

**July 10, 1945.**

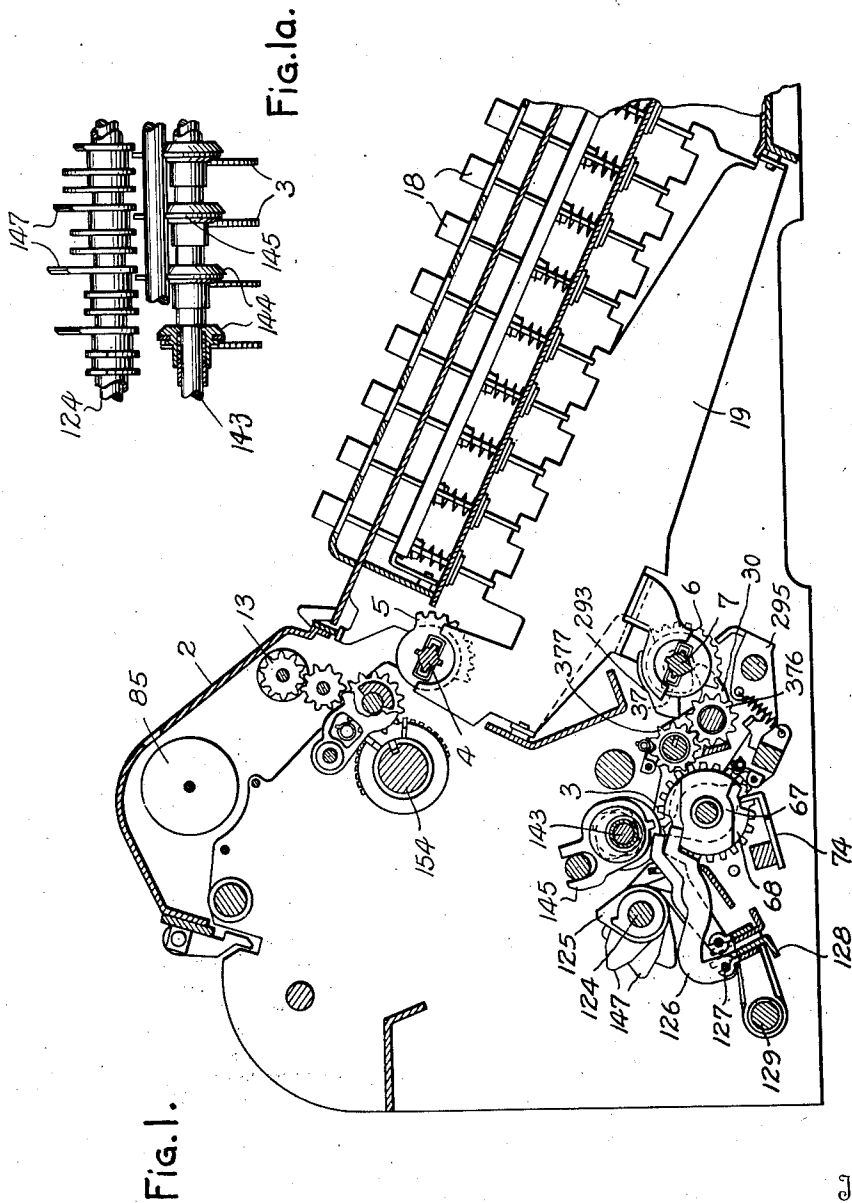
E. F. BRITTEN, JR

# CALCULATING MACHINE

Filed Nov. 13, 1941

**2,379,877**

7 Sheets-Sheet 1



Inventor  
EDWIN F. BRITTEN, JR.

E. W. Anderson & Son.

Attorneys

July 10, 1945.

