Aug. 14, 1951 G. A. JUST 2,564,575

COMPUTING MACHINE

Filed June 19, 1948 7 Sheets-Sheet 1

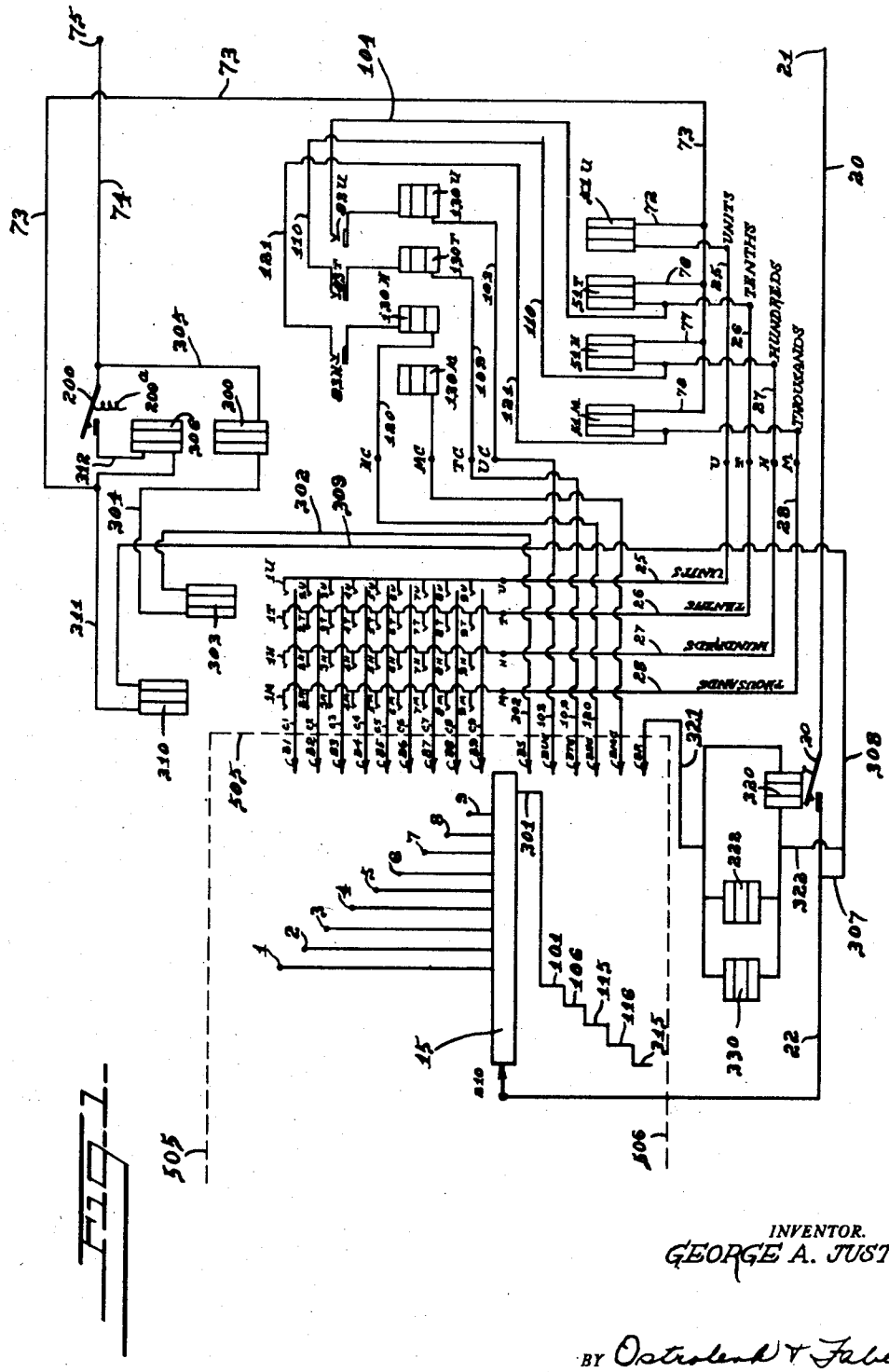

FIG. 1

INVENTOR.
GEORGE A. JUST

BY Ostrolenk & Faber
ATTORNEYS

Aug. 14, 1951 G. A. JUST 2,564,575

COMPUTING MACHINE

Filed June 19, 1948 7 Sheets-Sheet 2

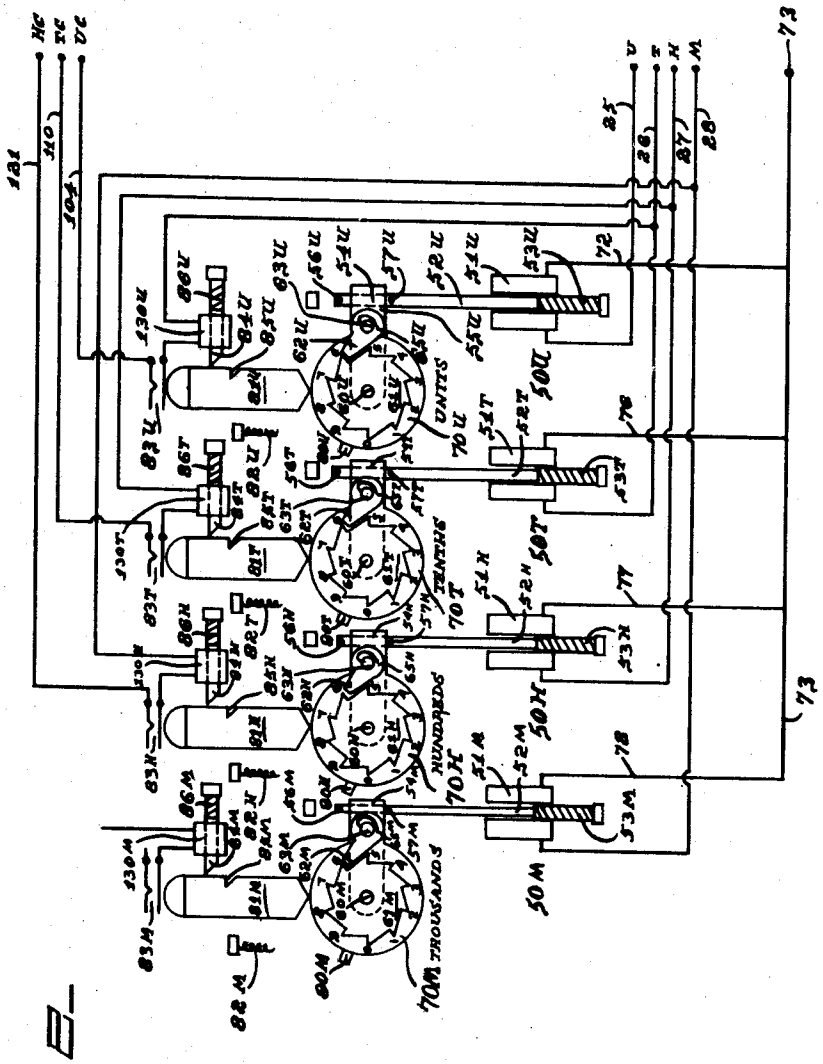

FIG. 2

INVENTOR.
GEORGE A. JUST

BY Ostrolenk & Faber
ATTORNEYS

Aug. 14, 1951 G. A. JUST 2,564,575

COMPUTING MACHINE

Filed June 19, 1948 7 Sheets-Sheet 5

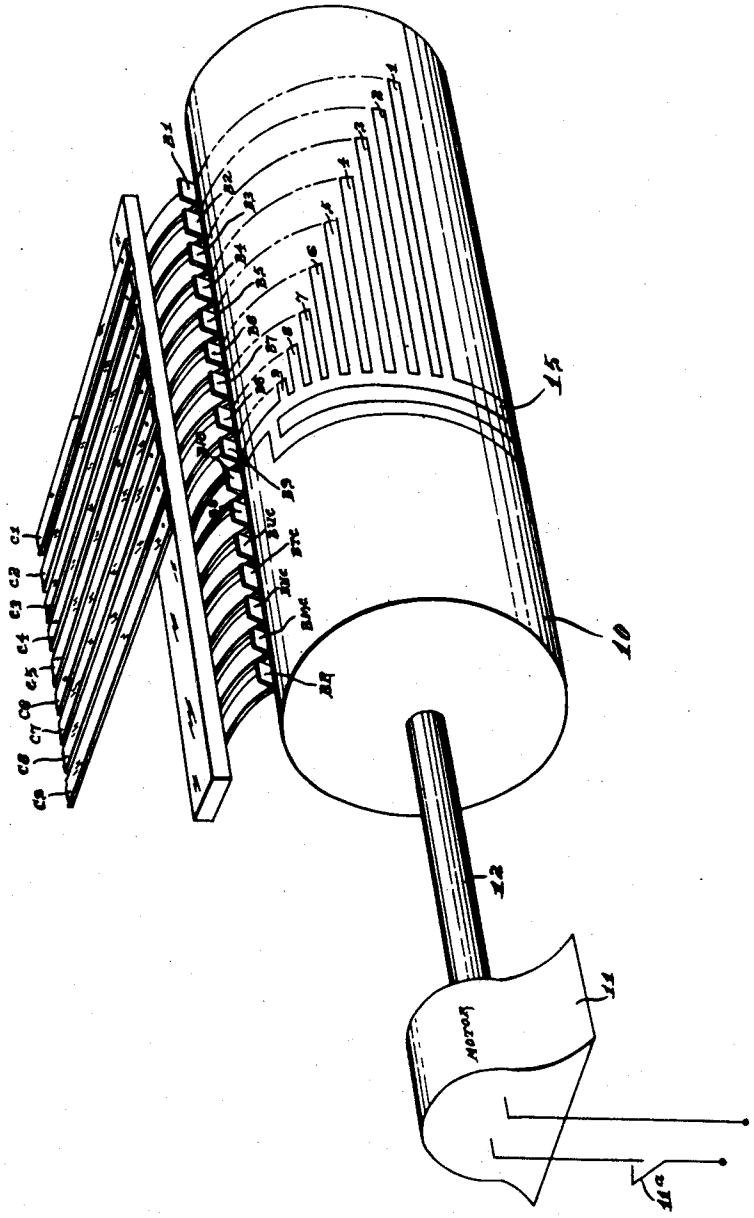

FIG. 8

INVENTOR.
GEORGE A. JUST

BY Ostrolenk & Faber
ATTORNEYS

Aug. 14, 1951

G. A. JUST

2,564,575

COMPUTING MACHINE

Filed June 19, 1948

7 Sheets-Sheet 4

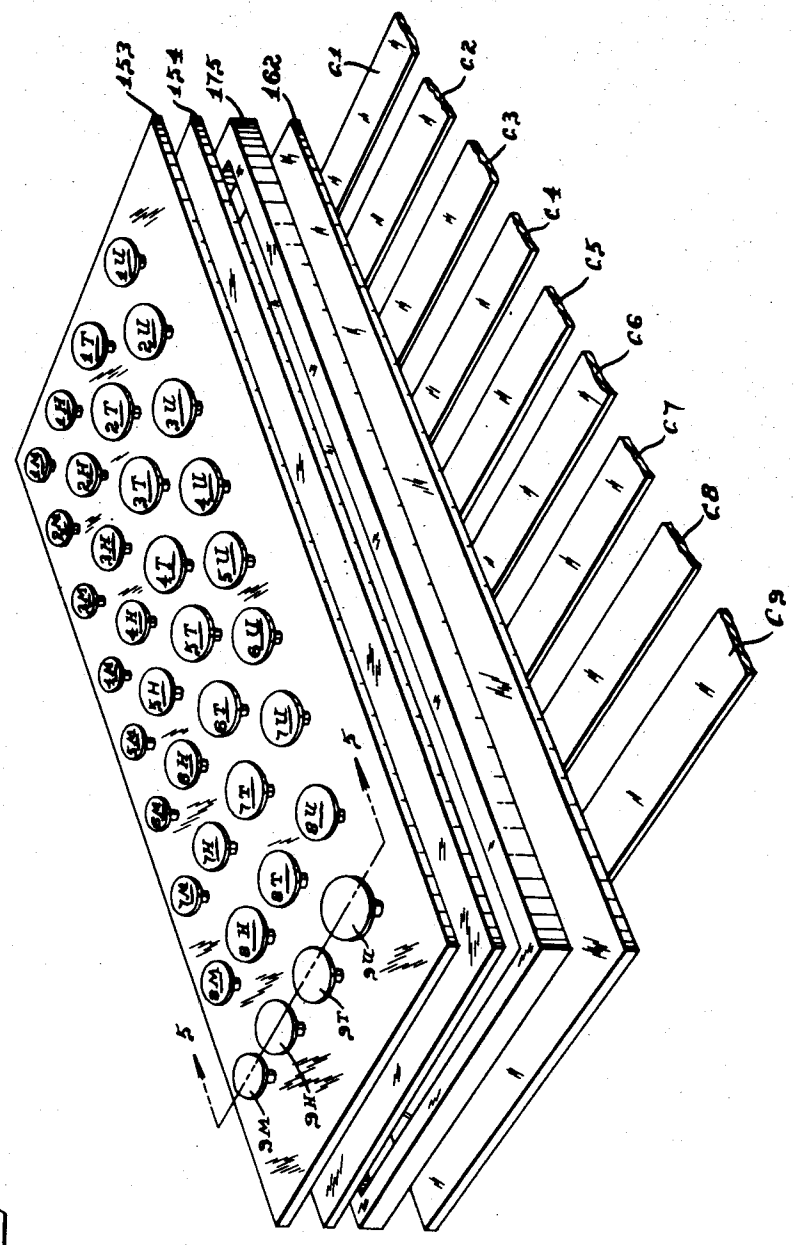

FIG. 4

INVENTOR.
GEORGE A. JUST

BY Ostrolenk & Faber
ATTORNEYS

Aug. 14, 1951 G. A. JUST 2,564,575

COMPUTING MACHINE

Filed June 19, 1948 7 Sheets-Sheet 5

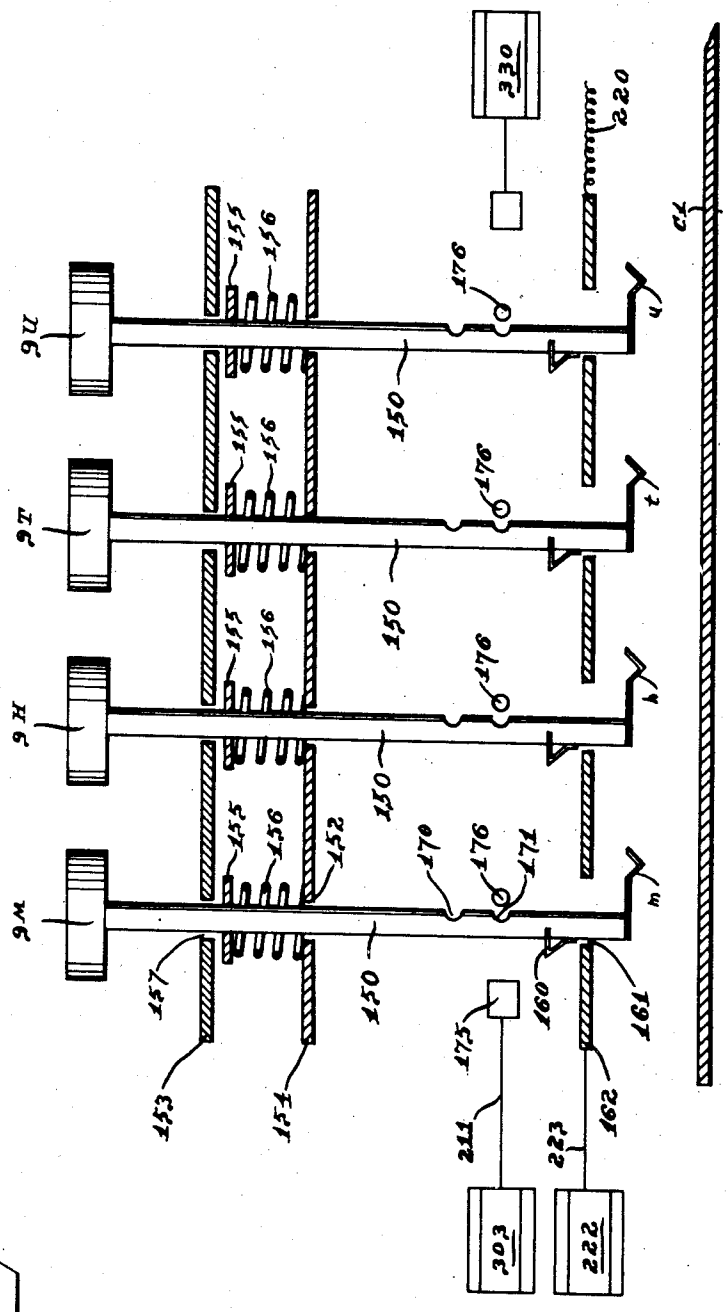

FIG. 5

INVENTOR.
GEORGE A. JUST

BY Ostrolenk & Faber
ATTORNEYS

Aug. 14, 1951 G. A. JUST 2,564,575

COMPUTING MACHINE

Filed June 19, 1948 7 Sheets-Sheet 6

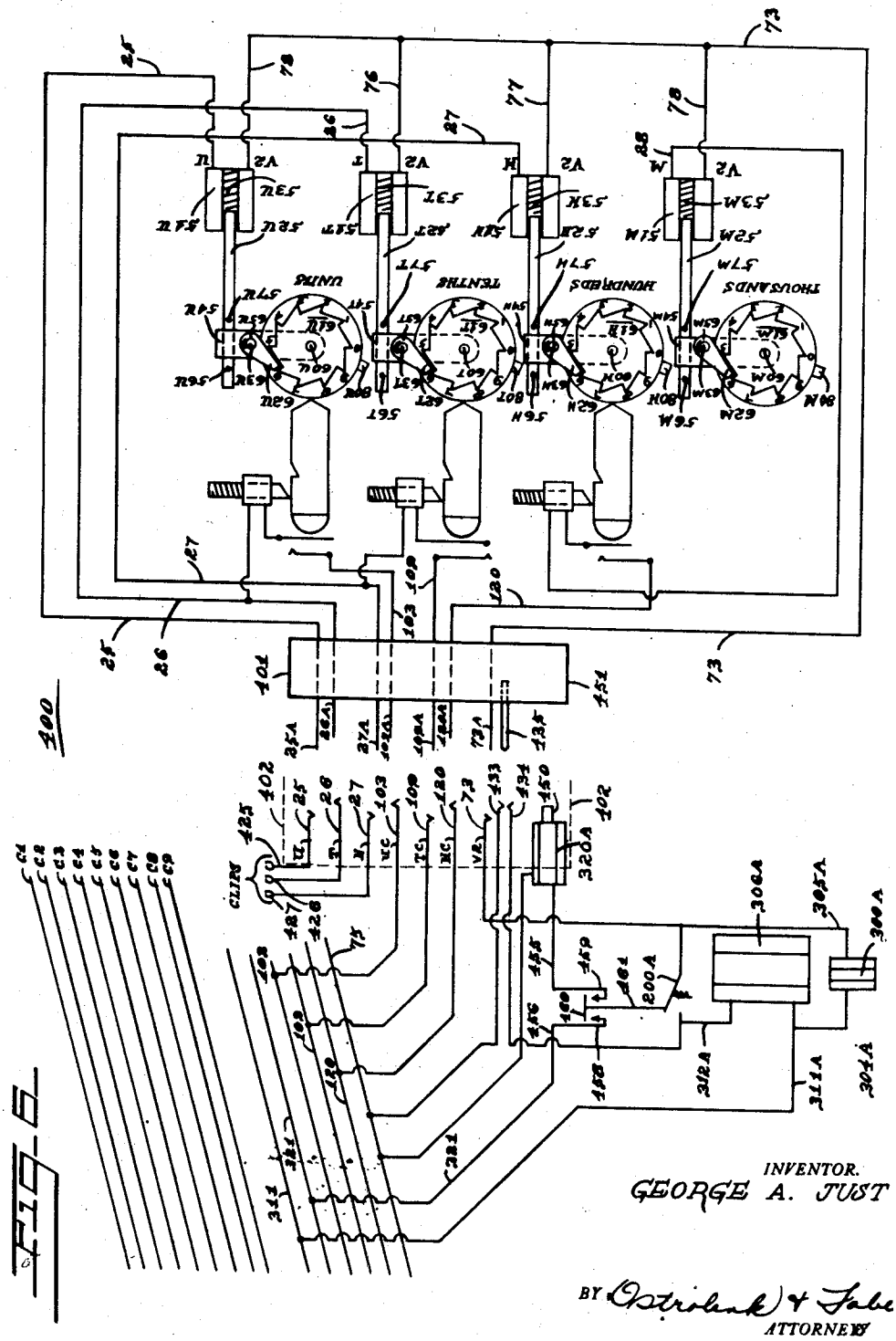

FIG. 6

INVENTOR.
GEORGE A. JUST

BY Ostrolenk & Faber
ATTORNEYS

Aug. 14, 1951 G. A. JUST 2,564,575

COMPUTING MACHINE

Filed June 19, 1948 7 Sheets-Sheet 7

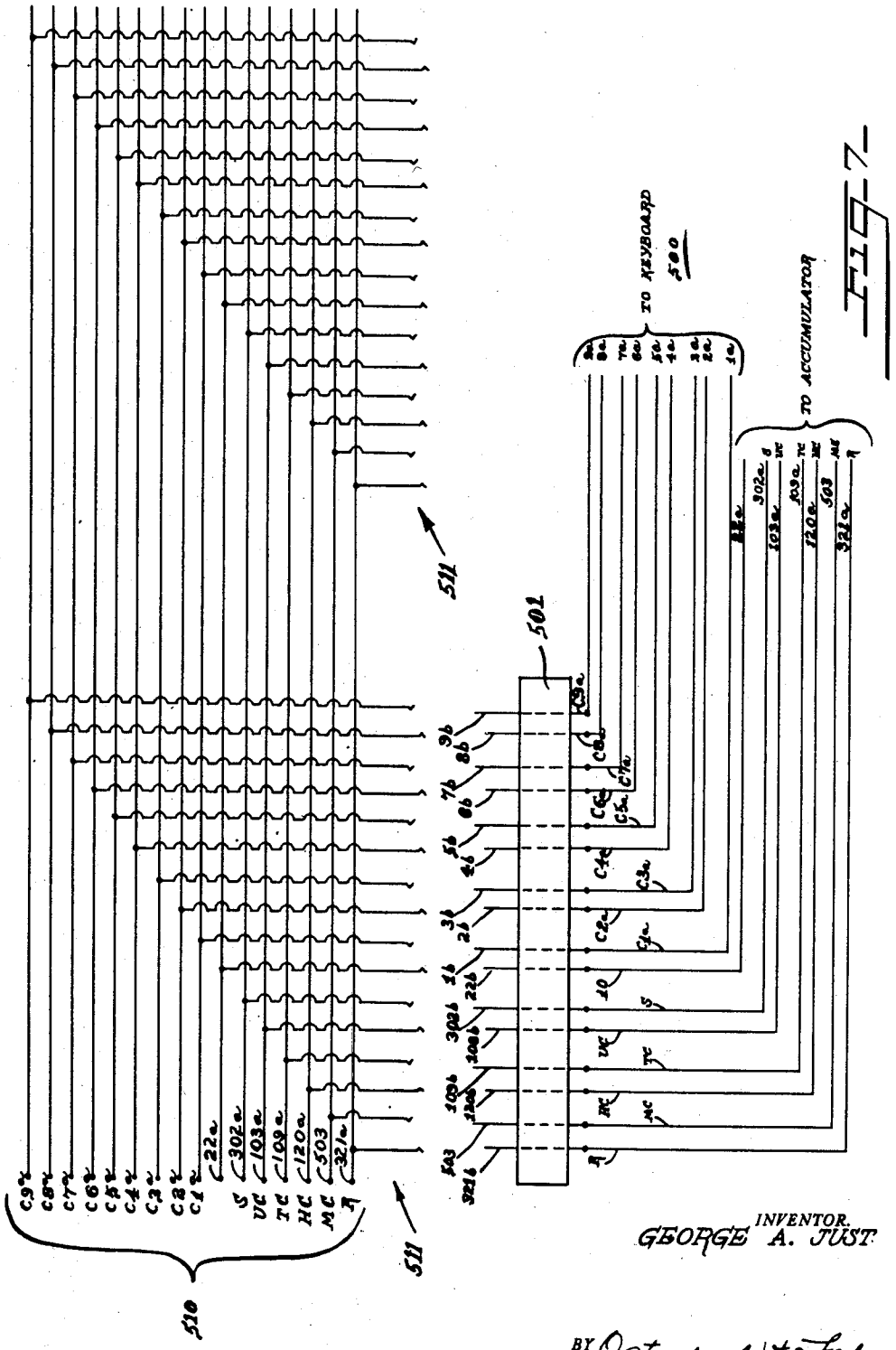

FIG. 7

INVENTOR.
GEORGE A. JUST

BY Ostrolenk & Faber
ATTORNEYS

Patented Aug. 14, 1951

2,564,575

UNITED STATES PATENT OFFICE

2,564,575

COMPUTING MACHINE

George A. Just, Scarsdale, N. Y.

Application June 19, 1948, Serial No. 33,989

3 Claims. (Cl. 235—61)

1

My present invention relates to computing devices and more particularly to a simplified electrically operated computing device comprising a minimum of operating parts.

My invention also contemplates the arrangement of the computing device so that it may readily be severable or usable in two or more sections whereby the basic computations may be made in one section, container, housing, or arrangement and the results of the computations may be tabulated, recorded, or otherwise made available to the user in another portable section, housing, or key.

Thus, for instance, in automatic merchandising and displaying cabinets, it is desirable not merely to provide arrangements which will deliver goods on insertion of coins or tokens but also to arrange cabinets so that they will deliver goods on actuation by a customer controlled mechanism while at the same time tabulating the value of the goods delivered on a key or other device carried by the customer or assocated in some way with the specific customer. In a food store the various cans or packages of food may be arranged for delivery automatically on energization of proper mechanical or electrical devices.

