

March 2, 1948.

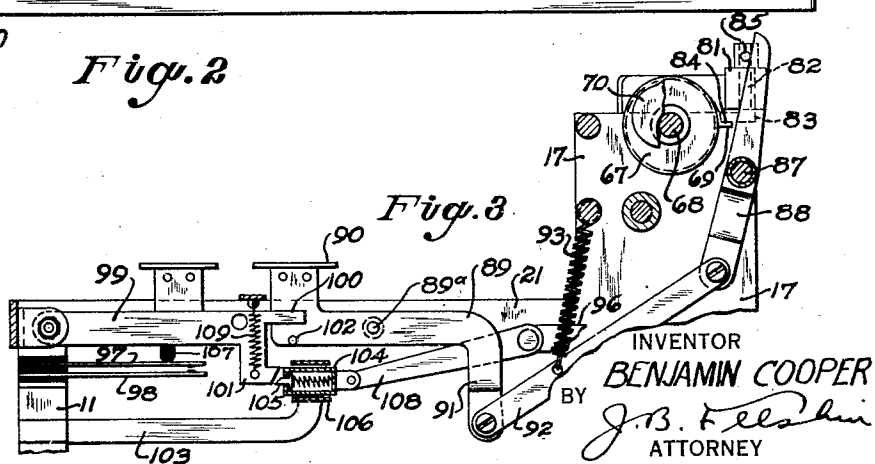
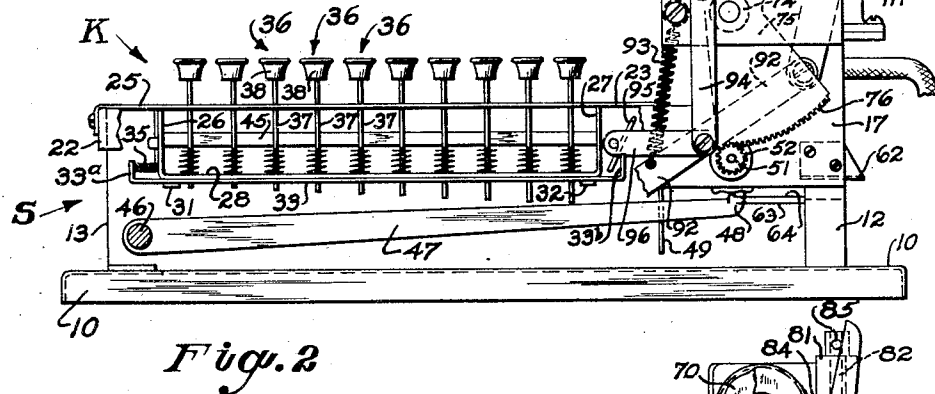
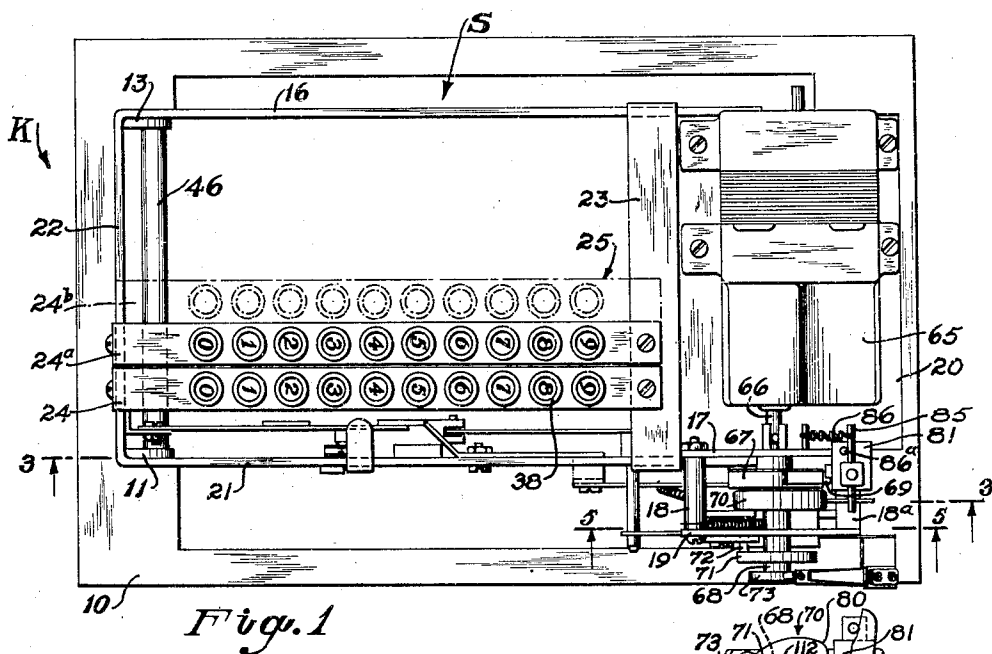
B. COOPER

2,436,790

ADDING MACHINE

Filed June 26, 1940

4 Sheets-Sheet 1



March 2, 1948.

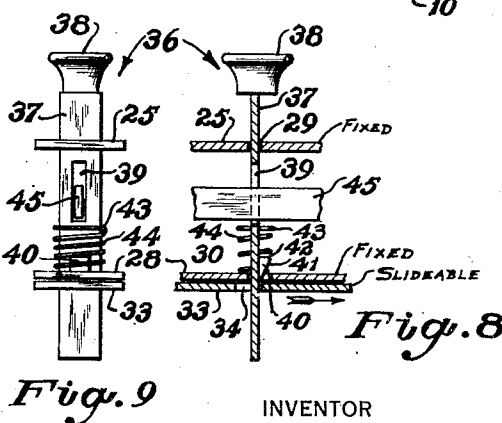
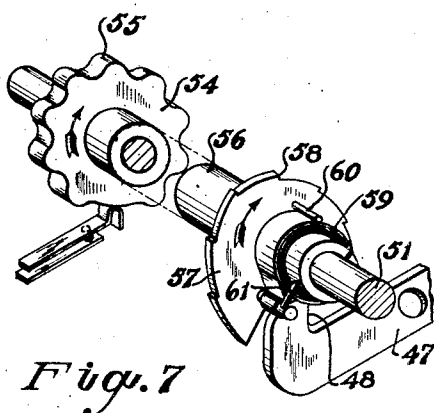
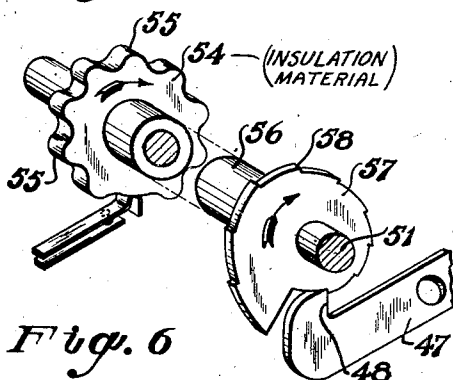
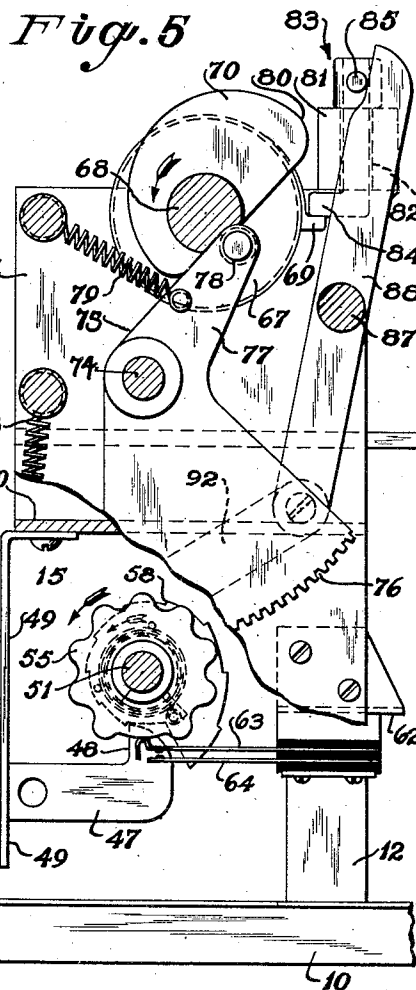
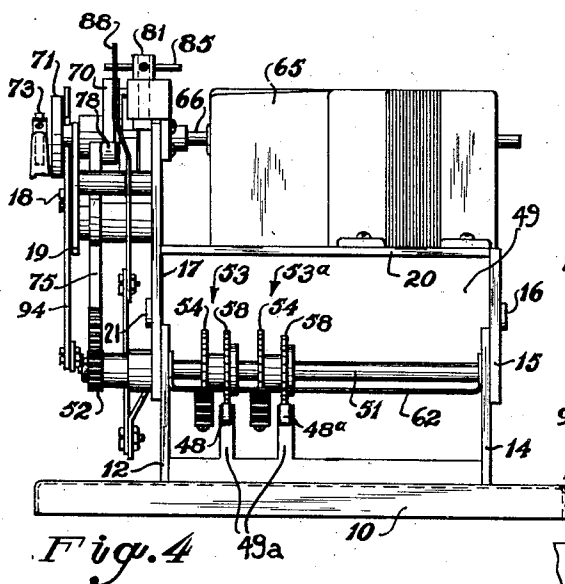
B. COOPER