E. F. BRITTEN, JR

2,379,877

CALCULATING MACHINE

Filed Nov. 13, 1941

7 Sheets-Sheet 2

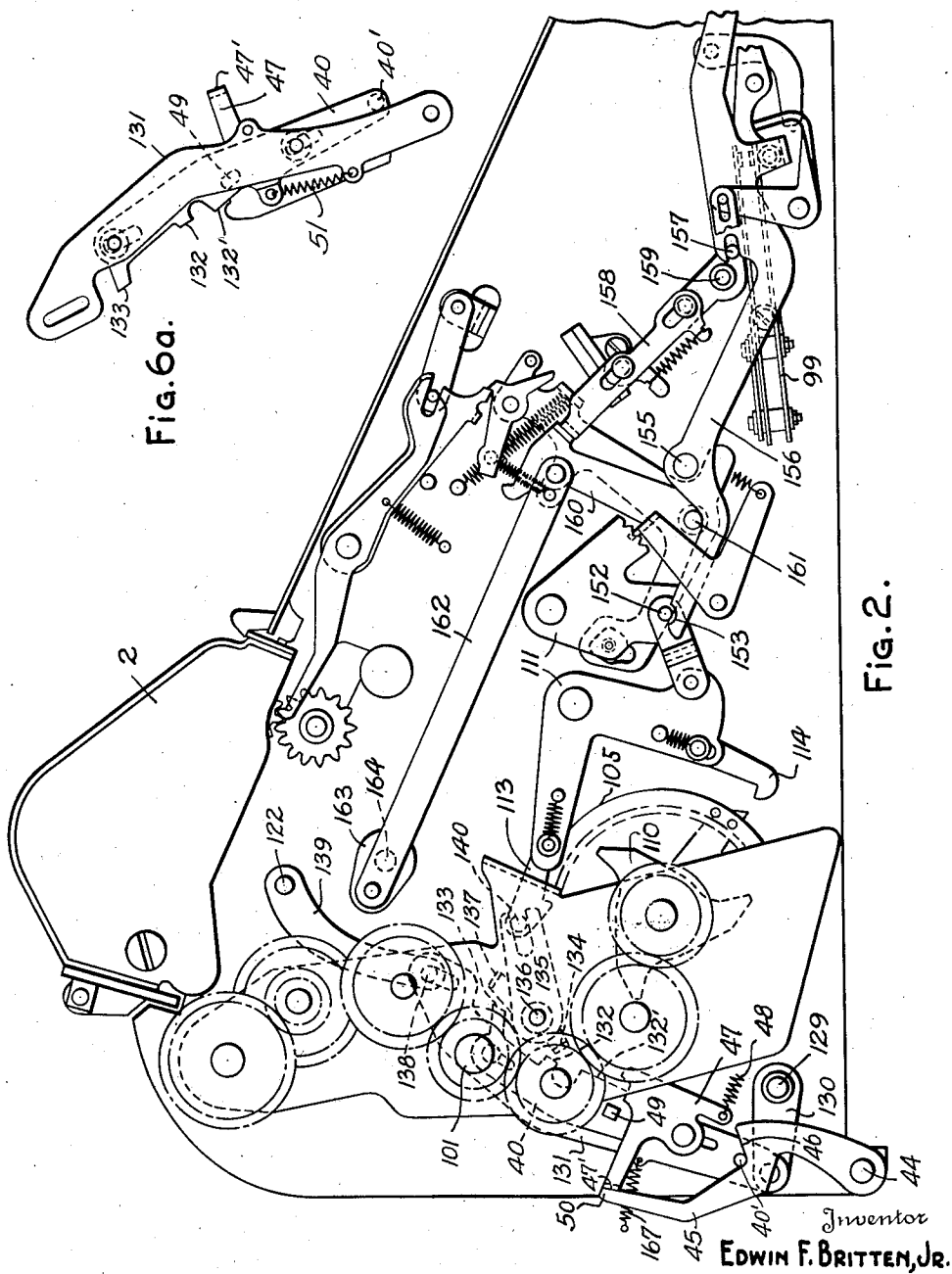


Fig. 2.

Fig. 6a.

Inventor  
EDWIN F. BRITTEN, JR.

334

C. W. Anderson & Son.

Attorneys

July 10, 1945.

E. F. BRITTEN, JR

2,379,877

CALCULATING MACHINE

Filed Nov. 13, 1941

7 Sheets-Sheet 3

Fig. 3.

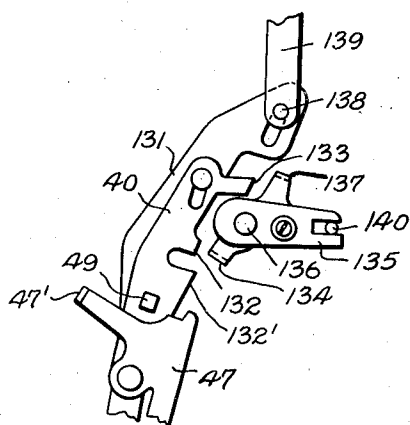


Fig. 5.

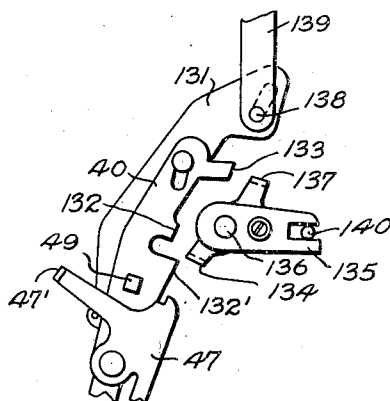


Fig. 4.

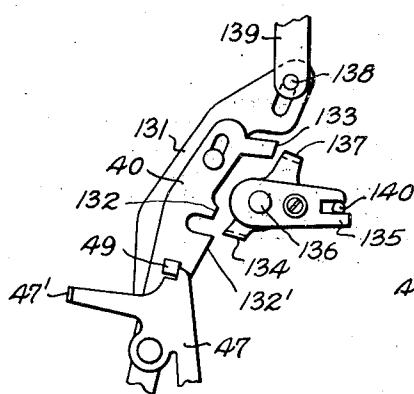
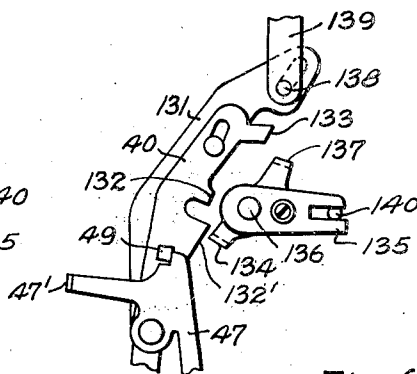


Fig. 6.



Inventor  
EDWIN F. BRITTEN, JR.

E. W. Anderson, Jr.

By

Attorneys

July 10, 1945.