The purchaser as he enters may be provided with a tabulating key which totals the amounts of the purchases. The customer may then on reaching a desired display insert the key in the appropriate opening for that display connecting electrical circuits between the key carried by the customer and the remainder of the computing machine which may be common to all of the openings, energizing other mechanical or electrical devices to deliver the merchandise and at the same time having the key show either the amount of the purchase or the total of that purchase together with previous purchases.

My present invention is not limited specifically to such automatic delivery devices but is especially concerned with a computing machine which may be housed in a single cabinet as an individual computing machine or which lends itself just as readily to utilization in the foregoing merchandise plan whereby each individual customer or purchaser carries a key which is actually the tabulating part of the computing machine and a single central operating element electrically engaged by the key operates the tabulating elements in the key to add the total of the particular purchase to prior totals.

Essentially, my device contemplates a drum which is continuously or intermittently rotatable according to the type of operation desired. This

2

drum carries a plurality of contacting elements spaced from each other by insulation and rotating in contact with a number of brushes or other contact members.

Among the contacting elements on the drum are nine bars or electric conductive lines extending parallel to each other on the circumference of the drum and parallel to the axis of the drum. These bars are successively staggered in length so that a contact which will engage the shortest bar will also engage the eight other bars during a single rotation of the drum, and current will thus flow through that contact during nine spaced intervals for one rotation of the drum.

Thus, any operating element which is intended to indicate or register the number 9 will be connected to a contact which will engage all nine bars during a single rotation.

Similarly, any operating elements which are intended to tabulate or indicate the number 8 will be connected to a contact arranged to intercept only eight of the conducting bars during a single rotation of the drum; and so on down to the point where any operating or indicating element which is intended to indicate the number 1 will be connected to the contact which will engage only one of the bars during the rotation of the drum.