2,436,790

ADDING MACHINE

Filed June 26, 1940

4 Sheets-Sheet 2



INVENTOR  
BENJAMIN COOPER  
BY J. B. Felsch  
ATTORNEY

**March 2, 1948.**

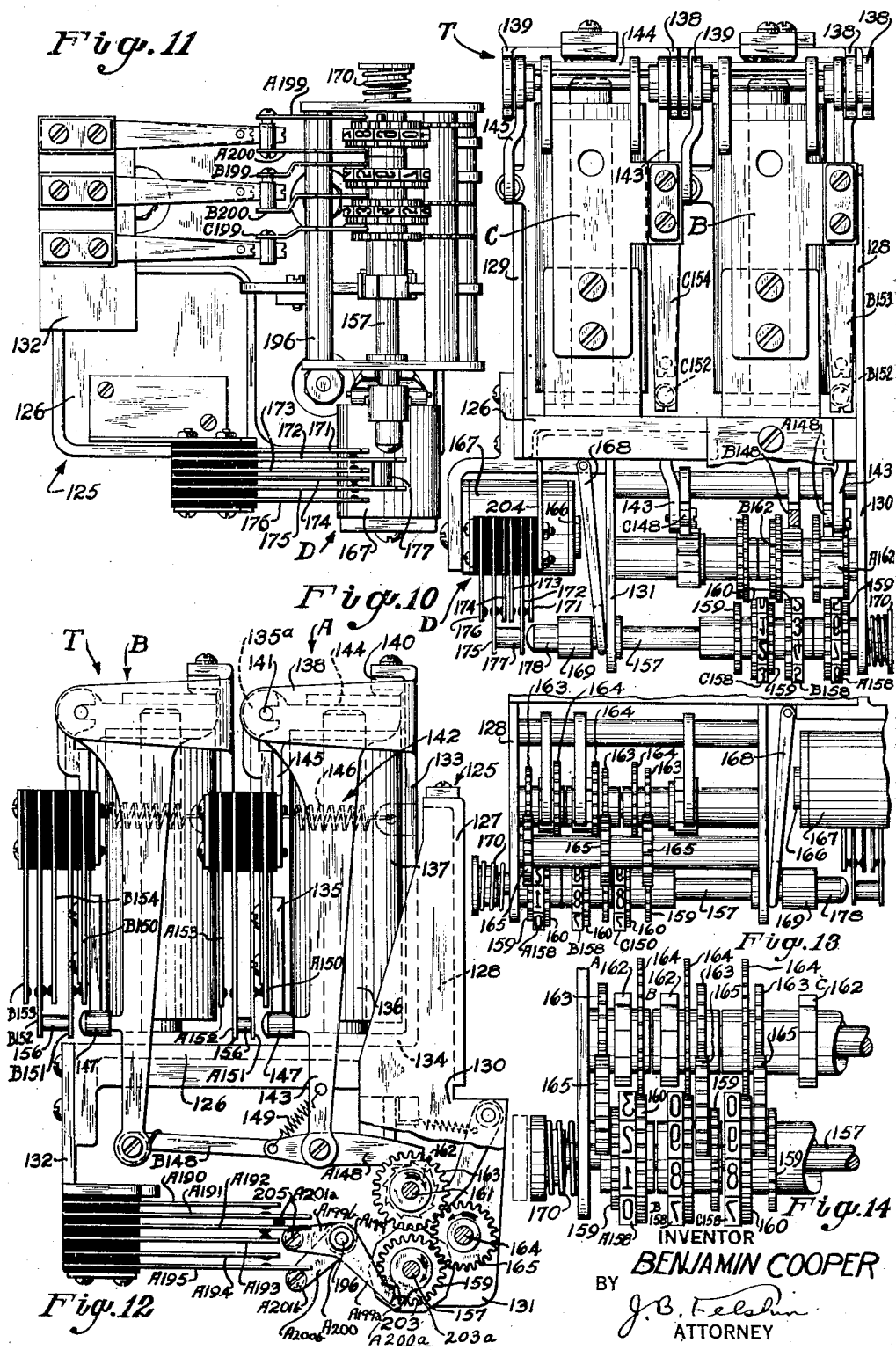
B. COOPER

**2,436,790**

ADDING MACHINE

Filed June 26, 1940

4 Sheets-Sheet 3



**March 2, 1948.**

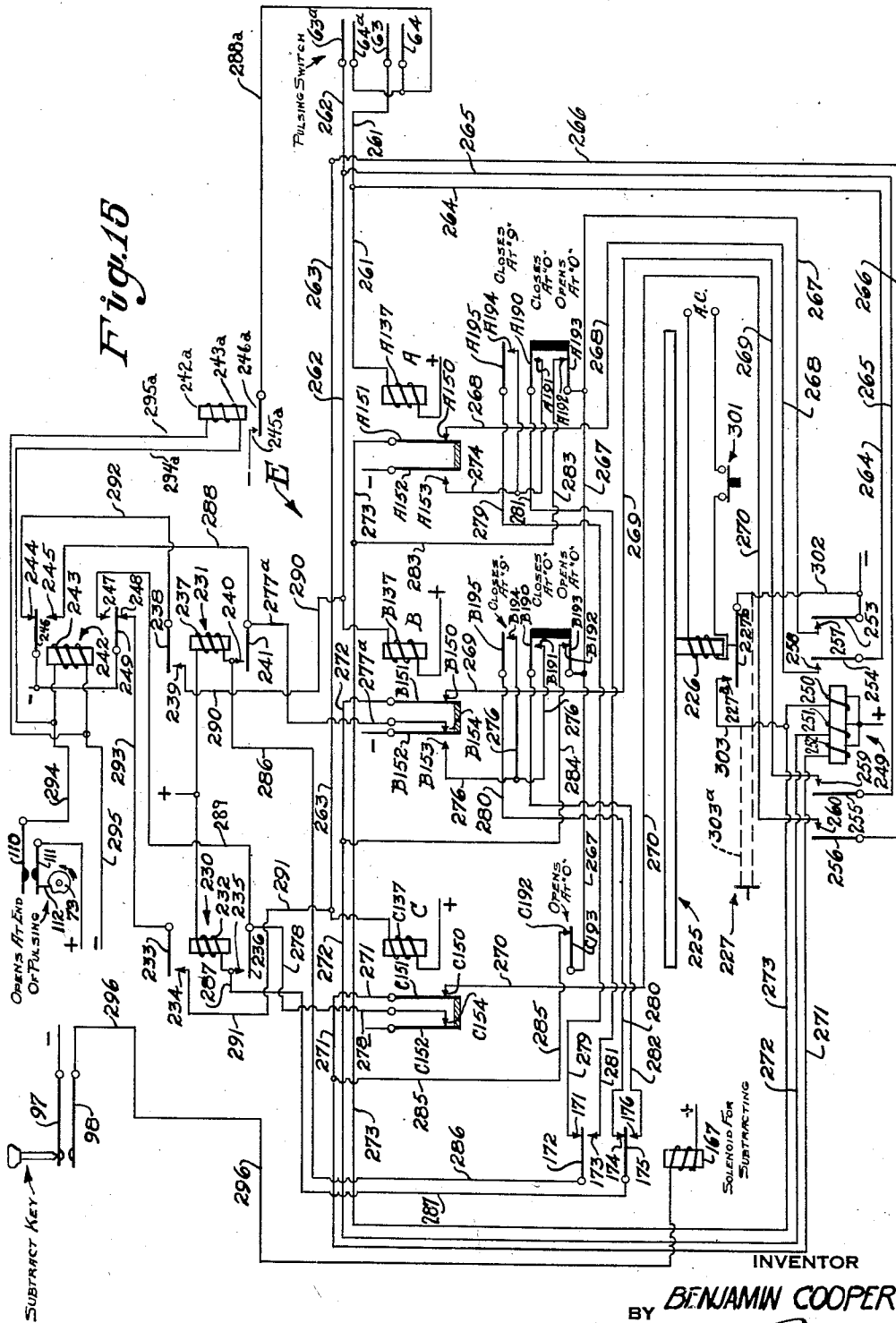
B. COOPER

**2,436,790**

# ADDING MACHINE

Filed June 26, 1940

4. Sheets-Sheet 4



INVENTOR

BY *BENJAMIN COOPER*

*J. B. F. Elshin*  
ATTORNEY

## UNITED STATES PATENT OFFICE

2,436,790

## ADDING MACHINE

Benjamin Cooper, Jersey City, N. J.

Application June 26, 1940, Serial No. 342,505

7 Claims. (Cl. 235-133)

1

This invention relates to adding machines.

Certain features disclosed herein are disclosed in applicant's copending application, Ser. No. 277,006, filed June 2, 1939, for Weight recording system.

Adding machines generally comprise two parts; a keyboard on which the number to be added or subtracted is set up by depressing keys corresponding to the digits of said number, and a totalizer controlled by the depressed keys which performs the numerical operations and indicates by counter wheels on type racks the total sum of several consecutive additions and/or subtractions. In prior adding machines, the keyboard and totalizer were usually incorporated into one machine because of the complex mechanical connections required between them.

It is an object of this invention to provide an improved adding and subtracting machine in which the keyboard and totalizing unit may be located remotely from each other. Thus, in department stores clerks may operate the keyboards at the sales counters, and the totals will be automatically recorded in a central administration department. Said improved adding machine comprises a keyboard pulsing unit, having a plurality of pulsers for pulsing separately the digits of the numbers represented by a plurality of depressed keys; a totalizing unit, comprising a plurality of electromagnetically actuated type wheels responsive to said pulses; and a circuit connecting said pulsing unit and totalizing unit, having means to add and subtract on the totalizing type wheels the numbers represented by successive groups of pulses transmitted by the keyboard pulsing unit.