E. F. BRITTEN, JR

2,379,877

CALCULATING MACHINE

Filed Nov. 13, 1941

7 Sheets-Sheet 4

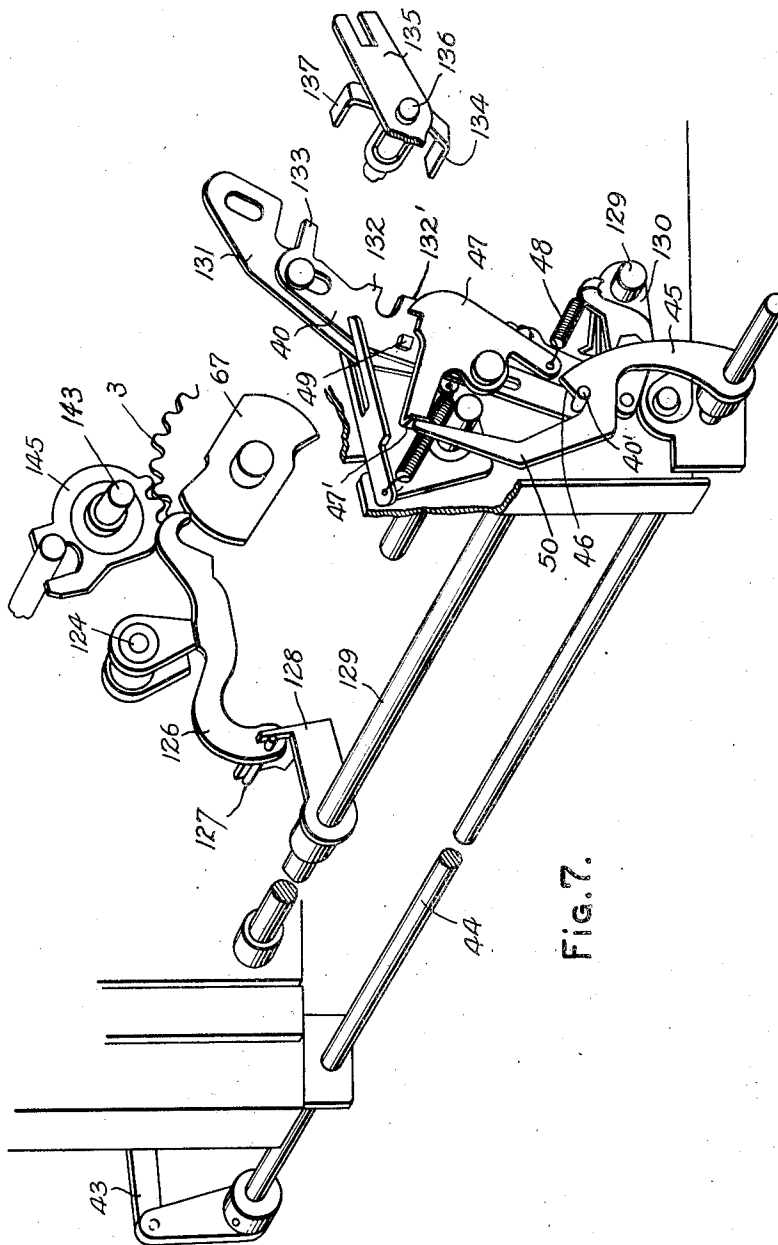


Fig. 7.

Inventor  
EDWIN F. BRITTEN, JR

C. W. Anderson & Son.

By

Attorney

July 10, 1945.