The drum also carries contact elements intended to phase the operations, operate the carry over elements and perform such other operations as are necessary to provide a complete computer.

Thus, for instance, it is important that no change in the setting of the computing device be made during the period that the aforementioned nine parallel bars are passing the tabulating contact.

Therefore, the drum is provided with means which may be electrically operated or mechanically operated, preferably electrical, to lock the mechanism so that no change in its setting may be made during that specific period. This will prevent an incomplete registry or tabulation of a single digit; i. e., registering only 6 when the number 9 is desired.

Where my computer is to be used as part of a merchandising scheme, then instead of providing a plurality of individual hand pressed buttons or keys for the units tens, hundreds, etc. places on the computing machine, I provide at each opening where the hand carried tabulator is to be inserted a connection to the appropriate contact which engages the nine bars on the drum.

Thus, for instance, if the article to be delivered costs $.19, then in the units place a con-

nection would be made to the plug-in opening for the tabulator from the contact of the units circuit which engages the nine bars and a connection would be made to the opening into which the tabulator is plugged at that particular delivery point from the contact in the tens place which engages only one of the bars.

For this purpose, the basic portion of the computer including the drum and its contacts would then be located at a central area, and the nine contacts for the units digits would then be led in a parallel circuit past all of the delivery points.

Similarly, the wires from the nine contacts in the tens place would be led in parallel lines past each delivery point. Each delivery point then would have a single connector for the tens place and, if necessary, a single connector for the hundreds place, one for the thousands place, etc.

In most cases, as for instance in chain grocery stores, connectors would be required only for the units and tens place, except for certain specific counters as for instance the meat counter.

To set up a recording of $.19, the connector of the units place would be clipped to the 9 wire and the connector for the tens place would be clipped to the 1 wire. A price change to, for instance, $.21 would simply require moving the units clip from the 9 wire to the 1 wire and the tens clip from the 1 wire to the 2 wire.