Another object of this invention is to provide a keyboard pulsing unit for use in an adding machine of the character described, which will transmit electrical impulses corresponding to the digits of the number represented by depressed keys on the keyboard.

Yet another object of this invention is to provide an electromagnetic totalizing counter of the character described which will respond to successive groups of pulses representing the digits of numbers, for adding or subtracting said numbers.

Still another object of this invention is to provide, with a totalizing counter of the character

2

described, means for obtaining printed records of the totalizing counter total whenever desired by the operator.

Yet another object of this invention is to provide a totalizing counter of the character described which can be readily reset to zero for starting a new series of arithmetical operations.

In totalizing counters of the character described, means must be provided for advancing a succeeding digit wheel when any wheel is rotated through zero. When adding, each time a digit wheel is advanced through zero the succeeding wheel must be advanced one digit; and when subtracting, each time a wheel is reversed through zero the succeeding wheel must be retarded one digit. In prior adding machines the transfer of digits is accomplished by mechanical interconnection between the wheels. It is a still further object of this invention, therefore, to provide an adding and subtracting counter of the character described in which the transferring of digits from one wheel to the next is accomplished electrically, without any mechanical connection between said wheels.

Still another object of this invention is to provide a device of the character described which shall be relatively inexpensive to manufacture, positive in operation and yet practical and efficient to a high degree in use.

Other objects of this invention will in part be obvious, and in part be hereinafter pointed out.

This invention accordingly consists in the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereinafter described, and of which the scope of application will be indicated in the following claims:

In the accompanying drawings,

Fig. 1 illustrates a top elevational view of the keyboard pulsing unit embodying the invention;

Fig. 2 illustrates a side elevational view of the structure shown in Fig. 1, with part of the keyboard panel removed to show the interior construction;

Fig. 3 illustrates a view of the adding and subtracting actuating lever taken on the line 3-3 of Fig. 1;

Fig. 4 represents a rear view of the structure shown in Fig. 1;

Fig. 5 is a cross-sectional view taken on line 5—5 of Fig. 1;

Fig. 6 is a perspective view of the pulser units;

Fig. 7 is another perspective view of said pulser units;

Fig. 8 is a cross-sectional view of one of the digit keys;

Fig. 9 is a rear elevational view of said digit key;

Fig. 10 is a rear view of the totalizing unit;

Fig. 11 is a bottom elevational view of the structure shown in Fig. 10;

Fig. 12 is a side elevational view of the structure shown in Fig. 10;

Fig. 13 is a partial front elevational view of the digit wheels in adding position;

Fig. 14 is a partial front elevational view of the digit wheels in subtracting position; and

Fig. 15 is a schematic drawing of the electrical circuit connecting the keyboard and the totalizing unit.

The adding machine described herein, and embodying the invention, comprises a keyboard pulsing unit K, illustrated in Figs. 1 through 9, a totalizing counter T, illustrated in Figs. 10 through 14, and an electrical circuit E connecting said keyboard K and totalizer T and illustrated schematically in Fig. 15.

#### The keyboard

Referring in detail to Figs. 1 and 4, the keyboard pulser K comprises a horizontal rectangularly shaped base 10, having attached thereto four upwardly extending vertical legs 11, 12, 13 and 14, disposed one adjacent each corner of said base. Attached to the legs 12, 14 are vertical side plates 15, 17, respectively. The plate 17 is longer than plate 15 and extends upwardly above said plate. Attached between the top edge of plate 15 and plate 17 is a horizontal shelf 20. Also attached to the plate 17, and spaced outwardly therefrom on the side opposite the plate 15, is a parallel plate 19 attached to said plate 17 by spacers 18 and 18a.

The front leg 11 is attached to side plate 17 by a horizontal side strap 21 and leg 13 is attached to side plate 15 by a similar horizontal side strap 16. The front legs 11 and 13 are further fastened together by a transverse strap 22, thus forming a rigid supporting structure. Attached to the side straps 16, 21, and extending transversely across the top of side straps adjacent the rear legs 12, 14, is a horizontal cross arm 23.

Longitudinally positioned within said supporting structure is a pair of similar key guide boxes 24, 24a, 24b, etc. Only the first two boxes, 24, 24a, are disclosed. Each box comprises an upper longitudinal horizontal guide plate 25 fastened to arms 22, 23.

Rigidly attached to plate 25, as by vertical arms 26, 27, is a parallel lower guide plate 28. The plates 25 and 28 are formed with preferably ten slots 29, 30 in vertical alignment, Figs. 2 and 8, the slots 30 being slightly wider than the slots 29. Slidably attached to said lower guide plate 28, as by guide studs 31, 32 is a horizontal locking plate 33 having longitudinal slots to receive said studs. The plate 33 is also formed with ten slots 34 of the same width as the slots 30 and aligned therewith. Said plate 33 is normally urged to the left, looking at Fig. 2 of the drawing, by a coil compression spring 35 interposed between an ear 33a, on plate 33, and the arm 26.

Slidably received in each group of vertically aligned slots 29, 30 and 34, is the shank 37 of

a key 36, Figs. 8 and 9, having attached to the top thereof a finger knob 38, having marked thereon the digit represented by the key. The shank 37 is formed with a vertical slot 39, and also has integral therewith and near the bottom thereof a stop 40 formed with an inclined edge 41 and a top horizontal edge 42. Also integrally attached to said shank 37 is a collar 43. A coil compression spring 44, interposed between said collar 43 and plate 28, normally urges said key upwardly. There is further, attached to the arms 26, 27, a horizontal longitudinal bar 45 passing through the slots 39 of all the keys 36 in the key guide box 24. Said bar 45 serves as a stop to limit the upward movement of the keys 36 by the spring 44, and also acts as a further guide for maintaining said keys in vertical position.

When a key 36 is depressed, the inclined edge 41 of the corresponding stop 40 engages the edge of slot 34 moving locking plate 33 to the right against the tension of spring 35. When the key is completely depressed stop 40 has passed beneath the slot 34 releasing plate 33 and permitting said plate to be returned to the left by spring 35, thus locking the horizontal edge 42 of said stop beneath said locking plate 33 for maintaining said key in depressed position. If a second key of the same key guide box is subsequently depressed, as for example to cancel an error, the initial movement to the right of plate 35 releases the first depressed key and the return movement to the left locks the second key so that two keys cannot unintentionally remain depressed simultaneously.

Received in horizontally aligned holes in the legs 11, 13 is a transverse shaft 46 having pivotally mounted thereon two arms 47, 47a, positioned below and in vertical alignment with the key guide boxes 24, 24a, respectively. Said arms 47, 47a have at their free ends upwardly extending pawls 48, 48a, respectively, for purposes hereinafter appearing. There is further attached to the plate 20, and extending downwardly therefrom, a guide plate 49 formed with vertical grooves 49a slidably receiving the arms 47, 47a for maintaining said arms in longitudinal alignment. Attached between the plate 49 and the arms 47, 47a are coil tension springs 50, 50a, respectively, normally urging said arms in a counterclockwise direction.

#### The pulsing units

Rotatably received, in a pair of horizontally aligned holes in side plates 15, 17, is a transverse shaft 51 having rigidly attached to one end, adjacent the outside face of plate 17, a pinion 52. Also rotatably mounted on said shaft 51 and disposed between the plates 15, 17 are two similar pulsing units 53, 53a.

Each pulsing unit, Figs. 6 and 7, comprises a disc 54 of insulating material formed with preferably nine teeth 55 on its circumferential edge. Rigidly attached to said disc, as by collar 56, is a cam 57, also provided with preferably nine steps 58 on its circumferential face. Said steps 58 encompass the same circumferential angle as the teeth 55, but are formed in ascending heights, whereby said cam has a stepped spiral shape. Connected between the cams 57 and the shaft 51 are coil spiral springs 59. Also rigid with each cam 57 and projecting outwardly therefrom is a stud 60. Cooperating with said stud 60, in a manner to be hereinafter described, is a pin 61

integral with and projecting radially from shaft 51.

The pulsing units 53, 53a are disposed on the shaft 51 so that the cams 57 are vertically above the pawls 48, 48a, and in position to have their steps engaged therewith.

There is further fastened between the vertical legs 12, 14, contact mounting panel 62 having mounted thereon, and insulated therefrom and from each other, two pairs of normally open contacts 63, 64 and 63a, 64a, etc. Said contacts are positioned to be engaged and closed by the teeth 55 of pulsing discs 54 of the respective pulsers 53, 53a, so that when said disc 54 is rotated, in a manner to be hereinafter described, the corresponding contact arms are pressed together each time a tooth 55 of said disc 54 moves by said contact arms.

Means is provided to rotate shaft 51 in a counter-clockwise direction, looking at Figs. 2 and 5, for causing disc 54 to be rotated for actuating said pulser switches 63, 64 and 63a, 64a. To this end, there is mounted on the horizontal plate 20, a motor 65 of any suitable type and having a horizontal output shaft 66 projecting through an aperture in plate 17 and connected to the input side of a one-revolution clutch 67. The output shaft 68 of said clutch is journaled in plate 19 and has a portion thereof projecting through said plate beyond the outside face thereof.

The one-revolution clutch 67 may be of any suitable type, having a radially extending ear 69. When said ear is restrained from moving in a counter-clockwise direction, looking at Fig. 5, in a manner to be explained herewith, the mechanism within said clutch 67 is released for preventing transmission of the rotation of shaft 66 to shaft 68. However, when said ear 69 is released the clutch mechanism becomes actuated for engaging the two shafts and allowing rotation of the shaft 66 to also rotate the shaft 68. One-revolution clutches of this character are known and old to the art.