E. F. BRITTEN, JR

2,379,877

CALCULATING MACHINE

Filed Nov. 13, 1941

7 Sheets-Sheet 5

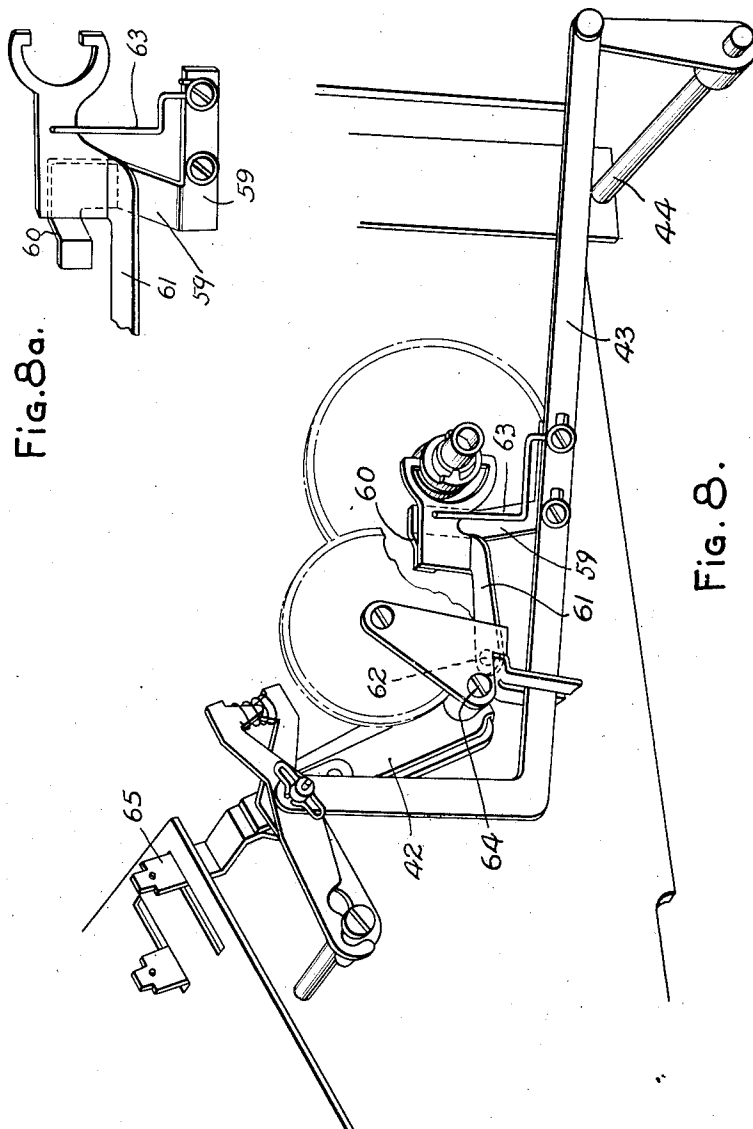


Fig. 8a.

Fig. 8.

Inventor  
EDWIN F. BRITTEN, JR.

E. W. Anderson & Son

By

Attorneys

July 10, 1945.

E. F. BRITTEN, JR

2,379,877

CALCULATING MACHINE

Filed Nov. 13, 1941

7 Sheets-Sheet 6

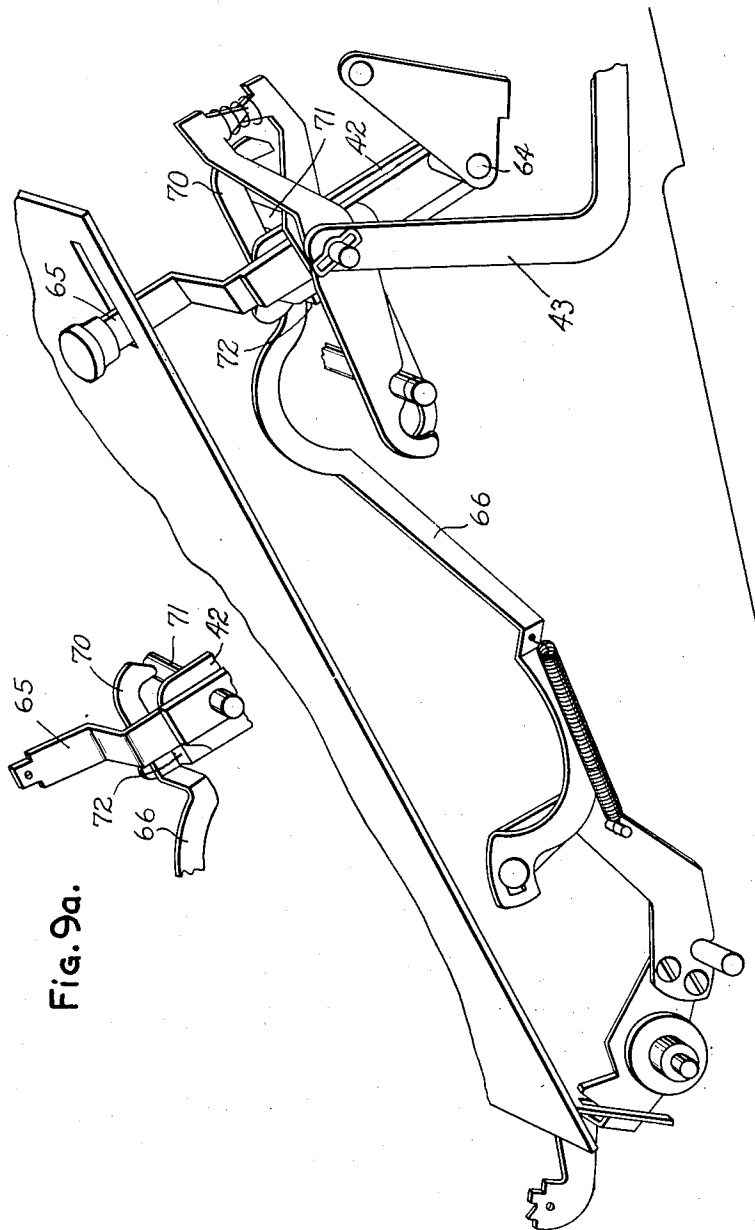


Fig. 9a.

Fig. 9.

Inventor  
EDWIN F. BRITTEN, JR.

E. W. Anderson & Son

By

Attorneys

July 10, 1945.