This is made possible by the arrangement of my invention from which a single operating drum may operate one or more tabulating devices. The tabulating devices of my invention are preferably solenoid operated ratchet mechanism individual to each place.

Each actuation of the solenoid at each place operates the ratchet to rotate a tabulating, indicating, or printing wheel one digit.

Thus, when the 9 ratchet is energized for any place, the solenoid for that place will be energized and de-energized nine times, operating the ratchet nine times and moving the tabulator, indicator, or printing wheel through nine digits.

The carry over from one tabulating, indicating, or printing wheel to the next as, for instance, from the units to the tens is preferably accomplished by a cam on the preceding disc which at the zero point closes a contact in series with the solenoid operator of the succeeding disc.

This contact and the solenoid of the succeeding disc are in turn in series with a contacting element of the operating drum which at the completion of the passage of the nine parallel bars past their respective contacts, energizes the succeeding solenoid once more to add the carry over unit.

Appropriate means are provided to maintain the first-mentioned contact closed until the completion of the initial tabulation so that the carry over occurs only after the initial tabulation has occurred.

The primary object of my invention, therefore, is the provision of a novel electrically operated computer comprising a principal operating section and a tabulating or recording section.

Another object of my invention is the provision and arrangement of a computer of the foregoing type in which one or more tabulating or recording sections may be utilized in conjunction with a single operating mechanism.

Another object of my invention is the arrangement of the operating mechanism of a computer so that the operating mechanism is cyclically operable and so that during each cycle of

operation circuits connected to the tabulating or recording mechanism may be repeatedly opened and closed a number of times equal to the specific digit which it is desired to tabulate or record at the particular place.

Another object of my invention is the arrangement and provision of a simplified electrically operated computing and recording device utilizing a minimum of electrical and mechanical parts and no gear trains.

The foregoing and many other objects of my invention will become apparent in the following description and drawings in which:

Figure 1 is a schematic view showing the electrical and mechanical operation of my novel device as a single computer; the computing portion of the circuit is detailed in Figure 2.

Figure 2 is a schematic detail of the computing portion of the circuit of Figure 1.

Figure 3 is a schematic view of the operating drum of my invention.

Figure 4 is a view in perspective of the keyboard of my novel device.

Figure 5 is a cross-section through the keyboard of my novel device taken from line 5—5 of Figure 4.

Figure 6 is a schematic view illustrating the application of my invention to a store merchandising scheme.

Figure 7 is a circuit diagram illustrating the application of my invention to multiple keyboards.

Referring first to Figures 1, 2, 3, 4 and 5, the principal operating portion of my device comprises a drum 10 preferably made of insulating material or having an insulating surface driven by motor 11 through shaft 12.

The drum 10 is provided with a plurality of parallel conductive bars 9, 8, 7, 6, 5, 4, 3, 2, 1, the said bars extending on the surface of the drum parallel to each other and parallel to the axis of the drum.

The bars are of unequal length or at least are staggered at one end so that bar 9 is the shortest and bar 1 is the longest and the bars in between vary regularly in step by step proportion in length.

In the form shown, bars 1 to 9, inclusive, are interconnected by the continuous bar 15 of which they may conveniently be made a part. Current is led to the contact bars 1 to 9 and other contact elements of the drum by conductor 20 leading from line terminal 21 to brush B10 which brush during a portion of the cycle of rotation of drum 10 engages the bar 15. Contact bar 15 extends circumferentially of the drum so that during one portion of the cycle at least bar 15 moves continuously and not intermittently under the contact or brush 22.

The contact members B1, B2, B3, etc. to B9 are linearly arranged along a line parallel to the axis of the drum and in contact therewith. The contact buttons 1*u* to 9*u*, 1*t* to 9*t*, 1*h* to 9*h*, 1*m* to 9*m* may be pressed into engagement with respective stationary bars C1 to C9 to connect lines 25, 26, 27 and 28 to brushes B1 to B9. These contact buttons may be movable toward and away from the bars, being mounted on buttons or keys hereinafter described as shown in Figures 3, 4 and 5, or they may be continuously in contact with the drum surface in order to function in connection with the device as it is arranged for use in the modification of Figures 6 and 7.

Contact elements 1*u* to 9*u*, inclusive, are each connected to the units conductor 25 in parallel

with each other. Thus, as the drum rotates, if the contact 9*u* has been pressed into engagement with bar C9, it is in a position where it will be energized by all of the bars 1 to 9, inclusive.

However, if instead contact 5*u* has been pressed, it engages bar C5, the brush C5 of which will clear bars 6, 7, 8, and 9 not coming in contact therewith and will only engage bars 1 to 5 as the drum rotates.

Each of the contact members 1*u* to 9*u* is, therefore, so located that they will be energized only by the specific number of bars applicable to the digit which the contact is desired to signify in the computing machine.

The movable contacts 1*t*, 2*t*, etc. to 9*t* are each connected in parallel with each other to the tens conductor 26. The operation of these contacts is the same as that previously described in connection with the units contacts, but conductor 26 is connected to operate the tens digit in the tabulator or recorder or printing disc or bar.

The hundreds contacts 1*h*, 2*h*, etc. to 9*h* are connected in parallel with each other to conductor 27 which in turn is connected to operate the hundreds digit section of the tabulator, recorder, or indicator.

These contacts also operate in the same manner as previously described for the units contacts.

The thousands contacts 1*s*, 2*s*, etc. to 9*s* are connected in parallel with each other to conductor 28 which in turn is connected to operate the thousands digit indicator, tabulator, or recorder.

A line of contacts may also be provided for the ten thousands place, another line for the hundred thousands place, and still another line for the millions place and so forth; the number of lines of contacts being limited only by the purpose for which the device is built.

The buttons or keys which operate the contacts may be arranged in rows parallel to each other.

The units tabulator 50*u* comprises a solenoid 51*u* having an armature 52*u* normally extending upwardly and outwardly from the solenoid and being biased upwardly by the compression spring 53*u*. The armature 52*u* passes through the opening 54*u* in the lever 55*u*, being provided with collars 56*u*, 57*u* so that any downward or upward movement of the armature 52*u* will result in a corresponding downward or upward movement of the end of the lever 55*u*.

Lever 55*u* is journaled for rotation freely by shaft 60*u* which carries the ten-tooth ratchet 61*u*. Lever 55*u* carries the pawl 62*u* pivotally mounted thereon at the pin 63*u*, the pawl being biased into engagement with the ratchet wheel 61*u* by the coil spring 65*u*, connected between the pawl and the lever. The ratchet wheel 61*u* carries keyed thereto the tabulating, recording, or indicating wheel 70*u* having the digits from 1 to 9 and zero on the periphery thereof.

When now, for instance, contact 1*u* is pushed down into engagement with bar C1 connected to brush B1 engaged only by bar 1 of drum 10, a circuit will be closed to solenoid 51*u* from terminal 21, through conductor 20 and the closed operating switch 30 to conductor 22 and brush B10 to contact bar 15, thence through the bar 1, brush B1, contact bar C1, contact button 1*u*, units conductor 25 to the solenoid 51*u*, from the solenoid 51*u* to conductor 72, thence to conductor 73, through the switch 200, conductor 74 and back to the opposite terminal 75. The

function of switches 30 and 200 will be hereinafter described.

The solenoid 51*u* will be energized once when the bar 1 moves under brush B1 of contact bar C1, thereby pulling down the armature 52*u*, pulling down the end of lever 55*u*, and pulling down the pawl 62*u* past the ratchet 61*u*.

As soon as the bar 1 on rotation of the drum leaves the contact bar C1, the solenoid 51*u* will be de-energized and spring 53*u* will drive the end of lever 55*u* up to drive the pawl 62*u* against the ratchet wheel 61*u* thereby rotating the ratchet one step to the next digit.

Any appropriate friction or holding means may be used on the ratchet 61*u* to ensure that it will not drift between operations of the pawl 62*u* and to make sure that it will not move backwards on the upward movement of the pawl.

If instead of depressing contact button 1*u* into engagement with bar C1, contact button 9*u* is pushed into engagement with bar C9, then as the drum rotates all of the bars 1 to 9, inclusive, passing successively under the brush B9 will energize and de-energize solenoid 51*u* nine times, thereby rotating the ratchet 9 steps, thereby adding the digit 9 to the indicator 70*u*.

The only limit on the speed of rotation of the drum is thus that imposed by the rapidity with which the solenoid can respond to energization to attract its armature 52*u* and the compliance of spring 53*u* which returns the armature 52*u* and lever 55*u* and pawl 62*u* to its original position.

The solenoid may be made very small because the only work it need do with each operation is to move the ratchet wheel 61*u* and its indicator 70*u* $\frac{1}{10}$ of a revolution. The stroke of lever 55*u* may correspondingly be made small and the spring 53*u* may be made substantially powerful and with a very short period of vibration.

Thus, when it is desired to tabulate, for instance, the number 5 in the units column, contact button 5*u* is pressed into engagement with bar C5 connected to brush B5 and in the course of one rotation of the drum the solenoid 51*u* is energized and de-energized five times to rotate ratchet wheel 61*u* and indicator 70*u* five steps.

Other means hereinafter described, including switches 30 and 200 and their respective holding solenoids, must be provided to ensure that when a particular contact such as contact 5*u* is pushed into engagement with its bar, the initiation of the energization of the drum will occur just before bar 9 begins to pass under the brushes B and to arrange the unit so that such buttons as have been depressed into engagement with their bars will be raised up out of engagement therewith after all of the operations have been performed by the drum and before the drum completes one full cycle or before the next cycle begins.

Such apparatus for preventing recycling and additional recording of a number or partial recording of a number and for preventing interruption of a cycle will be more specifically described, particularly in connection with the description of the contact buttons.

The tens tabulator, indicator, or recorder 50*t* operates in exactly the same manner as that described in connection with the units indicator, recorder, or tabulator 50*u* and the parts thereof have been given the same reference numbers, except that the suffix letter *t* has been substituted for the suffix letter *u*.