Rigidly mounted on shaft 68, and disposed adjacent the clutch 67, is a cam 70. Cooperating with said cam 70 is a crank 75, pivoted to plate 17, as at 74, one arm of which is in the form of a gear sector 76 engaging the pinion 52. Said crank 75 also has an upwardly extending arm 77 carrying rotatably mounted at its upper end a horizontal roller 78 engaging the peripheral edge of the cam 70. A spring 79 attached between said arm 77 and the plate 17 tensions said roller in contact with the edge of said cam 70.

There is further provided, mounted to the plate 17, a block 81 having therein a vertical through opening 82 rotatably receiving a stud 83. Said stud 83 has a horizontal projection 84 at its bottom end engaging the ear 69 of the clutch 67. The top end of said stud 83 has rigid therewith a horizontal transverse pin 85, one end of which is connected to the wall 17 by a spring 86 for urging said stud to pivot in a counter-clockwise direction, against a stop 86a on block 81, looking at Fig. 1 of the drawing, for maintaining the projection 84 in engagement with the ear 69 of the clutch 67. Pivoted to the plate 17, as at 87, is a vertical arm 88 whose top end engages the pin 85. Pivotally connected to the side strap 21, Fig. 3, as at 89a is a lever 89 having at one end an addition key 90. The other end of said lever 89 comprises a downwardly extending arm 91 connected by link 92 to the lower end of arm 88.

The link 92 is connected to plate 17 by a coil tension spring 93.

The motor 65 is constantly excited from any suitable power source so that the shaft 66 continually rotates in a counter-clockwise direction. When the key 90 is depressed the link 92 is moved upwardly pivoting arm 88 in a counter-clockwise direction for rocking the stud 83 to move the projection 84 and release the ear 69, thus permitting the shaft 68 to be rotated by the motor 65. When said key 90 is released the stud 83 is returned to normal position by the spring 86 thus returning the projection 84 into the path of the ear 69 so that when clutch 67 has completed one revolution the ear 69 again engages the projection 84 for stopping the shaft 68.

It is seen that when shaft 68 is rotated in a counter-clockwise direction the segment 75 is rotated clockwise by the action of cam 70, and shaft 51 is also consequently oscillated first in a counter-clockwise direction and then returned clockwise. Said cam 70 is so proportioned that when the reversing point 80 of said cam passes the roller 78 the shaft 51 will have been rotated one complete revolution. The continued motion of shaft 68 pivots segment 75 in the reverse or counter-clockwise direction, looking at Fig. 2 of the drawing, so that shaft 51 is returned one revolution in a clockwise direction.

It is therefore understood that each actuation of the addition key 90 results in an oscillation of the shaft 51; first one revolution in a counter-clockwise direction, and then returning one revolution in the clockwise direction.

#### *The operation of the keyboard and pulsing units*

The operation of the keyboard will now be described when an addition is to be performed. First the keys 36 are depressed corresponding to the number to be added. Referring to Figs. 2 and 5, it is seen that the shanks 37 of the keys 36 are of different lengths. When a key 36 is depressed the corresponding shank 37 engages the arms 47 pivoting said arm clockwise against the tension of spring 59, and moving pawl 48 downwardly.

The lengths of shanks 37 are so proportioned that the angle through which the arm 47 is pivoted is proportional to the digit represented by the depressed key. Furthermore, the distance which pawl 48 moves downwardly, when lowered by the depression of any key, is equal to the digit represented by the key, multiplied by the height of each step of the cam 57.

The angle determines the number of pulses which hence corresponds to the digit on the depressed key.

Although shaft 51 oscillates for a complete revolution, back and forth, the pulsers 53, 53a move only through an angle determined by the key, and the pulser pulses a number of times equal to the digit on said key.

After the number has been set up on the keyboard, the addition key 90 is depressed causing shafts 68 and 51 to be rotated. As shaft 51 is rotated counterclockwise, the pulsing discs 54 will also be rotated counter-clockwise through the spring 59, moving the said pulsing discs past the respective switches 63, 64 and 63a, 64a, etc., and causing said switches to be pulsed as heretofor described. However, as each cam 57 rotates, one of its steps 53 will be engaged by the corresponding pawl 48, 48a preventing further rotation of said cam 57 and pulsing disc 54. The step which engages the pawl is determined by

the key which has been depressed, as the position of the pawl 48 is determined by the depressed key. As shaft 51 continues to complete its revolution, after cam 57 has stopped rotating, the spring 59 will absorb the additional movement and become tensioned.

For example, if the digit key number "7" were depressed, lever 47 would be rotated to such a position that pawl 48 would engage the seventh step of cam 57 thus permitting the disc 54 to be rotated an amount corresponding to the seven notches thereof and closing arms 63, 64 seven times.

Upon the reverse, or clockwise, rotation of shaft 51 the pin 60 will become engaged by the stud 61 for rotating said pulser discs 54, 54a, etc. back to normal position after the pulsing is completed. On the return motion of said discs, the pulsing switches 63, 64, etc. are again closed. As will hereinafter be described, the pulsing switches during the return motion of the said discs will not be connected in a pulsing circuit.

Means is provided to release the digit keys depressed after the completion of the pulsing operation. To this end there is provided, rigidly attached to the shaft 68 adjacent the outside face of plate 19, a disc 71 carrying an inwardly extending stud 72. Also pivoted to plate 17, as at 94a, is a lever 94 having a hooked upper end disposed in the path of said stud. There is further pivoted to the side straps 21, 15 a plate 95 engaging the rearward upturned ends 33b of the locking plates 33 of the key guide boxes 24, 24a, etc. Said plate 95 is connected to the lower end of arm 94 by a link 96.

The pin 72 is so positioned on disc 71 to engage the arm 94 just before the shaft 68 completes its revolution whereby lever 94 is rocked counter-clockwise, looking at Fig. 2, after the pulsing operation is terminated, moving link 96 to the right and pivoting plate 95 counter-clockwise. The locking plates 34 are consequently moved to the right releasing the stops 40 of the depressed keys 36 and permitting said keys to be returned to normal position by the springs 44. The lever 94 is released by pin 72 just as the shaft 68 completes its revolution, thus permitting the locking plates 34 to return to the left under the influence of springs 35 and resetting the key guide boxes for subsequent reactivation.

As heretofore described, if after the digit keys are depressed and before the addition key is actuated, the depressed key in any column may be changed by subsequently depressing a second key in the same column, whereby the first depressed key is automatically returned to normal position. However, means is provided to return all the depressed keys to normal position after the addition key is depressed and the pulses transmitted.

Means is also provided to energize an electric coil, to be described hereinafter, when a subtraction operation is to be performed. To this end there is mounted on the vertical leg 11 a pair of normally open contact arms 97, 98, insulated therefrom and from each other, extending rearwardly from said leg. Also pivoted to said leg 11 is a horizontal arm 99 normally urged upwardly by a spring 109 interconnected with the arm. Said arm 99 carries an insulating stud 107, positioned to engage the contact arm 97. Said arm 99 also has at its free end a projection 100 and a downwardly extending hook 101. Positioned below projection 100 is a stud 102 integral with the lever 89, adapted to be contacted by said finger when arm 99 is depressed. Slidably fastened to

the leg 11, as by bracket 103, is a hollow cylinder 104 carrying therein a small bolt 105 projecting through an aperture in one end of said cylinder. Said bolt 105 is tensioned against the end of said cylinder 104 by a coil compression spring 106.

The cylinder 104 is connected to the link 96 by an arm 108.

When the subtraction arm 99 is depressed, the projection 100 engages the pin 102 on arm 89 for depressing the adding lever 89 for releasing the clutch 67 and actuating the pulsing switches 63, 64 and 63a, 64a, as heretofore described. Also, the projecting stud 107 on arm 99 moves contacts 97, 98 into engagement. During the downward movement of hook 101 the bolt 105 is engaged by said hook 101, and is moved to the right, looking at Fig. 3, to permit said hook to pass on its downward motion. When said subtraction lever 99 is released it is returned upwardly by the spring 109 a sufficient distance to release the adding arm 89. However, the subtraction lever 99 is not completely returned to normal position since the hook 101 becomes engaged beneath the bolt 105. Thus, the contacts 97, 98 are maintained in closed position.

After the pulsing operation is completed and the arm 94 is pivoted for releasing the keys 36, the cylinder 106 is simultaneously moved to the right by link 108. The hook 101 is released from engagement with the bolt 105, permitting the subtraction arm 99 to be completely returned to normal position for opening the contacts 97, 98.

There is further mounted on the plate 19, in any suitable manner, insulated therefrom and from each other, a pair of normally open contact arms 110, 111. Means is provided to close said contact arms 110, 111 during the time crank 75 is actuated and returns to normal. To this end, there is provided, fastened to the end of shaft 68, a cam 73. Contact arm 111 carries at its end an insulating stud 112 engaging the peripheral edge, with said cam 73. Referring to Fig. 2, it will be seen that during the initial movement of the shaft 68, said insulating stud 112 is engaged by cam 73 for moving the contact arm 111 into engagement with the arm 110. However, during the last part of the motion of shaft 68 said insulating stud 112 is released by said cam 71 for opening said contact arms 110, 111. The cam 73 is so proportioned that the contact arms 110, 111 are maintained in closed position when the pulsing discs are initially rotated, and said contacts are opened during the portion of the revolution of shaft 68 in which the pulsing discs are being returned to normal position.