E. F. BRITTEN, JR

2,379,877

CALCULATING MACHINE

Filed Nov. 13, 1941

7 Sheets-Sheet 7

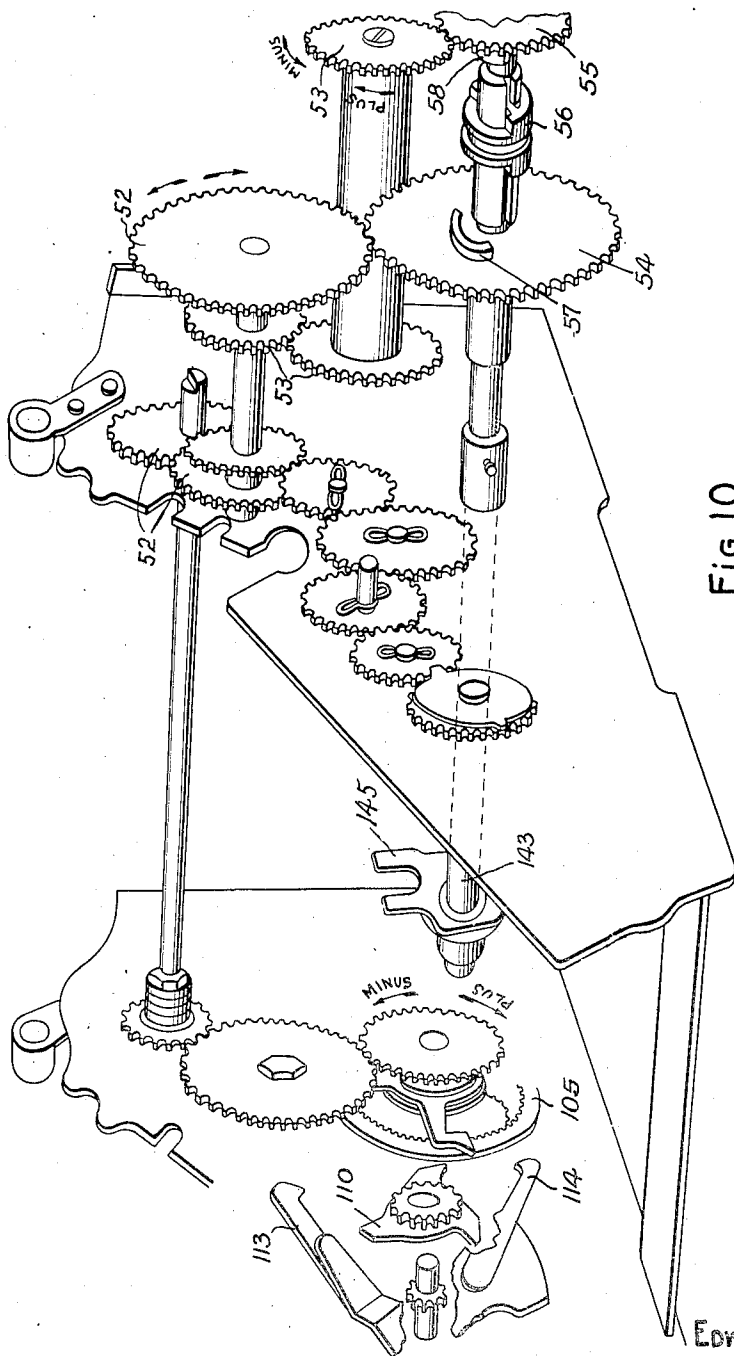


Fig. 10.

Inventor

EDWIN F. BRITTEN, JR.

C. W. Anderson

Attorney

## UNITED STATES PATENT OFFICE

2,379,877

## CALCULATING MACHINE

Edwin F. Britten, Jr., Short Hills, N. J., assignor  
to Monroe Calculating Machine Company,  
Orange, N. J., a corporation of Delaware

Application November 13, 1941, Serial No. 418,984

3 Claims. (Cl. 235—79)

The invention relates to calculating machines, and particularly to means for performing multiplication automatically upon entering the factors and starting the machine in operation.

The method of multiplication employed is that of repeated addition, modified by the well-known use of subtraction to effect short cuts; multiplication by 9 for instance being effected by adding the multiplicand once in the next higher denominational order and subtracting it once in the order being computed. Also, if an addition and one or more subtraction operations are both indicated for any one denominational order, the number of subtraction operations may be reduced by one and the addition operation eliminated. Means are employed for storing a constant multiplier value, which may thereafter be used to automatically control the multiplication operation.

An object of the invention is to provide an improved machine capable of performing automatically positive, short-cut positive, negative and short cut negative multiplication operations. Other objects and advantages will appear hereinafter.

The invention consists in the novel construction and combinations of parts as hereinafter set forth in the claims.

In the accompanying drawings,

Figure 1 is a vertical section taken through the keyboard, the registering means and the multiplier setting means of the machine, being substantially the same as Figure 1 of the U. S. patent to Britten, hereinafter referred to.

Figure 1a is a detail plan view of the multiplier counting out devices, being substantially the same as Figure 2 of said patent.

Figure 2 is a left side elevation of the machine, showing the calculating cycle starting and stopping means, the invention being shown as applied, and being similar to Figure 4 of the British patent hereinafter referred to, with certain modifications.

Figures 3 and 5 are detail partially diagrammatic side views, of the automatically settable lever, the slide borne thereby, the latch for the slide, etc., showing the parts in position for adjusting the clutch member for controlling the sign character of successive registrations in positive multiplication operations.

Figures 4 and 6 are detail views similar to Figures 3 and 5 and showing the parts in position for adjusting the clutch member for controlling the sign character of successive registrations in negative multiplication operations.

Figure 6a is a detail side view of the reverse side of the automatically settable lever, the slide borne thereby, and associated parts, showing the spring for restoring the slide.

Figure 7 is a detail perspective view of the automatically settable lever, the slide borne thereby, the latch for the slide, the rock shaft and its crank arm for disengaging the latch, one of the control fingers and the cam for setting the same for adjusting the clutch member for plus or minus character of operation of the machine, and other associated parts.