In the case of the tens tabulator 50*t*, current passes from terminal 21 and conductor 20, oper-

ating switch 30 to conductor 22, to brush B10 and conducting bar 15, then through any of the bars 1 to 9 to the particular bar C1 to C9 into engagement with which a contact button 1t to 9t has been pressed, then through conductor 26 to solenoid 51t, and then through conductor 76, conductor 73, switch 200 and conductor 74 to the opposite terminal 75.

Similarly, the hundreds tabulator, indicator, or recorder 50h operates in the same manner as units 50u and 50t.

Current to energize the solenoid 51h in the manner as for energization of the solenoid 51u passes from terminal 21, conductor 20, operating switch 30, conductor 22, brush B10, conducting bar 15 and any or all of the bars 1 to 9 to the particular contact bar C1 to C9 into engagement with which a button 1C to 9C has been pressed, then through conductor 27 to solenoid 51h, thence through conductor 77 to conductor 73 and through switch 200 and conductor 74 back to the opposite terminal 75.

The thousands tabulator, indicator, or recorder 50m also operates in the same manner as the units member 50u and has been given the same reference numbers with the suffix m in place of the suffix u.

Current for energizing solenoid 51m of the unit 50m passes from terminal 21, conductor 20, the operating switch 30, conductor 22, brush B10, contact ring 15, and any of the bars 1 to 9 to the particular contact bar C1 to C9 upon which a contact button 1m to 9m has been pressed, then through conductor 28 to the solenoid 51m, thence through conductor 78, to conductor 73 and through switch 200 and conductor 74 back to terminal 75.

It will thus be seen that in order to place the number 123 on the computer, the operator will depress contact buttons 1h, 2t, and 3u. As the drum rotates since contact 3u engages bar C3, the brushes of which will engage successively bars 3, 2, and 1, solenoid 51u will be energized three successive times, turning the ratchet wheel 61u and indicating wheel 70u three digits.

Contact 2t engages bar C2, the brush B2 of which will engage only bars 1 and 2 and will energize solenoid 51t twice, turning the ratchet wheel 61t ano the indicator 70t $\frac{2}{10}$ of a revolution or two digits.

Contact 1h engages bar C1, the brush B1 of which is engaged only by the contact bar 1 of the drum to energize solenoid 51h only once during the revolution, moving the ratchet wheel 61h and the indicator 70h $\frac{1}{10}$ of a revolution or one digit.

If now after the number 123 has been cleared from the machine and placed on the tabulating disc 70u, 70t, and 70h, the number 999 is placed on the machine by depressing contact buttons 9h, 9t, and 9u to be added on to the previous indication 123, each of the discs 70u, 70t, and 70h will pass through zero, and it will be necessary to carry over the 10 from each of the discs 70u, 70t, and 70h to the next placed disc by adding one digit to the next placed disc, in response to the passing of the respective discs through zero.

Thus, the disc 70u will be carried around by the addition of 999 to 123 through zero to indicate 2. In order to obtain the carry over, the fact that disc 70u reaches zero must result in adding of one unit to the next higher placed disc.

This is accomplished in the case of the transference or carry over from the units disc to the tens disc by the cam 80u located on the units disc or ratchet wheel between the numerals 9 and zero.

As the disc 70u moves from 9 to zero the cam 80u raises the rod 81u against the compression of the return spring 82u to close the spring switch 83u. The rod 81u is latched upwardly by the engagement of latch 84u in latching detent 85u of the rod 81u, the said latch 84u being biased into engagement by the compression spring 86u.

This prepares a circuit to the solenoid 51t of the tens operator 50t, the switch 83u being energized and closed only at such times as the units indicator 70u passes from 9 to zero.

If during the passage from 9 to zero as in the case of the addition of 999 to 123 the units indicator continues to retate beyond zero up to the digit 2, the latch 84u nevertheless holds up the rod 81u to maintain the switch 83u in closed position.

Similarly, the tens disc 70t is operated by the rotation of durm 10 from the digit 2 of number 123 around through zero to indicate 1 by reason of the addition of the tens digit 9 to the tens digit 2.

Likewise, the hundreds disc 70h is operated from 1 of 123 up to zero by reason of the addition thereto of the hundreds digit 9 of the number 999.

In each case, the passage of the cam 80u, 80t, and 80h past the rod 81u, 81t, and 81h closes the switches, respectively, 83u, 83t, and 83h.

At the conclusion of the movement of bars 1 to 9 past the contact, the indication on the tabulating discs 70h, 70t, and 70u would read 012.

However, the closing of switches 73t and 83h has prepared the necessary circuits to obtain the carry over. The full rotation of each of the discs 70u, 72t, and 70h has now been obtained by the movement of bars 1 to 9 of drum 10 past the contact bars C1 to C9 apart from the carry over.

On completion of the movement of bars 9 to 1 past contacts 9u, 9t, and 9h resulting in an indication of 012, the contact bar 101 passes under the brush BuC. This now establishes, a circuit from terminal 21, conductor 20, through the switch 30, conductor 22, brush B10, contact ring 15, bar 101, brush BuC, conductor 103, solenoid 130u to the now closed switch 83u and then through conductor 104 to conductor 26 through the solenoid 51t, through conductor 76 and current carrying elements 73, 200, 74, back to terminal 75.

This results in a single additional energization of the tens solenoid 51t to move the indication thereof one digit from an indication of digit 1 to an indication of digit 2.

The carry over from tens to hundreds is operated by the contact bar 106.

When conductor 106 moves under the brush BtC, then if the contactor 83t is closed as it is in the present instance, the circuit is closed to solenoid 51h for one impulse of operation from terminal 21, conductor 27, switch 30, conductor 22, brush B10, contact ring 15, contact element 106, brush BtC, conductor 109 solenoid 130t, contactor 83t, conductor 110, to conductor 27 through solenoid 51h and through current carrying members 77, 73, 200, 74, back to the opposite terminal 75. This causes the hundreds disc 70h to advance from 0 to 1.

Similarly, as the hundreds disc 70h reached the zero point, the cam 80 actauted rod 81h to close the contactor 83h, and thereby prepare a circuit for operation of solenoid 51m of the thousands unit.

When now contact element 115 on the drum

passes beneath brush B*h*C a circuit is closed to a solenoid 51*m* from terminal 21 through elements 20, 30, 22, B10, 15, 115 and B*h*C to conductor 120, to solenoid 130*h*, then through contactor 83*h*, conductor 121 to conductor 28, through solenoid 51*m* and current carrying element 78, 73, 200, 74, back to the terminal 75.

This causes the thousands indicator 70*s* to move from zero to 1, thereby placing the indicators in positions 1, 1, 2, 2, for, respectively, the units 50*m*, 50*h*, 50*t*, 50*u* which, of course, is the proper total of 1122 when 999 is added to 123.

The carry over contact elements 101, 106, and 115 are staggered with respect to each other so that a carry over may take place which occurs as a result of a carry over.

Thus, the tens member may end up at the conclusion of a passage of bars 9 to 1 at the indication 9. A carry over from the units member will result in the movement of a tens member from 9 to 0, thereby requiring a carrying over from the tens members to the hundreds member in response to the carry over from the units to the tens.

By staggering the members 101, 106, and 115 so that they engage their respective brushes at spaced successive intervals, a carry over of this type is permitted.

This type of carry over will occur, for instance, when 23 is added to 77. The addition of 3 to 7 will result in the original setting up of the carry over as previously described in the unit section, but the addition of the 2 to 7 in the tens place will not result in the setting up of a carry over.

Now, when the carry over elements 101 and B*u*C operate in conjunction with the closed switch 83*u* to carry over from the units to the tens place, the 9 in the tens place will be moved to 0, at the same time setting up a carry over from the tens place to the hundreds place. By spacing elements 101, 106, and 115 from each other by a sufficient distance to permit the carry over to be set up especially when it results in response to a prior carry over, full carrying over of all digits can occur.

Thus, when adding 23 to 77 the indication in response to the movement of bars 9 to 1 on the contacts is 90. When the carry over from units to tens occurs, the indication that then results in response to movement of contact elements 101 under brush B*u*C is 00.

This results in closing switch 83*t* and preparing the circuit so that when contact element 106 moves under brush B*t*C the carry over results in the hundreds place producing the proper result of 100.

Thus, the only requirement as to spacing between 101 and 106 and 115 is that sufficient time be given between them so that a contact 83*u*, 83*t*, or 83*h* may be closed after one of the elements 101 or 106 has passed beneath its respective brush and before the next succeeding element passes under its brush.

After the final result has thus been reached on the indicator discs, it is necessary to reset or return such rods 81 as have been raised up to close the contactors 83.

For this purpose, solenoids 130*u*, 130*t*, and 130*h* are provided, the armatures of which constitute the latches 84*u*, 84*t*, and 84*h*, respectively.

Each carry over energization as above described also simultaneously energizes solenoids 130*u*, 130*t*, 130*h* or 130*m* as the case may be, pulling their

armatures 84 to the right and permitting the springs 82 or the spring contact of switches 83 to drop the member 81 in response to the unlatching thereof.

Since the brushes B*u*C, B*t*C and B*h*C and their associated contact elements 101, 106, 115, are respectively in series with contactors 83*u*, 83*t*, and 83*h* which, respectively, are in series with solenoids 51*t*, 51*h*, 51*s*, it will be seen that none of the solenoids will be energized for carrying over purposes unless the contactor 83 of the preceding place is first closed by the passing of the preceding place recording disc 70 to or through zero.

While here my invention has been demonstrated in connection with four places, it will be obvious that it may be used in connection with as many places as is required for the particular computer.

An additional row of contact buttons must be added to engage contact bars C1 to C9 for each additional place and an additional contactor 83 and its associated elements must be added to the preceding place for each additional place.

Thus, if in the illustration shown in Figure 1 a ten thousands place is added, then an additional contactor 83 would be necessary in the thousands place and the associated elements and cam operator therefor would be required.