The operations of the pulsing unit K are accordingly performed in the following sequence: First the keys 36 are depressed by the keyboard operator for indicating the number to be added or subtracted. If the number is to be added, the addition key is then depressed by the operator for releasing the shaft 68 and rotating the shaft 51 to cause the corresponding pulsing switches 63, 64 and 63a, 64a to be actuated for pulsing the digits corresponding to the keys depressed. After completion of the pulsing operation the arm 94 is pivoted for releasing the keys and resetting the keyboard. If the number indicated on the keyboard is to be subtracted, the subtraction key is depressed by the operator thereby closing the contacts 97, 98 in addition to actuating the pulsing units 53, 53a for transmitting pulses representing the number set up on the keyboard.

Referring to Figs. 10, 11 and 12, there is illustrated a totalizing unit T comprising a mounting frame 125 having a horizontal base 126, and integral therewith and extending upwardly from the edge thereof, a vertical front wall 127. Integrally fastened between the side edges of front wall 127 and the horizontal wall 126 are a pair of parallel vertical side walls 128, 129. Wall 128 has a portion 130 projecting downwardly below the base 126. Fastened to the bottom surface of base 126 and projecting downwardly therefrom is a flange 131 parallel and similar to the portion 130 of the side wall 128. Also integrally fastened to the horizontal base 126 at the back portion thereof, is a downwardly extending contact mounting panel 132.

Rigidly mounted to base 126 are three similar upright electromagnetic solenoids, A, B, and C. Solenoids A and C are disposed side by side, adjacent the front wall 127, and the solenoid B is mounted behind solenoid A.

Each solenoid, A, B, and C, comprises a U-shaped frame having a front vertical wall 133, a bottom wall 134, and a rear vertical wall 135 parallel to wall 133. Rigidly attached to the bottom wall 134, and extending vertically upwardly between the walls 133, 135, is a solenoid core 136 having an actuating coil 137 thereabout.

Integral with the top edge of said front wall 133, and projecting to the rear over the coil 137, is a stop 140. The front wall 133 also carries at its upper portion a pair of similar rearwardly extending ears 138, 139, one on either side of said wall. Said ears 138, 139 are formed with a pair of horizontally aligned holes receiving therein a shaft 141 to which the rear solenoid wall is attached, as at 135a. Pivotaly mounted on said shaft 141 is a bell crank member 142 having a downwardly extending arm 143 adjacent the ear 138 and projecting below the base 126. Said bell crank 142 also comprises a horizontal plate portion 144 overlying the solenoid core 136, and an arm 145 extending downwardly therefrom adjacent the ear 139. Connected between the arm 145 and the front solenoid wall 133 is a spring 146 urging bell crank member 142 to pivot in a counter-clockwise direction, looking at Fig. 12 of the drawing, to normally tension plate 144 against the stop 140.

The crank arm 143 has integral therewith, at approximately the level of the base 126, a rearwardly projecting stud 147 of insulating material. The bottom of said arm 143 has pivoted thereto a pawl 148, normally urged to rotate in a clockwise direction, looking at Fig. 12 of the drawing, by a spring 149 attached between the pawl and arm 143.

Solenoid A has mounted on its rear wall 135 and positioned directly behind the arm 143, four vertical contact arms A150, A151, A152, and A153, insulated from said wall and from each other. The arms A151, A152 are fastened mechanically at their lower ends by an insulating spacer 156. Arm A150 normally contacts arm A151. When coil A137 of solenoid A is energized, plate 144 is attracted downwardly toward the core 136 pivoting arm 143 in a counter-clockwise direction, looking at Fig. 12, and moving stud 147 to the left. Said stud 147 is positioned to engage the arm A151 for moving the contacts A151, A152 to the left, opening the normally closed arms A150, A151, and closing the normally open contacts A152, A153.

Solenoid B similarly has a crank arm 143, carrying a pawl B148 at its bottom end. There are also mounted on the rear wall of solenoid B, five contact arms, B150, B151, B152, B153, and B154, disposed similarly to the contact arms of solenoid A. The contacts B150, B151 and contacts B152, B154 are normally in engagement, but are opened when the arm 143 of solenoid B is pivoted by energization of coil B137. The normally open contacts B152, B153 are brought into engagement when the coil is energized.

Similarly solenoid C has a crank arm 143, carrying a pawl C148 at its bottom end. The arm 143 controls four contact arms C150, C151, C154 and C152, of which the contacts C150, C151 and the contacts C154, C152 are normally in engagement, but which are opened upon energization of solenoid C.

Received between a pair of horizontally aligned holes in the flanges 130, 131 is a transverse shaft 157 carrying rotatably mounted thereon three digit wheels A158, B158 and C158, having equidistantly spaced about their circumferential edge the ten digits from "1" to "0." Each wheel also carries rigidly attached thereto, two concentric gears 159 and 160.

Means is provided to advance the digit wheels A158, B158 and C158 one digit upon each actuation of the respective solenoids A, B, and C. To this end, there is mounted between the flanges 130, 131 a shaft 161 carrying, rotatably mounted thereon, three ratchet wheels A162, B162 and C162. Rigidly fastened to each ratchet wheel and two concentric gears 163, 164.

Also receiving by the flanges 130, 131 is a horizontal shaft 164a, carrying three gears 165. The gears 159 on shaft 157 are enmeshed with the respective gears 163 on shaft 161, through gears 165.

Referring to Fig. 10, the ratchet wheels A162, B162 and C162 are positioned on shaft 161 in alignment with the pawls A148, B148 and C148, respectively, each ratchet wheel being engaged by the corresponding pawl.

Referring to Fig. 12, it is seen that when any solenoid A, B, or C is energized its pawl A148, B148 or C148 is moved to the left engaging the succeeding tooth of the corresponding ratchet 162. When the solenoid is de-energized the pawl 148 is returned to the right by spring 146, advancing the ratchet wheel one-tenth of a revolution, in a clockwise direction. The corresponding gears 163, 165 and 159 are consequently rotated one-tenth of a revolution in the counter-clockwise direction and the corresponding digit wheel is rotated one-tenth of a revolution in the clockwise, or forward direction, for advancing said digit wheel one digit.

#### Subtracting operations

Means is also provided for causing the digit wheels to be reversed one digit on each actuation of the corresponding solenoid, when a subtracting operation is to be performed. To this end there is provided, mounted to the base 126, a small auxiliary solenoid D, comprising a horizontal core 166 and a coil 167 thereabout. Pivoted to said base 126 is an arm 168 controlled by the core 166 so that when the coil 167 is energized the arm 168 is attracted thereto for pivoting said arm in a clockwise direction, looking at Fig. 10. Rigid with the shaft 157, and disposed outside the flange 131, is a collar 169 engaged by the lower end of arm 168, so that when solenoid D is energized shaft 157 is moved to the left, looking at Fig. 10. A coil compression spring 170,

connected between shaft 157 and the flange 130, normally urges said shaft to the right when solenoid D is not energized.

As shaft 157 is moved to the left, under the influence of solenoid D, the gears 159 mounted on said shaft, are moved out of engagement with the gears 165. At the same time, the gears 160 are moved into engagement with the respective gears 164.

Fig. 14 illustrates a front view of the digit and ratchet wheels, with the shaft 157 shown in the position to which it is moved by the solenoid D when said solenoid is energized. It is seen that, under such condition, the gears 159, 165 are disengaged, whereas the gears 160, 164 are in mesh. Each time any ratchet wheel is advanced in a clockwise direction, as heretofore explained, the corresponding gear 164 is also advanced clockwise, rotating the corresponding gear 160 counterclockwise, and retracting the corresponding digit wheel one digit. By shifting the shaft 157, the idler gears 165 are made inoperative, and the direction of rotation of the digit wheels are reversed.

It is therefore seen that, for addition, each actuation of a ratchet wheel advances the corresponding digit wheel one digit, the drive being from the ratchets A162, B162 or C162, through the corresponding gears 163, 165, 159, to the digit wheel. For subtracting, the solenoid D is energized in a manner to be hereinafter explained, so that the drive for each digit wheel comes from the ratchet wheels directly through gears 164, 160 to the digit wheels, thus reversing the rotation of said wheels.

Mounted to a bracket 204, fastened to the lower end of base 126, are six downwardly extending contact arms 171, 172, 173, 174, 175 and 176. The arms 172, 175 are connected at their bottom ends by an insulating spacer 177. Arms 171, 172 and arms 174, 175 are normally in contact. Integral with shaft 157 is a horizontal stud 178 positioned to engage the arm 172. When shaft 157 is moved to the left, under the influence of solenoid D, arms 172, 175 are moved out of engagement with contacts 171, 174 and are moved into engagement with contacts 173, 176, respectively.

Mounted on the panel 132 are three vertical columns of horizontal contact arms, there being a column for each of the digit wheels A158, B158 and C158. Each column of contact arms is in approximate alignment with its respective digit wheel.

The contact column associated with digit wheel A158 comprises six contact arms A190, A191, A192, A193, A194 and A195. The arms A191, A192 are joined together at their free end by insulating stud 205. The arms A190, A191 and arms A194, A195 are normally open, whereas the arms A192, A193 are normally closed.