Figure 8 is a detail perspective view of the negative multiplication lever, adjusted to rearward position, the slidable clutch member adjusted accordingly, the parts connecting with the rock shaft for adjusting the slide, and other associated parts.

Figure 8a is a detail fragmentary perspective view showing the slidable clutch member in normal position.

Figure 9 is a detail perspective view of the negative multiplication lever, the restoring means therefor in effective position and the means for rendering the restoring means ineffective.

Figure 9a is a detail fragmentary perspective view, showing the restoring means in ineffective position.

Figure 10 is a detail partially diagrammatic perspective view showing the differential reversing gearing, its branched gear train connection with the spaced gears, and other associated parts.

The invention is shown as applied to a Monroe calculating machine the essential features of which are disclosed in the British Patent No. 509,747, and the prior art therein referred to, as modified by the disclosure of the U. S. patent to E. F. Britten, Jr., No. 2,201,713, dated May 21, 1940.

According to these disclosures, amounts set up on the differential actuators 5 of the machine upon depression of the value entering keys 18 of the keyboard are registered in the numeral wheels 13 either additively or subtractively according to the direction of rotation of the actuator shaft 4 and the shaft 154 upon which the tens carry members are mounted. Shafts 4 and 154 are connected at 101 (Fig. 2) with an electric motor (not shown) through suitable gearing including differential reversing gearing 105, 110, shown in part in said figure and constituting oppositely driven clutch elements. Normally this differential gearing runs idly and no rotation is transmitted therefrom to said actuators, but upon operation of suitable control means engagement

of arm 114 of clutch lever 111 forming part of said control means and constituting a clutch member, with clutch element 105, additive operation of the machine will result, while upon engagement of arm 113 of said lever with clutch element 110 subtractive operation will result through reverse rotation of said actuators. The number of rotations of shafts 4 and 154 representing the operative cycles of the machine is registered upon multiplier-quotient wheels 85 by means of revolution counting fingers in the usual manner.

The numeral wheels 13 and 85 are mounted upon a shiftable carriage 2, utilized in the well known manner, said carriage having its movements controlled as disclosed in said patents.

In performing multiplication the carriage 2 is shifted to the left, preferably into the extreme left hand position wherein the right hand numeral wheel 13 will be in line with the right hand column of keys 18.

The value entering keys 18 are adapted upon depression to rock balls 19 and thereby set selected values into the multiplicand register actuators 5 and into the multiplier control wheel actuators 6, a plurality of columns of these elements being provided into which a complete multiplier and thereafter a complete multiplicand are entered.

The multiplier having been entered by means of the keys 18, the shaft 7 will be given a single rotation and the multiplier actuators 6 will transmit the values entered therein through intermediate gearing 376 and 377 to the multiplier storage wheels 3.

The multiplicand is now entered in the actuators 5 upon depression of the keys 18 and thereafter the actuator shaft 4 is repeatedly rotated under control of the wheels 3, thereby effecting a repeated registration of the multiplicand in the register wheels 13 to represent the product. Control cams 67 are secured to the hubs of the storage gears 3 and as said gears 3 are displaced in accordance with the multiplier digit during the set-up cycle of the machine, said cams are rotated counterclockwise.

Fast upon a transverse shaft 124 (Figs. 1 and 1a) pivotally supported in the framing of the multiplying unit, is a series of cams 125, there being one of said cams for each denominational order of the machine, arranged helically around shaft 124. These cams 125 are adapted to cooperate with related control fingers 126, settable by cams 67 for adjusting the aforesaid clutch member for plus or minus character of operation of the machine. Plus-minus control fingers 126 are pivotally supported on a rod 127 fast upon a transverse bail 128, fast to a transverse shaft 129 (Figs. 1 and 2) pivotally supported in the right and left hand framing of the multiplying unit. Shaft 129 extends through the left hand main framing of the machine and has secured to this end thereof a rearwardly extending arm 130. Pivotally supported upon arm 130 is a lever 131 provided with a pair of spaced projections 132, 133. So long as the reversing control finger 126 engages the low portion of cam 67, projection 132 will lie adjacent and rearwardly of a projection 134 of a bell crank lever 135, fulcrumed to the framing at 136, while projection 133 will lie rearwardly of and beneath the projection 137 of said bell crank lever. Lever 131 has pin and slot connection 138 with an arm 139 fast to shaft 122, and as said shaft is rocked counterclockwise as described in British Patent 509,747, arm 139 will

rock the lever 131 clockwise, whereupon projection 132 engaging projection 134 will rock lever 135 counterclockwise. Lever 135 has pin and slot connection 140 with clutch lever 111 and will therefore rock said clutch lever to bring the arm 114 thereof into engagement with member 105 of the reversing gearing, thereby initiating an additive cycle of operation of the machine.

Fast to the clutch lever 111 is a pin 152, having engagement with a cam notch 153 of an arm 156 pivoted to the framing at 155. During the above described movement of clutch lever 111, arm 156 will be rocked counterclockwise to engage the contacts of switch 99 and start the motor. Arm 156 has pin and slot connection 157 with the full cycle positioner arm 158 pivoted to the framing at 159. During the said movement of arm 156, arm 158 will be rocked downwardly and out of the path of movement of a rock arm 160 pivoted at 161 and operated through link 162 by crank arm 163 fast to cyclically driven shaft 164, forming part of the cycle stopping means.