If desired, the last place of the series, as for instance the thousands place in the illustration of Figure 1, may be provided with a carrying over contactor 83 and its associated solenoid 130*m* operated by contact bar 116 on the drum and brush B*m*C and connected back to operate solenoid 51*u* for the units place so that the addition may go through zero with the fifth place number being carried in mind.

In this case, the addition of the number 1 to a tabulated total of 9999 would result in the setting of all of the indicators to zero by the carry over operation described.

The ring 15 and bars 1 to 9 may be made in one piece as may also the bars 101, 106, 115, etc., provided they are zig-zagged as shown in Figure 1. If the zig-zag form is not followed, then the connection from bars 101, 106, etc. should be made beneath the surface of the drum to prevent false operation of the various elements.

Phasing of the various elements is essential. It is necessary that all elements operate at the right point in the cycle and that they be released properly. This can be accomplished by energizing the motor 11 through an appropriate switch 11*a* after each number has been set up on the machine and braking or latching the motor shaft at the end of one cycle or by placing a clutch in the output shaft of the motor and latching it closed by a mechanically releasable or solenoid operated latch for one cycle.

I prefer however that the motor 11 and drum 10 rotate continuously and to utilize circuit connections which will phase the elements properly ensuring that the buttons 1*u* to 9*u*, 1*t* to 9*t*, etc., will be locked up or down as the case may be during the cycle and that all elements will be put back to neutral at the end of the cycle. This is accomplished by switches 30 and 200.

When switch 30 is closed, all circuits are prepared for operation, when switch 30 is opened all circuits are opened.

Switch 30 is manually operated to close and is so arranged that it will remain in the condition in which it is left, open or closed as the case may be.

When a number is set up on the machine, switch 30 is manually closed. The drum is as above pointed out rotating continuously but no closed circuit exists since switch 200 (biased open by spring 200a) is open and the by-pass circuit through solenoid 300 is open at brush Bs, the starting brush. The drum, just before the beginning of the cycle rotates to a point where contact bar 301 connected to contact ring 15 passes momentarily under brush Bs. This energizes solenoid 300 from terminal 21, elements 20, 30, 22, B10, 15, 301, Bs, conductor 302, through solenoid 303, conductor 304, solenoid 300, and the conductors 305 and 74 to the opposite terminal 75.

Solenoid 300 attracts the armature of switch 200 to close the switch against the opening spring 200a. Solenoid 306 is then energized to hold switch 200 closed, the circuit for solenoid 306 extending from terminal 21 and elements 20, 30 and 22 to conductors 307, 308 and 309 through solenoid 310, conductor 311 to solenoid 306, then through conductor 312, switch 200 and conductor 74 to the opposite terminal 75.

Solenoid 303 will operate the locking plate 175 hereinafter described. Solenoid 310 may operate any auxiliary arrangement that may be required at the end of the cycle.

Since switch 200 is in circuit with conductor 73, the computing units 50 operate only after switch 200 is closed. Contact bar 301 on the drum determines the time of closing of switch 200 and hence the beginning of the cycle.

Contact bar 301 therefore is first to engage its brush Bs. Thereafter, the other contact bars engage their brushes in the order 9, 8, 7, 6, 5, 4, 3, 2, 1, 101, 106, 115 and 116. Lastly the contact bar 315 engages brush BR, the release or end-of-cycle brush. This closes a circuit to solenoid 320 which pulls switch 30 open, de-energizing all circuits. Solenoid 320 is momentarily energized from terminal 21 over elements 20, 30, 22, B10, 15, 315, BR conductor 321, solenoid 320, conductor 322 and elements 308, 309, 310, 311, 306, 312, 200, 74 to the opposite terminal 75.

Solenoid 330, in parallel with solenoid 320, now pulls the locking plate 175 hereinafter described back to non-locking position and solenoid 222 in parallel with solenoid 320 simultaneously pulls the latch plate to the left to disengage the buttons which have been depressed and to permit the springs to return these butons to the raised position.

Contact bar 315 is thus the end-of-cycle bar and its engagement with brush BR ends the cycle.

If the number is to be repeated, it is only necessary to place a normally closed switch in the circuit of brush BR to operate it to open position by a "repeat" button and the number will be repeated for the number of cycles of drum 10 that the repeat button is pressed, making multiplication possible.

The contact buttons 1*u* to 9*u*, 1*t* to 9*t*, etc., each comprises, as seen in Figures 4 and 5, a vertical shaft 150 at the lower end of which is secured the contacting element *m*, *h*, *t*, or *u*, as the case may be. Nine buttons or keys are provided and, accordingly, nine contacts *h*, *t*, and *u* are provided for each plate to engage the bars C1, C2, etc.

The shaft 150 of each button passes through aligned openings 151, 152 in the mounting plates 153, 154. A collar 155 on each button shaft 150 comprises a spring 156 between itself and the lower mounting plate 154, thereby biasing each button upwardly.

Each button is also provided with a spring latch 160 at the portion thereof which passes through slot 161 in the latching plate 162. An individual slot may be provided for each shaft 150 of each button and its associated latch 160, or a single longitudinal slot or rail may be provided for each row of buttons.

When a button is pressed down to bring its associated contact against the contact bar C1, C2, etc., the spring latch 160 snaps under the opening 161 in plate 162 and holds the button and its contact against the surface of the bar. The particular button which has been depressed will hold its contact against the surface of the contact bar until the latching plate 162 is moved to the left with respect to release the latch 160 and permit the compression spring 156 to raise the button to snap it up again.

Consequently, whatever number is to be tabulated is placed on the machine by pressing the appropriate buttons for that number.

Thus, for the number 123 the 1*h* button in the hundreds place, the 2*t* button in the tens place and the 3*u* button in the units place are depressed, each of these buttons being held down by the engagement of its latch 160 beneath the latching plate 162.

The drum rotates and the solenoids are energized to operate the indicators, tabulators, or recorders in accordance with the buttons which have been depressed as previously described and the number 123 is placed on or added to the machine.

Where the drum 10 is being rotated continuously, it is important that phasing be properly accomplished so that none of the buttons can be pressed or pushed down while the bars 1 to 9 are passing under the contact brushes and so that none of the buttons can be lifted up accidentally during that particular phase of the cycle.

In order to accomplish this result, each of the shafts 150 is provided with a pair of notches 170 and 171, the corresponding notches 170 and 171 being aligned with respect to similar notches on all the other buttons.

Above the latching plate 162 is mounted the stop plate 175 having a plurality of longitudinal bars 176. The bars 176 extend along the rows of button shafts 150, one bar for each row of buttons.

In the up position of the buttons, the notches 171 of each button are opposite the bars 176. In the down position of the buttons the notch 170 of each button is opposite the bar 176.

When now a button is depressed so that the latch 160 is caught on the plate 162, the notch 171 moves down from the bar 176 and the notch 170 moves opposite the bar 176.

Just before the first bar 9 on the drum begins to move beneath the contacts, solenoid 303 is energized to attract its armature 211. Armature 211 is connected to the left side of plate 175.

Energization of solenoid 303 pulls the plate 175 to the left, pulling the bars 176 to the left. The bars 176 enter the notches 171 of the buttons which have not been depressed, and the notches 170 of the buttons which have been depressed and lock the buttons in raised or lowered position, preventing any change in their position while the contact elements of the drum are moving under the contacts which engage the drum.

On completion of that portion of the cycle of the drum during which contacts of various kinds are made, the solenoid 303 is de-energized by opening of switch 30 while at the same time solenoid 330 is momentarily energized to pull the

plate 175 to the right and thereby removing the locking bars 176 and permitting the buttons to be operated. A spring may be substituted for solenoid 330 to bias plate 175 to the right at all times.

The latching plate 162 is so mounted that it is biased to the right to latching position by springs 220.

Solenoid 222 is provided with an armature 223 connected to the left side of the plate 162. Solenoid 222 is in parallel with solenoid 320.

Therefore, at the end of the cycle, solenoid 222 is energized to pull the latching plate 162 to the left and release all of the depressed buttons, permitting the spring 156 to snap them up once more.

The energization of solenoid 222 should occur simultaneously with the de-energization of solenoid 303 and energization of solenoid 330 so that the locking bars 176 move to the right at the same time as the latching plate 162 moves to the left, thereby permitting the tabulating keys to rise.

The solenoid 303 and hence the locking bars remain de-energized and out of locking position during the period between the operating portion of the cycle, while the latching plate 162 is pulled momentarily to the left just at the end of the operating cycle.

The utilization of the locking bars 176 prevents false operation of the buttons or any operation intermediate or during the operating portion of the cycle so that false tabulation or improper setting up or clearance of numbers cannot occur during the operating portion of the cycle. Also the switch 200 ensures that the operation will begin at the proper point in the cycle and contact 315 and brush BR ensures that the operation will end at the proper point in each cycle.

In the construction shown herein, errors can be corrected before pressing switch button 30. The correction of such errors may be obtained by a push button connection for solenoid 222 on the latching plate, connecting it directly across terminals 21 and 75, to pull the latching plate to the left and lift the buttons before any recording operation is obtained, or a mechanical means may be provided to push latch plate 162 to the left to release all buttons.

The indicators, tabulators, or recording elements 70*u*, 70*t*, 70*h*, and 70*m* may have any desired form and may, if desired, contain or operate printing elements in conjunction with any printing apparatus well known in the art in order to record successive totals as they are reached by the machine, adapting my invention for use in cash registers and other devices where permanent recording is desired.

For this purpose, additional contacts on the drum may operate a pressure bar to bring a sheet of paper with a ribbon against its surface or other suitable printing devices may be used energized by an appropriate contact on the machine.

In Figure 6 I have shown my invention adapted to a store merchandising plan in which the customer is provided with a key 400 containing essentially the accumulator apparatus shown in Figure 2 and the operation of which will now be understood from the prior description of Figure 2 taken in connection with Figure 1.

Hence, all of the elements in the key 400 have been given the same reference numbers as the identical elements in Figures 1 and 2.