Mounted on the side flanges 130, 131 is a horizontal shaft 196 carrying two pivoted levers A199 and A200. The lever A199 has a rearwardly extending arm A199b carrying an insulating stud A201a, positioned directly below the contact arm A192. The forward arm A199a, of said lever extends adjacent the side face of the digit wheel A158. Projecting outwardly from said face of the digit wheel is a stud 203, positioned to engage the arm A199a when the said wheel has its zero in bottom position. Under such condition, the lever A199 is pivoted clockwise about shaft 196, Fig. 12, moving contact arms A191, A192 upwardly, closing the arms A190, A191 and

opening arms A192, A193. The lever A200 similarly has a forward arm extending forwardly adjacent the opposite edge of wheel A158 and engages a stud 203a, similar to stud 203, but positioned to engage the lever A200 when the wheel A158 moving in adding direction has its 9 in bottom position and a rearwardly extending arm A200b carrying an insulating stud A201b, positioned directly below contact arm A195. When lever A200 engages the stud 203a the lever A200 is pivoted clockwise about shaft 196, Fig. 12, raising contact A195 into engagement with contact A194. It is seen, therefore, that when wheel A158 moving in subtract direction, has its zero in bottom position the normally open contacts A190, A191 are closed, and the normally closed contacts A192, A193 are opened. When said wheel A158 moving in adding direction has its nine in bottom position, the normally open contacts A194, A195 are closed.

The column of contact arms, aligned with the wheel B158, similarly comprises normally open contact arms B190, B191; normally closed arms B192, B193, and normally open contact arms B194, B195. The shaft 196 carries two levers B199, B200 similar to levers A199, A200, and similarly controlled by the digit wheel B158. When said wheel B158 has its zero at bottom position, the contacts B190, B191 are closed and the contacts B192, B193 are opened. When said wheel B158 has its nine in bottom position, the contacts B194, B195 are closed.

Wheel C158 controls only two normally closed contact arms C192, C193, similar to the arms A192, A193. Shaft 196 carries an arm C199 similar to arm A199, and similarly controlled by a stud on wheel C158 to open the arms C192, C193 when wheel C158 has its zero in bottom position.

#### *The adding and subtracting circuit*

Referring to Fig. 15, the pulsers of the keyboard unit K and the totalizer T are interconnected by an electrical circuit E.

Means is provided to connect and disconnect the pulsing switches 63, 64, etc. in the circuit E. To this end there is provided the relay 242a having a coil 243a. Coil 243a is connected at one end by wires 294a and 294 to contact 110, and at its other end by wires 295a and 295 to negative power supply. Switch arm 246a is adapted to be moved into engagement with contact 245a when relay 242a becomes energized. Contact 245a is connected to negative power supply and arm 246a is connected by wire 228a to switch arms 64, 64a, etc.

When the addition key 90 is depressed contacts 110—111 are closed by the cam 73 as heretofore described. Contact 111 is connected to positive power supply. Closing the said contacts will energize relay 242a, the circuit being through contacts 111, 110, wires 294 and 294a, coil 243a, wires 295a and 295. Switch arm 246a will engage contact 245a giving a negative polarity to the switch arms 64, 64a, etc.

As has been previously described, the said contacts 110, 111 will open at the end of the pulsing operation. Relay 242a will then be de-energized allowing switch 246a, 245a to open, thereby disconnecting the pulsing switches 63, 63a; etc., from the circuit E.

Means is provided in the circuit to advance the digit wheels A158 and B158 a number of digits equal to the number of pulsations transmitted by the pulsing switches 63, 64 and 63a, 64a, respectively. To this end, coil A137 controlling digit

wheel A158 has one end connected to the positive power supply and the other end connected by wire 261 to the switch arm 63. Arm 64 is connected to negative power supply, through wire 288a and switch 245a, 246a. Each time contact arms 63, 64 are brought into engagement, a circuit is completed through coil A137 from negative power supply, switch 245a, 246a wire 238a, switch 64, 63, wire 261, coil A137, to positive power supply, thereby advancing wheel A158 one digit. As heretofore explained, when the addition button is depressed switches 63, 64 will be pulsed a number of times equal to the digit represented by the depressed key in the corresponding column of the keyboard. Consequently wheel A158 will be advanced the corresponding number of digits.

Similarly, the coil B137 has one end connected to the positive power supply and its other end connected by wire 262 to the switch arm 63a. Arm 64a is connected to the negative power supply through wire 288a, and switch 245a, 246a so that coil B137 is energized on each closure of the pulser switch 63a, 64a through a circuit from negative power supply, arm 64a, 63a, wire 262, coil B137, to positive power supply. Consequently wheel B158 will be advanced a number of times equivalent to the digit represented by the depressed key in the column of the keyboard controlling the pulser 63a, 64a.

It will be understood that if neither wheel A158 nor wheel B158 is rotated to zero while they are being advanced by the pulsers, the number represented by the depressed keys will be added directly to the previous number on the counter wheels. However, if while the wheels are being advanced any wheel should be rotated through or to zero it is necessary to advance the next succeeding wheel one digit in order to obtain a true total.

#### *The "tens" transfer circuit*

Means is accordingly provided to advance wheel B158 one additional digit whenever wheel A158 is pulsed to zero and to advance wheel C158 whenever wheel B158 is pulsed to zero. Furthermore, since the wheels A158, B158 are pulsed simultaneously, means is also provided for delaying the transfer of the digit from one wheel to the next until the pulsing from the keyboard pulsers are completed and the digit wheels are completely advanced thereby. To this end there are provided three relays 230, 231 and 242. Relay 230 has an actuating coil 232 and controls two normally open contact arms 233, 236. When the coil 232 is energized the arms 233, 236 are moved into contact with the fixed contacts 234, 235 respectively.

Relay 231 similarly has a coil 237 and controls normally open contact arms 238, 241 which move into engagement with the fixed contacts 239, 240 when said relay is energized.

Relay 242 has an actuating coil 243 and controls switch arms 246, 249 normally contacting the fixed contacts 244, 248. When coil 243 is energized the arms 246, 249 are moved out of engagement with their respective contacts and into engagement with the fixed contacts 245, 247 respectively.

Coil 243 of relay 242 is connected at one end to the negative power supply and its other end to the contact arm 110 on the keyboard. Contact arm 111 is connected to the positive power supply. Contact arms 246, 249 are connected to negative power supply. Fixed contacts 244, 245 are connected by wires 292 and 288 respectively, to the switch arms 238, 241 of relay 231. The fixed con-

tacts 247, 248 are connected by wires 289 and 293 respectively, to the switch arms 239, 233 of relay 230.

Coil 237 of relay 231 has one end connected to positive power supply and its other end connected to fixed contact 240. Contact 240 is also connected by wire 286 to the switch arm 172 controlled by the subtract solenoid 167. Fixed contact 239 is connected by wire 290 to the coil B137 of solenoid B.

Coil 232 of relay 230 is connected at one end to positive power supply and at its other end to the fixed contact 235. Said contact 235 is also connected by wire 287 to the switch arm 175 controlled by the subtract solenoid 167. Fixed contact 234 is connected by wire 291 to coil C137.

The contact arms A152, B152 and C152 are connected to negative power supply. Contact B154 is connected by wire 277a to switch arm 241 of relay 231. Contact C154 is connected by wire 278 to switch arm 236 of relay 230. Contact A153 is connected by wire 274 to the contacts A191 and A194. Contact arm A195 is connected by wire 279 to contact 171. Contact B153 is connected by wire 276 to contacts B191, B194. Switch arm B195 is connected by wire 280 to the fixed contact 174. Switch arm B190 is connected by wire 282 to the fixed contact 176.

The operation of the digit transfer circuit will now be described. When the addition key 90 of the totalizer is depressed the contacts 110, 111 on the pulser are closed by cam 73 as heretofore described, energizing relay 242 through a circuit from positive power supply, arms 111, 110, wire 294, coil 243, wire 295, to negative power supply. Contact arms 246, 249 are consequently moved into engagement with the fixed contacts 245, 247, respectively. At the same time the pulsers 63, 64 and 63a, 64a are actuated for energizing the coil A137, B137 and advancing their respective digit wheels as heretofore described.

When the wheel A158 is advanced to "9" the contacts A194, A195 are closed. On the next energization of coil A137 when the crank arm A143 is pivoted for advancing the wheel to zero, the contact arm A152 is brought into engagement with the fixed contact A153 (Fig. 12) thereby completing a circuit through coil 237 of the relay 231 from negative power supply, arm A152, contact A153, wire 274, contact A194, A195, wire 279, contact 171, 172, wire 286, coil 237, to positive power supply. When relay 231 is energized the arms 238, 241 are brought into engagement with their respective fixed contacts 239, 240.

The closure of contact arm 241 completes a holding circuit for the coil 237 from positive power supply, coil 237, contact 240, arm 241, wire 288, contact 245, arm 246, to negative power supply. Thus, when the contacts A152, A153 are opened by the completion of the advancing of digit wheel A158 to zero, relay 231 remains in energized condition.

After the pulsing operation is completed the cam 73 opens contacts 110, 111, as heretofore described, deenergizing the relay 242 and disrupting the holding circuit for relay 231 at contact 245. However, there is provided a second holding circuit for the coil 237 from positive power supply, coil 237, contact 240, arm 241, wire 277a, contact B154, arm B152, to negative power supply. Consequently, when relay 242 is released the relay 231 remains energized.

As the contact arm 246 of relay 242 re-engages the fixed contact 244, a circuit is completed for energizing coil B137 of electromagnet B from

negative power supply, arm 246, contact 244, wire 292, arm 238, contact 239, wire 230, coil B137, to positive power supply. The electromagnet B consequently pivots its crank arm 143 for advancing the digit wheel B158 one additional digit. After crank arm 143 is pivoted, contact arm B152 is moved out of engagement with contact B154, Fig. 12, disrupting the second holding circuit for relay 231 and de-energizing said relay. The circuit is consequently completely reset and ready for reactivation when the next number is added from the keyboard.