As the multiplier storage gears 3 are successively restored step by step to normal position, the multiplying operation will be terminated in each denominational order, following which the carriage will be automatically shifted to the next higher order columnar position, and the machine will continue to function until the full multiplication operation is completed, the carriage being then automatically shifted to its extreme right hand position.

The wheels 3 are successively "counted out" or returned step by step to original position or advanced to a position diametrically opposite the original position depending upon whether the multiplicand is being entered directly or complementally by means of counting fingers 145 mounted on a shaft 143 which has one-to-one ratio gear connection with the multiplicand actuator shaft 4. The counting fingers 145 are normally held out of meshing relation with the teeth of the wheels 3 by spring means and are brought successively into meshing relation therewith during the multiplying operation by means of projections 147 mounted upon intermittently rotated shaft 124 and adapted to engage the cam surfaces of guides serving to slide the fingers 145 axially along shaft 143.

As the wheels 3 are returned to their original or zero position, control means will be operated to interrupt the cyclic rotation of shaft 4; the shifting of the register carriage and the resumption of cyclic movement in the next ordinal position taking place in well known manner.

The constant multiplier value may be stored for future use in the intermediate transmission-gears 377, to which end these gears are adapted to be shifted out of mesh with the teeth of the wheels 3, and are provided with zero setting means whereby the wheels may be individually restored to a fixed or zero position.

If a multiplier value is to be retained as a constant, it is first entered by means of the keys 18 and is set in the wheels 3 in the usual manner. Thereafter, and before the multiplying operation is started, the intermediate transmission gears 377 are shifted out of mesh with the teeth of the wheels 3, cleared to zero, and shifted back into mesh. As the wheels 3 are counted back to zero during a multiplying operation, the values are transferred therefrom into the gears 377. To set a stored multiplier value into the wheels 3, the gears 377 are cleared to zero while in mesh with the teeth of the wheels 3, this operation taking

the place of the setting of a key value by rotation of shaft 7. It is to be observed that after a constant multiplier value has been stored in the gears 377, other multiplier values may be entered by means of the keys 18, set in the wheels 3 and counted out without disturbing the constant multiplier value so stored and which may still be used whenever desired. It will be further noted that it will never be necessary to clear a stored constant multiplier value from the gears 377 by a special operation since this clearing takes place automatically in the entering of a new constant multiplier value in gears 377.

A feeling bail 74 is provided with teeth engaging zero notches of cams 68 fast to the multiplier storage wheels 3, this bail being held in rocked position so long as any value remains set in any of the said wheels 3 and having control connections disclosed in the British Patent No. 509,747 for insuring operation of the machine until the entire multiplier value has been counted out.

The disclosure of said British patent provides for short cutting the multiplying operation by treating the higher value multiplier digits complementally. That is to say, an operation involving a multiplier 9 will be effected as plus 10 minus 1 in two cycles of operation of the machine.

As disclosed in the U. S. Patent No. 2,201,713, the setting of the unit in the higher order multiplier storage wheel 3 is effected by means of a projection 293 (Fig. 1) fixed in one of the actuator elements 6 contacting with a finger 295 provided with a tooth extending into the zone of the higher order wheel 376. Projection 293 having brought the tooth of finger 295 between the teeth of gear 376, a cam 37 mounted on shaft 7 will operate parts to cause such of the gears 376 as are engaged by a finger 295 to advance an additional step of movement. Thereafter, the fingers 295 will be released from the projections 293 and allowed to be restored to normal position.

In the disclosure of the said British patent there are provided multiplier storage wheels and means including an automatically settable device (lever 131 having spaced projections 132, 133) for automatically adjusting the clutch lever 111 into engagement with the clutch elements 105, 110, to control the sign character of successive registrations in accordance with values stored in said wheels in positive multiplication operations.

In the machine of applicant there are provided means for automatically adjusting the clutch lever 111 into engagement with the clutch elements 105, 110, to control the sign character of successive registrations in accordance with values stored in said wheels 3 in positive multiplication or alternatively in negative multiplication operations wherein the projections 132 and 133 form part of a slide 40, having pin and slot connection with the automatically settable lever 131, and function as if they were a rigid part of said lever 131 for adjusting the clutch lever 111 as above stated. The slide 40 is also provided with projection 132' spaced slightly below projection 132 and the purpose of which will be explained. Said means for automatically adjusting the clutch lever 111 for the purposes stated includes manipulable means for independently setting said slide 40 prior to the automatic setting of the lever 131 and said slide 40 as an entirety in a negative multiplication operation. This manipulable means includes negative multiplication lever 42, mounted at the right hand side of the machine and having link connection 43 with transverse rock shaft 44, the opposite end of said rock shaft having crank arm 45 provided with cam edge 46 engaging pin

40' of said slide 40. Upon manipulation of the negative multiplication lever 42 from normal or "off" position, to rearward or "on" position, the slide 40 will be cammed upwardly (Figs. 4 and 6), where it will be held by latch 47, urged by its spring 48 into engagement below pin 49 of said slide. Manipulation of the negative multiplication lever to rearward position also serves to adjust parts to provide for the same directions of rotation of the shaft 143 and of the counting fingers 145 fast thereon in negative as in positive multiplication operations as will be described.