Instead, however, of having the accumulator apparatus directly connected to the impulse generating apparatus of Figure 3 or the left-hand end of Figure 1, the leads 25, 26, and 27 which, respectively, energizes the solenoids 51*u*, 51*t*, and 51*h* are connected to the prongs 25*a*, 26*a*, and 27*a* of the jack 401 of the key 400.

Likewise, the carry-over connections 103, 109, and 120 instead of being directly connected to the impulse generator are connected to the prongs 103*a*, 109*a*, and 120*a* of the jack 401 of the key 400.

Also, the return circuit 73 for the accumulator apparatus instead of being connected to terminal 75 as shown in Figures 1 and 2 is connected to the prong 73*a* of jack 401.

The various prongs 25*a*, 26*a*, 27*a*, 193*a*, 109*a*, 120*a*, and 73*a* of jack 401 may now be plugged into the contacts 25, 26, 27, 103, 109, 120, and 73 in the socket 402. A plurality of sockets 402 are provided, each individual to the particular merchandising element.

When the customer goes into a store, he or she is given the key 400 containing the accumulator elements. When she sees a particular display from which she desires to make a purchase, she may pick up the piece of merchandise and at the same time plug the key 400 into the socket 402. The price of that purchase will be added to the total on her accumulator in the manner hereinafter described.

Since, however, the design of Figure 6 is intended primarily for chain stores where much time has previously been lost in the totaling of merchandise when it was brought to the checking desk and where a substantial amount of merchandise has been lost by pilferage, it is intended that my device including the key 400 be utilized in connection with vending devices which on the closing of a circuit or on mechanical actuation will deliver the item.

For this purpose, the key may include a circuit connection for a mechanical element which unlocks the display cabinet and energizes a delivery device which will deliver the item.

At the same time, the circuit connection made by the key will add the price of the unit to the total on the key.

The vending elements themselves do not constitute a part of my present invention, but the means by which the accumulator apparatus from the key 400 adds on the specific total constitutes the specific adaptation of my invention to such a merchandising scheme.

The connecting elements 25, 26, and 27 for units, tens, and hundreds in the socket 402 are provided with individual contact clips 425, 426, and 427 electrically connected to the circuit connecting elements 25, 26, 27 in the socket.

The contact bars C1 through C9 of the apparatus of Figure 1 connected to the impulse generator which includes the drum 10 of Figure 3 are extended behind all of the displays as a continuous set of nine parallel conductors with taps at convenient locations running the length of the display and vending machines.

Where the price of an individual item to be merchandised is $1.25, the hundreds clip 427 will be clipped to bar C1; the tens clip 426 will be clipped to bar C2; and the units clip 425 will be clipped to bar C5.

Should the price then be changed to $1.15, it will be necessary only for the store manager to move the tens clip 426 from bar C2 to bar C1.

Thus, prices may be set up and readily changed simply by moving the clips around. The clips 425, 426, and 427 thus constitute the equivalent of the buttons *u*, *h*, *t*, and *m* of Figures 4 and 5, being treated as if these buttons were continu-

ously depressed and only one button for each place were provided.

Similarly, the carry-over connections 103, 109, and 120 which determine the carrying-over of one place to the next when the lower place goes through zero are carried to the leads 103, 109, and 120 which pass behind all of the displays. The carry-overs will be energized from contacts 101, 106, and 115 of the impulse generator located at the central point.

Consequently, the key 400 by simply being plugged into the socket 402 will be connected up so that the individual key and the central impulse generator will correspond to the unit illustrated in Figure 1.

It is necessary, however, that control means be provided individual to each key to ensure that when it is plugged in while the switch 200 of Figure 1 is closed and the impulse generator is somewhere in the middle of a cycle that the remainder of the cycle will not register on the key 400 and that the key will register only for a complete cycle.

For this reason, the central impulse generator will not have the contact 200 and the magnets 306 and 300. Instead, the contact 200A, the magnet 306*a*, and the magnet 300*a* will be provided at each socket location 402.

Switch 200*a* will be located in circuit between the lead 73 and terminal 75 as previously described in connection with Figure 1. However, the circuit will be broken at the gap 430, and leads 431 and 432 extend from this gap to contacts 433 and 434.

The plug 401 is provided with the bridging contact 435 which when the plug 401 is inserted in socket 402 will bridge contacts 433 and 434 placing the magnet 306*a* in a condition to be energized when contact 301 on the drum passes brush BS.

If this were not done or if the circuit to magnet 306*a* were not broken at the gap 430, then the magnet 306 may be energized to close the switch 200*a* every time the drum rotates and the possibility will then exist that a key may be inserted in the middle of a cycle to produce registry of only part of the cycle.

Since the circuit is broken at the gap 430, magnet 306*a* cannot be energized by the engagement of contact 301 with brush BS until after the key is inserted and the circuit to the magnet 306*a* is closed by the bridging contact 435 in engagement with contacts 433 and 434.

Consequently, the magnet 306*a* will be energized to close the switch 200*a* when contact 301 on the drum passes the brush BS at the beginning of a cycle following the insertion of plug 401 of key 400 in the socket 402.

The magnet 306*a* will then pull the switch 200*a* closed whereupon the magnet 300*a* will be energized to hold the switch 200*a* closed in exactly the manner described in connection with Figure 1, except that the solenoid 303 in series with magnet 300 of Figure 1 may be omitted.

The impulse generator now going through its cycle will operate the accumulator apparatus in the key 400 to add the particular cost of the item to the total on the key 400.

At the end of the cycle, the solenoid 320 connected on one side to lead 321 which in turn is connected to brush BR at the impulse generator and on the other side to the terminal 75 will be energized to extend its armature 450, pushing against the abutment 451 of the plug 401 and thereby pushing the plug 401 out.

The energization of magnet 320 which corresponds to magnet 320 of the unit described in connection with Figure 1 thus prevents the next recycling of the impulse generator from repeating the addition and adding a successive total.

At the same time, the magnet 320*a* or a magnet similarly connected may be utilized to energize the delivery apparatus. Since it is not desirable to have the magnet 320*a* energized unless a key is actually inserted in the socket, the circuit to magnet 320*a* is broken at 455. Leads 456 and 457 on opposite sides of the gap 455 are connected to contacts 458 and 459.

An additional bridging contact 460 is carried by the switch 200, being connected thereto by the insulated extension 461. When switch 200*a* is pulled down to close, it pulls down the bridging contact 460 to bridge contacts 458 and 459 and, therefore, prepare a circuit for operation of the magnet 320*a* after switch 200*a* is closed. Magnet 320*a* thus cannot be energized until switch 200*a* is closed.

Switch 200*a* cannot be closed by energization of magnets 306*a* and 300*a* until bridging contact 435 is inserted in the circuit therefor.

Thus, magnet 320*a* cannot be energized unless the key 400 has registered a full cycle; and the key cannot begin to register any part of the cycle until contact 301 on the drum of the centrally located impulse generator passes brush BS after the key is inserted.

As may now be understood, the impulse generator of the left-hand end of Figure 1 and of Figure 3 is located at some central source in the store.

The bars C1 through C9 extend continuously behind all the displays and are accessible for engagement by clips 425, 426, and 427. The leads 311, 321, 103, 109, 120, and 75 may be housed in a cable from which individual connections are made to the sockets at each display.

Socket 402 at each display has prongs 25, 26, and 27 which are connectable to the bars C1 to C9 and prongs 103, 109, 120 connected to the similarly numbered leads, as well as prong 73 which is connected through switch 200*a* to lead 75.

The prongs are contacted by the similarly numbered prongs on the plug 401. The contacts 433 and 434 are bridged by the bridging contact 435 on the plug 401. A switch 200*a* with its additional bridging contact 460 is located at each socket, and magnets 320*a*, 306*a*, and 300*a* are located at each socket.

It will be obvious that this system of using a centrally located impulse generator and individual keys may be applied not only to store merchandising but to various other types of operations including stock rooms, in factories or stores, warehouses, for inventory control and other related uses where individual sets of figures are to be totaled in accordance with the withdrawal of units from a stock.

The unit may be combined with automatic delivery mechanism or in the case of warehouses and stock rooms, the automatic delivery mechanism, which forms no part of the present invention but which may be energized by magnet 320*a* or an electrical circuit in parallel therewith, may be dispensed with.

In the case of chain stores, the utilization of the system of Figure 1 as modified in connection with the showing of Figure 6 makes it unnecessary to use a skilled checking clerk to price and total the merchandise since the customer need

merely present the key showing the correct total with the merchandise.

The checking desk, therefore, in a chain store will simply be a wrapping or packaging desk, and a single cashier may be used in place of the multiple cashiers and checking clerks heretofore used.

Since my invention as disclosed in connection with Figure 1 lends itself as shown in connection with Figure 6 to separation of its various elements, my novel device may be used in a form wherein a single impulse generator of the type of Figure 10 may control a multiplicity of accumulators.

This is shown schematically in Figure 7 where each adding machine **500** will have an individual keyboard of the type of Figure 4 and an individual accumulator of the type of Figure 2. The keyboard has the bars C1*a* to C9*a* connected to the prongs *1b*, *2b*, through *9b* of the plug **501**.

The energizing lead **22***a* is connected to the prong **22***b*. The start lead **302***a* is connected to the prong **302***b*. The units lead **103***a* is connected to the prong **103***b*. The tens lead **109***a* is connected to the prong **109***b*. The hundreds lead **120***a* is connected to the prong **120***b*. The thousands lead **503***a* is connected to the prong **503***b*, and the release lead **321***a* is connected to the prong **321***b*.

The individual adding machine thus connected to the plug **501** will have parts which correspond to all of the elements of Figures 1, 2, 4, and 5, except for the elements shown in Figure 3 and, therefore, the elements shown to the left of line **505** and above line **506** of Figure 1.

The leads from the terminals of Figure 3 and from the various brushes shown therein and in the schematic view of Figure 1 are connected to a cable **510** to which a plurality of sockets are connected. Each socket **511** is provided with connectors individually connected to each of the leads of cable **510** and arranged to match the connecting prongs of the plug **501**.