The transfer of a digit from wheel B158 to wheel C158 is accomplished in a similar manner. When wheel B158 is being advanced from "9" to "zero," relay 230 is energized through a circuit from negative power supply, arm B152, contact B153, wire 276, contact B194, arm B195, wire 280, contact 174, arm 175, wire 287, coil 232, to positive power supply. Upon energization, said relay 230 completes a holding circuit for itself from positive power supply, coil 232, contact 235, arm 236, wire 289, contact 247, arm 249, to negative power supply. After the pulsing is completed, relay 242 is de-energized and the holding circuit for relay 230 is transferred to the circuit from negative power supply, arm C152, contact C154, wire 278, arm 236, contact 235, coil 242, to positive power supply. Also when relay 242 is de-energized a circuit is completed through coil C137, from positive power supply, coil C137, wire 291, contacts 234, 233, wire 293, contact 248, arm 249, to negative power supply. As crank 143 of solenoid C is pivoted for advancing wheel C158 the additional digit, the holding circuit of relay 230 is disrupted by the opening of contacts C152, C154. As relay 230 is de-energized the circuit for coil C137 is broken at contacts 233, 234 thus restoring the circuit to normal position after the digit has been transferred.

A carry on a carry takes place as follows: Assuming the addition of numbers 75 and 27, the addition of the 7 and the 2 is simply one of pulsing which will set up the tens digit wheel at 9. While this is going on, the 5 and the 7 are being added and, as the digit wheel passes from 9 to 0, a transfer count is stored in relays 230 and 242 as explained above. Upon completion of the pulsing, this count is transferred to the tens wheel, moving it from 9 to 0. In doing so, a circuit is set up from negative through arm B152, B153, wire 276, B194, B195, wire 280, arms 174, 175, wire 287, coil 232 to positive. This energizes relay 230. Relay 230 locks itself in through the circuit from positive through coil 232, contact arm 235, arm 236, wire 278, arm C154, arm C152 to negative. At the same time, it completes a circuit for relay C137 from positive, wire 291, contact 234, arm 233, wire 243, contact 248, arm 249 to negative. This energizes relay C137 causing it to advance digit wheel C158 one step. Operation of relay C137 breaks the holding circuit for relay 230 by opening contacts C152 and C154. Thus relay 230 is restored to normal and the circuit is ready for the next operation.

#### *Operation of the circuit for subtraction*

When a subtracting operation is to be performed the switch arms 97, 98 are closed by the subtracting key, as heretofore described. Arm 97 is connected to negative power supply, and arm 98 is connected by wire 296 to one side of coil 167 of solenoid D. The other side of said coil is connected to positive power supply. Consequently, when the subtract button is operated, coil 167 is

energized and the arms 172, 175 are moved into engagement with the fixed contacts 173, 176, as heretofore described. In addition the gears within the totalizer T become arranged so that each pulse received by the coils A137, B137 and C137 subtract one digit from their respective counter wheels. Consequently the number pulsed by the keyboard pulsers is subtracted from the counter total.

It is understood that for subtraction, the transfer of digits from one wheel to the next must be accomplished when a wheel is reversed from "zero" to "9," instead of when the wheel is advanced from "9" to "zero" as is done in addition.

To this end, there are provided the contacts A190, A191 and B190, B191 on the totalizer T which are closed when the corresponding digit wheel is at zero. Normally, said contacts are inoperative because the arms A190, B190 are connected, respectively, to the contacts 173, 176 which are open circuited. However, when a subtracting operation is to be performed, the arms 172, 175 are brought into engagement with the contacts 173, 176 thus rendering the subtracting switches A190, A191 and B190, B191 operative while, at the same time, disconnecting the adding switches A194, A195 and B194, B195.

Thus, during subtraction when wheel A158 resets on zero and its crank arm is pivoted for reversing said wheel to "9," the relay 231 is energized through a circuit from negative power supply, arm A152, contact A153, wire 274, contact A191, arm A190, wire 281, contact 173, arm 172, wire 286, coil 237 to positive power supply. After the pulsing is completed the coil B137 is energized in the manner similar to that heretofore described and the wheel B158 is retracted one digit.

Similarly, when wheel B158 is being reversed from "zero" to "9," relay 230 is energized through the circuit from negative power supply, arm B152, contact B153, wire 276, contact B191, arm B190, wire 282, contact 176, arm 175, wire 287, coil 232, to positive power supply. After the pulsing is completed the relay 242 is released and the coil C137 energized in the manner similar to that heretofore described. It is therefore seen the electric circuit E provides means for adding the number set up by the depressed keys on the keyboard to the totalizer when the add button is depressed, and to subtract the number when the subtract button is depressed.

It will furthermore be understood that, although the circuit illustrated in Fig. 15 includes only three digit wheels, said circuit may be expanded to include as many digit wheels as desired. In such case, each additional digit wheel will be provided with the necessary contact arms such as solenoid B, and interconnected in the circuit in a similar manner. Each additional digit wheel will also require an additional relay similar to relay 230, 231 and additional contact arms on the relay 242 similar to the arms 246, 249 and interconnected into the circuit in the same manner.

#### *The resetting operation of the circuit*

Means is also provided to reset the counter wheels to zero when a new series of additions or subtractions are to be performed. To this end, there is provided relay 249 having three actuating coils 250, 251 and 252 controlling four normally open switch arms 253, 254, 255 and 256. When either of the coils 250, 251 or 252 is energized, the arms 253, 254, 255 and 256 are moved into engagement with the fixed contacts 257, 258, 259 and 260, respectively.

Coils 250, 251, and 252 have one end thereof connected together and to positive power supply, and have their other end connected by wires 273, 272 and 271 to the contact arms A151, B151 and C151, respectively, of the totalizer T.

The fixed contact 257 is connected by wire 267 to the contact arms A193, B193 and C193 of the totalizer. Fixed contact 258 is connected by wire 268 to the contact A150. Contact 259 is connected by wire 269 to the contact B150. Contact 260 is connected by wire 270 to the contact C150.

Switch arm 253 is connected to the negative power supply. Switch arm 254 is connected by wire 264 and 261 to the coil A137. Switch arm 255 is connected by wires 265 and 262 to the coil B137. Switch arms 256 is connected by wires 266 and 263 to coil C137.

Contact A192 of the totalizer T is connected by wires 283, 273 to the switch arm A151. Contact B192 is connected by wires 284, 272 to arm B151. Contact C192 is connected by wire 285 and 271 to arm C151.

A normally open switch 227, of any suitable type, is provided for initiating the resetting operation. One terminal of said switch is connected by wire 302 to the negative power supply and the other terminal is connected by wire 303 to coil 250 of relay 249.

When the switch 227 is closed, coil 250 of relay 249 is energized through a circuit from negative power supply, wire 302, switch 227, wire 303, coil 250, to positive power supply. As the relay 249 is actuated the arms 253, 254, 255 and 256 are brought into engagement with the fixed contacts 257, 258, 259 and 260, respectively.

The closing of arm 253 completes a circuit for the coils 250, 251, 252. Coil 252 is energized from positive power supply, coil 252, wire 271, wire 285, contact C192, arm C193, wire 267, contact 257, arm 253, to negative power supply. The contacts C192, C193 are normally closed but become open when the wheel C158 has its zero in printing position. It is therefore seen that after relay 249 has been energized by the closure of switch 227, coil 252 will become energized and will remain in energized condition as long as the wheel C158 is not positioned at zero. Similarly, coil 251 will become energized through a circuit from positive power supply, coil 251, wire 272, wire 284, contacts B192, B193, wire 267, contacts 257, 253, to negative power supply. Consequently, coil 251 will remain energized as long as wheel B158 is not in zero position.

In like manner, coil 250 is provided with a holding circuit through the contacts A192, A193 of solenoid A and will remain energized as long as said contacts are closed.

Also, the closure of the arm 254 of relay 249 completes a circuit through coil A137 of solenoid A, from positive power supply, coil A137, wire 261, wire 264, arm 254, contact 258, wire 268, contact A150, arm A151, wire 273, wire 283, contacts A192, A193, wire 267, contacts 257, 253, to negative power supply. Energization of coil A137 pivots its crank arm A143 causing the contacts A150, A151 to open and de-energize said coil. As the crank arm 143 is returned by spring 146 the wheel A158 is advanced one digit. At the same time, contacts A151, A152 are re-closed again energizing the coil A137 and repeating the operation. The cycle is continually repeated until the wheel A158 is advanced to zero, and the contacts A192, A193 are open. The opening of said contacts A192, A193 permanently disrupts the oscillating circuit for energization of coil A137

preventing oscillation of the crank arm A143 and the wheel A158 is positioned at zero. The opening of contacts A192, A193 also de-energizes the coil 250 of relay 249 as heretofore explained.

The closure of contacts 255, 250 of relay 249 closes a similar oscillating circuit through coil B137 of solenoid B from positive power supply, coil B137, wire 262, wire 265, arm 255, contact 259, wire 269, contact B150, arm B151, wire 272 wire 284, contact B192, arm B193, wire 267, contact 257, arm 253, to negative power supply. Coil B137 is consequently repeatedly energized by the oscillation of the switch B151, B150 and wheel A153 is advanced to zero. The contacts B192, B193 are thereupon also prevented further oscillation of the coil B137 and also de-energizing the coil 251 of relay 249.