In the position of the parts shown in Figs. 4 and 6, the projections 132' and 133 will function as if they were an integral part of lever 131 for adjusting the clutch lever 111 into engagement with the clutch elements 105, 110, to control the sign character of successive registrations in accordance with values stored in the multiplier storage wheels in negative multiplication operations.

Upon restoration of the negative multiplication lever to normal position, the free end 50 of crank arm 45 contacting offset 47' of latch 47 will restore said latch to normal position and thereby release slide 40, which latter will then drop under the influence of spring 51 (Fig. 6a) to normal position.

The driven shaft of the differential reversing gearing 105, 110 has gear train connection through two branches 52 and 53 of said train with spaced gears 54 and 55 both loose upon shaft 143 (Fig. 10), whereby said spaced gears are rotated in opposite directions; slidable clutch member 56 splined upon shaft 143 being engageable with clutch projection 57 of gear 54 or alternatively with clutch projection 58 of gear 55 to transmit movement of either of said spaced gears to said shaft 143.

Slidable clutch member 56 is engaged with the clutch projection of the one spaced gear in positive multiplication operations and with the clutch projection of the other spaced gear in negative multiplication operations. This engagement is effected by arm 59 of link 43 (Fig. 8) having cam 60 contacting shift lever 61 fulcrumed at 62 to adjust the latter against the tension of spring 63 upon adjustment of the negative multiplication lever to rearward or "on" position, said shift lever being restored to normal position by said spring upon restoration of the negative multiplication lever to normal position.

The negative multiplication lever 42 is fulcrumed at 64 and has a slidable handle section 65 having slot and pin connection with the lower section of said lever, whereby said handle section may be adjusted from "down" to "up" position and vice versa.

The keyboard clear key (not shown) of the machine has operating connection with link 66 (Figs. 9 and 9a), the hooked free end 70 of which engages pin 71 of the negative multiplication lever to restore the latter from rearward to normal forward position upon depression of said clear key; the slidable handle section of said lever having an offset 72 contacting said link 66 to raise the hooked free end thereof from engagement with pin 71 when said slidable section is adjusted to "up" position, in which latter case depression of the keyboard clear key will be ineffective to restore the negative multiplication lever from rearward to normal position.

The negative multiplication lever 42 is yieldably maintained in normal forward and in rear-

ward positions by suitable locator means (Figs. 8 and 9) and is prevented from being adjusted from normal to rearward position during the functioning of the machine in positive multiplication operations by suitable releasable locking means.

I claim:

1. In a calculating machine, the combination with a product register, and means for effecting plus or alternatively minus registrations therein including power driven reversible actuating means having a driving train provided with oppositely driven clutch elements and control means including a clutch member and manipulable means for controlling said clutch member; of multiplier storage wheels, means for storing multiplier values therein in repeated registration multiplication operations, and means for automatically adjusting said clutch member into engagement with said clutch elements to control the sign character of successive registrations in accordance with values stored in said wheels in positive multiplication or alternatively in negative multiplication operations including a settable composite device having a part settable therewith and also independently settable, means cooperating with and controlled by said multiplier storage wheels for automatically setting said device as an entirety and manipulable means for independently setting said part prior to said automatic setting in negative multiplication operations.

2. In a calculating machine, the combination with a product register, and means for effecting plus or alternatively minus registrations therein including power driven reversible actuating means having a driving train provided with oppositely driven clutch elements and control means including a clutch member and manipulable means for controlling said clutch member; of multiplier storage wheels, means for storing multiplier values therein in repeated registration multiplication operations, and means for automatically adjusting said clutch member into engagement with said clutch elements to control the sign character of successive registrations in accordance with values stored in said wheels in positive multiplication or alternatively in negative multiplication operations including a lever having a slide, means cooperating with and controlled by said multiplier storage wheels for automatically setting said lever and its slide as an entirety, and manipulable means for independently setting said slide prior to said automatic setting in negative multiplication operations.

3. In a calculating machine, the combination with a product register, and means for effecting plus or alternatively minus registrations therein including power driven reversible actuating means having a driving train provided with oppositely driven clutch elements and control means including a clutch member and manipulable means for controlling said clutch member; of multiplier storage wheels, means for storing multiplier values therein in repeated registration multiplication operations, and means for automatically adjusting said clutch member into engagement with said clutch elements to control the sign character of successive registrations in accordance with values stored in said wheels in positive multiplication or alternatively in negative multiplication operations including a settable composite device having a part settable therewith and also independently settable, means cooperating with and controlled by said multiplier storage wheels for automatically setting said device as an entirety, means including a manipulable device for independently setting said part prior to said automatic setting in negative multiplication operations, a latch for said independently settable part and means for releasing said latch upon restoration of said manipulable device.

4. In a calculating machine, the combination with a product register, and means for effecting plus or alternatively minus registrations therein including power driven reversible actuating means having a driving train provided with oppositely driven clutch elements and control means including a clutch member and manipulable means for controlling said clutch member; of multiplier storage wheels, means for storing multiplier values therein in repeated registration multiplication operations, and means for automatically adjusting said clutch member into engagement with said clutch elements to control the sign character of successive registrations in accordance with values stored in said wheels in positive multiplication or alternatively in negative multiplication operations including a lever having a slide, means cooperating with and controlled by said multiplier storage wheels for automatically setting said lever and its slide as an entirety, and manipulable means for independently setting said slide prior to said automatic setting in negative multiplication operations.

EDWIN F. BRITTEN, JR.