable finger-actuated dial plate and a driving disk connected to said plate for rotation therewith; a transmission unit including a shaft, the axis of said transmission unit being parallel to the axis of the assemblies and perpendicular to the axis of the driving disk, a driving element carried by said shaft and adapted to be moved longitudinally thereon into driving relation to any selected one of said counter-disk-assemblies and a driven element carried by said shaft for longitudinal movement thereon and adapted to be rotated by said driving disk for effecting rotation of said shaft, said driving element and any selected one of said counter-disk-assemblies in response to rotation of said driving disk, means for moving said driving disk out of and into driving engagement with said driven element; and means operable at such time as said driving disk is out of driving engagement with said driven element for shifting said driven element lengthwise of said shaft to various positions for engagement with said driving disk along its diameter and at opposite sides of its center of rotation as said disk is moved into driving engagement with said driven element, whereby said shaft and consequently any selected one of said counter-disk-assemblies may be rotated in either a positive or negative direction as desired and at various ratios of angular rotation with reference to that of said driving disk.

3. A calculating machine comprising a registering unit including a denominational series of counter-disk assemblies supported for rotation with respect to each other, a rotatable dialing unit, a transmission unit by which said registering unit may be actuated in response to operation of said dialing unit, said transmission unit being mounted for movement into a driving relation to any selected one of said counter-disk assemblies and including a tail piece, a transmission control unit by which selective positioning of said transmission unit with respect to said assemblies may be facilitated, said assemblies, transmission unit and transmission control unit being arranged in parallel axis, said control unit including a drum mounted for step-by-step rotation and having on its periphery a helix abutment presenting a series of contact areas corresponding in number to said assemblies and adapted to engage said tail piece in attaining selected operating positions of said transmission unit with reference to said assemblies so that any one of said assemblies may respond to the operation of said dialing unit, and actuating means for effecting step-by-step rotation of said drum.

4. A calculating machine comprising a registering unit including a denominational series of counter-disk assemblies supported for rotation with respect to each other, a rotatable dialing unit, a transmission unit by which said registering unit may be actuated in response to operation of said dialing unit, said transmission unit being mounted for movement into a driving relation to any selected one of said counter-disk assemblies and including a tail piece, a transmission control unit by which selective positioning of said transmission unit with respect to said assemblies may be facilitated, said assemblies, transmission unit and transmission control unit being arranged on parallel axes, said control unit including a drum mounted for step-by-step rotation and having on its periphery a helix abutment presenting a series of contact areas corresponding in number to said assemblies and adapted to engage said tail piece in attaining selected operating positions of said transmission unit with reference to said assemblies so that any one of said assemblies may respond to the operation of said dialing unit, actuating means for effecting step-by-step rotation of said drum whereby said contact areas are moved successive-

ly into functioning positions with relation to said tail piece and locking means operable incident to operation of said actuating means for rendering said transmission unit ineffective with relation to said assemblies during step-by-step rotation of said drum.

5. A calculating machine comprising a registering unit including a demoninational series of counter-disk assemblies supported for rotation with respect to each other, a rotatable dialing unit including a rotatable driving disk mounted for vertical displacement, a rotatable transmission unit normally operatively connected to said disk, axes of said driving disk and transmission unit lying in planes perpendicular to one another, said transmission unit being movable into driving relation with any one of said counter-disk assemblies and being there operable to rotate said any one of said assemblies in response to rotation of said dialing unit, said transmission unit including a driving gear normally engaging said driving disk, manually operable driving gear shifting means by which said driving gear may be shifted to various radial operations with relation to said disk in order that the ratio of rotation of said transmission unit and said assemblies with respect to the rotation of said dialing unit may be varied, and manually operable driving disk elevating means operable to lift said driving disk free of said driving gear to facilitate operation of said driving gear shifting means.

6. A calculating machine comprising a registering unit including a denominational series of counter-disk assemblies, a rotatable dialing unit, a translatory transmission unit by which selected denominational orders of said registering unit may be actuated in response to operation of said dialing unit, finger-actuated detent means adapted to be rendered effective incident to completion of rotation of said dialing unit from any one of a number of predetermined angular values to limit said dialing unit against undue rotation beyond a given angular value, pawl and ratchet means responsive to the operation of said detent means and adapted upon completion of each successive dialing operation to advance said transmission unit step-by-step into successive cooperative positions with relation to said counter-disk assemblies.

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