Similarly, the closure of contacts 256, 260 of relay 249 closes an oscillating circuit for coil C137 involving the switch arms C151, C150 and the switch C192, C193. Wheel C158 is consequently advanced to zero and the coil 252 of relay 249 de-energized.

It is seen therefore that when relay 249 is energized by closure of the switch 227, the wheels A158, B158 and C158 will be concurrently advanced to zero. Furthermore, as heretofore described, the coils 252, 251, 250 of relay 249 are maintained energized as long as the switches C192, C193; B192, B193; and A192, A193 are closed. Consequently, as soon as any wheel reaches zero position, corresponding coil of relay 249 is de-energized. When all the wheels reach zero position, all the coils in relay 249 are de-energized thus returning the circuit to normal condition with the counter wheels all set to zero.

It is to be noted that although the tens and hundreds transfer circuits are operative as described for the adding process previously, the tens and hundreds digit wheels will continue to rotate until all carry have been effected and the units, tens and hundreds wheel have been successively zeroized since relay 249 remains energized as long as any of the wheels is not at zero. Thus if a transfer, for instance, is effected when the units wheel passes from 9 to 0, and the tens wheel is already at 0, it will move to 1 and keep relay 249 energized. A similar thing will occur when a transfer is effected from the tens to the hundreds wheel.

Printing records of the counter total may be obtained by any suitable platen such as platen 225 energized by a coil 226 through a push button switch 301. The reset switch 227 may be released by a fixed contact 227a and a contact arm 227b actuated by the printing solenoid so that whenever the solenoid is energized for making a print, a switch 227a, 227b will be closed. Thus, the reset relay 249 will be automatically energized each time a print is taken and the totalizer T will be automatically reset to zero.

It will also be seen that if additional digit wheels are provided on the totalizer T a reset circuit similar to that described for the solenoids A, B and C may be used. Additional contacts may be provided on the relay 249 which can be interconnected to the additional solenoid in a manner similar to that heretofore described.

It will thus be seen that there is provided a device in which the several objects of this invention are achieved and which is well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiment above set

forth, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

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

1. In combination, a pair of pulsers, a register comprising an electromagnet for each pulser, a digit wheel associated with each electromagnet, means controlled by each electromagnet to advance its digit wheel once each time its electromagnet receives a pulse from its pulser, said digit wheels being of successively higher order and mounted on a common axis, a relay associated with the electromagnet of lower order, means to energize said relay upon movement of the digit wheel of lower order through "9" to "0," means to operate said pulsers, a normally "off" contact means, means to close said contact upon operation of said operating means and to open said contact upon completion of operation of said operating means, a holding circuit for said relay through said contact means, a second holding circuit for said relay controlled by the digit wheel advancing means for the electromagnet of higher order, said first holding circuit being adapted to be broken upon completion of operation of the pulse operating means, and means controlled by said relay and by said contact, and effective upon breaking of the first holding circuit to energize the electromagnet of higher order, whereby the wheel of the higher order is advanced an extra step and said second holding circuit is broken.

2. In combination, a pair of electromagnets, a digit wheel actuated by each electromagnet, a relay, a pair of switches, means to close advancement of one of said digit wheels to "9," means to close the other of said switches upon operation of electromagnet to advance said digit wheel from "9" to "0," means to energize said relay upon both of said switches being closed, and means controlled by said energized relay to send a pulse to said other electromagnet to advance its digit wheel one digit.

3. In combination, a pulser, means to actuate said pulser, an electromagnet adapted to receive pulses from said pulser, a second electromagnet, a digit wheel actuated by each electromagnet, the digit wheel of the second electromagnet being of successively higher order than the digit wheel of the first electromagnet, a relay for the first of said electromagnets, a pair of switches associated with the first of said electromagnets, means to close one of said switches when the digit wheel of the first electromagnet moves from "8" to "9," means to close the other of said switches when said electromagnet is energized to move its digit wheel through "9" to "0," means to energize said relay when both of said switches have been closed, a holding circuit for said relay, including a switch controlled by the second electromagnet, a second holding circuit for said relay controlled by the pulse operating means, means controlled by said pulse operating means to retain said second holding circuit in energized condition during the pulsing operation, and to break said second holding circuit upon the termination of the pulsing operation, and means effective upon breaking the second holding circuit, and controlled by said relay to pulse said second electromagnet to advance its digit wheel one extra step, and to break said first holding circuit.

4. In combination, a pair of pulsers, a register comprising an electromagnet for each pulser, a

digit wheel associated with each electromagnet, means controlled by each electromagnet to advance its digit wheel once each time its electromagnet receives a pulse from its pulser, said digit wheels being of successively higher order and mounted on a common axis, a relay associated with the electromagnet of lower order, means to energize said relay upon movement of the digit wheel of lower order through "9" to "0," means to operate said pulsers, a normally "off" contact, means to close said contact upon operation of said operating means and to open said contact upon completion of operation of said operating means, a holding circuit for said relay through said contact, a second holding circuit for said relay controlled by the digit wheel advancing means for the electromagnet of higher order, means to break said first holding circuit upon completion of operation of the pulse operating means, means controlled by said relay and by said contact means to energize the electromagnet of higher order, effective upon breaking of the first holding circuit, the means for energizing said relay including a pair of switches, means to actuate one of said pair of switches upon movement of the digit wheel for said electromagnet of lower order to "9," and means to actuate the second of contact and effective upon a breaking of the first holding circuit, to energize the electromagnet of higher order, whereby the wheel of the higher order is advanced an extra step and said second holding circuit is broken.

5. In a calculating machine having a pair of register wheels of adjoining denominational orders, a pair of electromagnets each for stepping one of said wheels, pulser means for energizing said electromagnets to effect entries into said wheels, reversible drive means intermediate said electromagnets and register wheels to effect additive or subtractive entries, and means for selectively conditioning said drive means; the combination of tens transfer means intermediate said register wheels comprising a transfer relay, a circuit for controlling said relay, transfer initiating contacts in said circuit closed by the wheel of lower order when in nine position, other transfer initiating contacts closed by said wheel of lower order when in zero position, further contacts in series with either of the above transfer initiating contacts and closed by the stepping electromagnet upon energization thereof to pick up said transfer relay either through said first or second transfer initiating contacts as the register wheel of lower order advances from nine to zero or zero to nine, means controlled by said drive conditioning means to selectively enable one or the other of said transfer initiating contacts, a transfer effecting circuit controlled by said relay whereby a transfer pulse is transmitted to the electromagnet of the higher order to impart an extra step to the higher order wheel, and means for holding said relay until a transfer operation of the higher order electromagnet is initiated.

6. In a machine according to the claim 5 wherein said holding means comprises a holding circuit associated with said pulser means to hold said relay during entry of values in the register, and further holding circuit controlled by the electromagnet of the higher order.

7. A machine according to claim 5 wherein said holding means comprises a holding circuit associated with said pulser means to hold said relay during entry of values in the register, and

## 21

a further holding circuit controlled by the electromagnet of the higher order and wherein contacts in said first holding circuit in one position thereof complete said holding circuit and interrupt said transfer effecting circuit, and in another position thereof complete said transfer circuit but interrupt the holding circuit, said contacts being shifted from one position to the other upon completion of entry in the register wheels.

BENJAMIN COOPER.

## REFERENCES CITED

The following references are of record in the file of this patent:

## UNITED STATES PATENTS

| Number    | Name    | Date          |
|-----------|---------|---------------|
| 988,327   | Foster  | Apr. 4, 1911  |
| 1,692,411 | Kassner | Nov. 20, 1928 |

## Number

|           |
|-----------|
| 1,221,653 |
| 1,930,252 |
| 2,093,529 |
| 961,806   |
| 1,176,959 |
| 348,437   |
| 390,788   |
| 400,359   |
| 502,287   |
| 1,687,045 |
| 2,285,153 |
| 2,329,744 |
| 2,176,934 |
| 2,190,710 |
| 1,288,259 |
| 1,649,478 |
| 2,110,987 |
| 1,789,811 |

## 22

## Name

## Date

|                |                |
|----------------|----------------|
| Baltisser      | Apr. 3, 1917   |
| Reynolds       | Oct. 10, 1933  |
| Tauschek       | Sept. 21, 1937 |
| Sears          | June 21, 1910  |
| Greenup        | Mar. 28, 1916  |
| Weiss          | Aug. 31, 1886  |
| Lincoln        | Oct. 9, 1888   |
| Pfeifer        | Mar. 26, 1889  |
| Ehrlich        | Aug. 1, 1893   |
| Suren          | Oct. 9, 1928   |
| Fletcher       | June 2, 1942   |
| Cooper         | Aug. 3, 1943   |
| Smith          | Oct. 24, 1939  |
| Furber         | Feb. 20, 1940  |
| Stickney       | Dec. 17, 1918  |
| Landsiedel     | Nov. 15, 1927  |
| Kammel         | Mar. 15, 1938  |
| Francis et al. | Jan. 20, 1931  |

**Certificate of Correction**

Patent No. 2,436,790.

March 2, 1948.

BENJAMIN COOPER

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 19, line 37, after the word "close" insert *one of said switches upon*; line 40, before "electromagnet" insert *said*;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of November, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,  
*Assistant Commissioner of Patents.*

**Certificate of Correction**

Patent No. 2,436,790.

March 2, 1948.

**BENJAMIN COOPER**

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 19, line 37, after the word "close" insert *one of said switches upon*; line 40, before "electromagnet" insert *said*;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of November, A. D. 1949.

[SEAL]

**THOMAS F. MURPHY,**  
*Assistant Commissioner of Patents.*