Thus, a central impulse generator may be used energizing the leads in cable **510** and individual adding machines without the impulse generator of Figure 3 or left-hand end of Figure 1 may be provided with plugs **501** to be plugged in at suitable locations wherever sockets **511** are provided.

By this means, therefore, the individual adding machines need only consist of the accumulator elements of Figure 2 plus the keyboard of Figure 4 and the associated magnets **306**, **300**, **303**, **320**, **222**, and **330** and the associated switches **200** and **30**.

As far as size is concerned, therefore, each individual adding machine may have lateral dimensions which need be only the size of the keyboard itself plus a sufficient extension to permit the numbers on wheels **70** of Figure 2 to be visible and a depth which is determined only by the height of the keyboard including the distance from contact bars C1 to the top of buttons *9m*, *9h*, *9t*, and *9u* plus a depth sufficient to house magnets **306**, **300**, **303**, **320**, **222** and **330** and the switches **200** and **30**. The switch **30** should, of course, be located in a position accessible from the top of the keyboard.

By this means, therefore, a plurality of small size adding machines may be operated from a single impulse generator reducing the cost of installation of a large number of adding machines and making each of the adding machines a small compact unit.

While I have shown my invention in connection with a specific type of accumulator and a specific

type of impulse generator, it will be obvious that many variations and modifications may be made.

Thus, instead of generating impulses which are transmitted to the solenoids of individual counters, the individual counters may be connected to the rotating drum or on the shaft thereof, and the electrical impulses generated by the rotating drum as above-described may be utilized to energize electro-mechanical elements to cause the counters to rotate with the drum or at a rate proportional to the rotation thereof for that portion of the revolution of the drum determined by the impulse or specific energization created by the revolution of the drum.

Thus, individual counters may be connected by magnetic clutches to the shaft of the drum and currents controlled by the drum may be utilized to energize and de-energize the magnetic clutches to control the angular rotation of each counter in response to the current controlled by the drum and in response to specific selecting or control elements similar to the buttons or contactors of Figures 4 and 5.

In another and obvious modification of my invention, a single accumulator of the type of Figure 2 may be utilized in connection with a large number of adding machines being connected in parallel with the device of Figure 2 as connected to Figure 1 or being so arranged that the individual adding machines have no accumulator at all but simply the keyboard.

In this way, individual adding machines would consist of nothing but the keyboard of Figure 4. A central generator of the type of Figure 3 would be used. This generator would be connected to the sixteen leads shown across the top of Figure 7.

Each keyboard plug would then have only prongs corresponding to the prongs *1b* to *9b* of Figure 7 and another set of prongs for connection to the leads **25**, **26**, **27**, and **28** of Figure 1. Leads **25**, **26**, **27**, and **28** would then go to the central accumulator and the remaining leads **302**, **103**, **109**, **120**, **321**, and **22** of Figure 1 would also go to the central accumulator.

Thus, in machines of the para-mutual type where it is desired only to know a single total, each operator would be provided with just a keyboard connected by a suitable plug to a cable containing leads for the contact bars C1 through C9 and leads to the elements **302**, **103**, **109**, **120**, **321**, and **22**.

The accumulator would then show the total of operations of all adding machines.

This will require, as above pointed out, a central impulse generator, a central accumulator, and a plurality of keyboards, each of which need contain only the elements shown in Figures 4 and 5.

For added security in operation, each keyboard may also contain the switch **30** and the switch **200** and associated magnets to control the operation.

In department stores where individual totals as well as composite totals are required, a master accumulator may be connected to all of the adding machines in parallel with the accumulators individual to adding machines.

This type of operation is also desirable in warehouses and in many other accounting systems where individual and composite totals are required.

The only difficulty that may arise is that when impulses are received simultaneously from two or more adding machines, a pair of such im-

pulses occurring together may result in only a single operation of the master accumulator.

To obviate this, it may be necessary to provide in the connection between each individual adding machine and the accumulator a relay which will disconnect the adding machine from the accumulator if the impulses from another adding machine are being registered and will instead energize either an auxiliary accumulator or preferably an electrical memory device which will retain the impulses until the master accumulator is free to receive them.

This may be accomplished by recording the impulses from an adding machine which is blocked by another adding machine on a tape recorder or a plurality of condensers which will be connected to the master accumulator whenever it is not receiving impulses from another adding machine.

In all of the prior description I have shown the various elements of my novel device, the impulses, the generator, the accumulator, and the keyboard interconnected electrically by wires and likewise in the constructions of Figures 6 and 7 I have shown the various elements interconnected electrically by wire.

My invention also contemplates that in large multiple installations the circuit connections need not necessarily be by direct wire but may be obtained by suitable radio transmitters and receivers working on appropriate frequencies of limited broadcasting range or direct telephone or telegraph wire, where desired.

Also, by interconnecting the units by radio, telephone, or telegraph, it will be possible for chain stores or a type of business having many branches to obtain instantaneous master totals at some specific central point.

Also, where desired, appropriate re-setting devices may be used to return the indication on the machine to zero after the completion of a tabulating operation. Such devices may be either mechanically or electrically operated and may follow any of the well known principles already used in standard adding machines.

However, it will be obvious that the carry-over cams 80 on each of the discs 70 may well furnish a mechanical element which can be interengaged by any re-setting device. One such resetting device may be a plurality of fingers concentric to each other, each individual to a specific disc 70, operated simultaneously by a knob accessible from the outside of the machine. A single rotation of the knob will cause the individual fingers to engage the extensions or cams 80 of the discs 70 and return them to the desired position.

The fingers are preferably mounted on the shaft which is operated by the externally accessible knob, the shaft being spring biased to a position where the fingers are out of the plane of the cams 80. To re-set the discs 70, the knob should then be pressed in to bring the fingers into the plane of the cams 80 and then rotated.

Automatic mechanical means may be provided to pull the shaft over to the proper position at the initiation of the re-setting operation and to push the shaft back to non-engaging position at the end.

Various electrical re-setting devices may be used, as for instance each of the discs 70 may have a contact engaging the plurality of contacts at different positions of the discs paralleling the bars C1 to C9. Thus when a disc is at position 4, the contact engaged thereby within the accumulator will be in parallel with bar C6. In this position, closing a switch to energize the accumulator through the said complementary contacts will automatically add to the accumulator a number which will bring the total on the accumulator to zero.

As above pointed out, my novel device and system is obviously applicable to multiplication in the manner presently used by the art. Various automatic means may be added thereto to facilitate such operations.

For subtraction operations it will only be necessary to duplicate each of the ratchets 61 and to duplicate the pawls operated by the solenoids. The addition would be accomplished by the ratchet and pawl as shown. The ratchet and pawl for subtraction would then work in an opposite direction.

To shift from addition to subtraction, it would then only be necessary to render one set of pawls inoperative and permit the other set of pawls to work. This can be accomplished by appropriate mechanical means which will either shift the solenoid 51 to the left or right as a group, or their armatures 52 left or right as a group, or simply the pawl carriers at the top of the armatures left or right as a group.

Since these many variations and modifications of my invention should now be obvious to those skilled in the art, I prefer to be bound not by the specific disclosures herein contained but only by the appended claims.

I claim:

1. An electrical computing device comprising accumulating apparatus responsive to electric current pulses to accumulate and register the algebraic totals of successive pulses; electric current pulse generating aparatus generating a successive series of successive pulses, each series including nine pulses and a plurality of control pulses; said pulse generating apparatus comprising a continuously rotating member having a contact member secured to it; said contact member comprising a rake-shaped section and a step-shaped section, said sections being formed in combination and integral with each other; said rake-shaped section comprising at least nine prongs of different graduated lengths; said step-shaped section comprising at least one step for each of said elements registering the digits; a first and a second plurality of circuit connecting members for the pulse generating apparatus, each connecting member of said first plurality of connecting members being responsive to and energized by a pre-selected group of the nine pulses of the series pulses; each connecting member of said first plurality of connecting members being spaced to intermittently engage a different number of prongs of said rake-shaped section of said contact member during each revolution of said continuously rotating member; each of said second plurality of connecting members being responsive to and energized by a single pre-selected pulse; each of said second plurality of contact members continually engaging a different step of said step-shaped section of said contact member during a different portion of a revolution of said continuously rotating member; and means interconnecting the electric current pulse generating apparatus and the accumulating apparatus, said last-mentioned means comprising a plurality of individually selectable and operable contactors each movable to interconnect electrically the pulse generating apparatus and the accumulating aparatus, individual contactors being mov-

able into and out of engagement with individual circuit connecting members of the pulse generating apparatus, said individual contactors being prevented from moving into and out of engagement with said individual circuit connecting members of said pulse generating apparatus when said pulse generating apparatus and electro-mechanical accumulating apparatus are energized; said pulse generating apparatus being energized when one of the second plurality of connecting members engages one of the steps of said contact member, said individual contacts being moved out of engagement with said individual circuit connecting members when said one of the second plurality of connecting members disengages said one of the steps of said contact member.

2. An electrical computing device as in claim 1 wherein the electric current pulse generating apparatus and the accumulating apparatus are separate units; and wherein the means interconnecting the electric current pulse generating apparatus and the accumulating apparatus comprises a manually separable and unitable connector.

3. An electrical computing device as in claim 2 wherein the electric current pulse generating apparatus is provided with a plurality of interconnecting means; and wherein a plurality of

accumulators are each provided with corresponding interconnecting means; the interconnecting means of each of said accumulators being engageable with any of the interconnecting means of the electric current pulse generating apparatus.

GEORGE A. JUST.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
515,110	Callender	Feb. 20, 1894
518,885	Hollerith	Apr. 24, 1894
1,302,616	Williams	May 6, 1919
1,933,353	Tauschek	Oct. 31, 1933
2,283,999	Kozma et al.	May 26, 1942
2,293,127	Fishack et al.	Aug. 18, 1942
2,353,046	Lake et al.	July 4, 1944
2,398,771	Compton	Apr. 23, 1946
2,402,989	Dickinson	July 2, 1946
2,432,324	May	Dec. 9, 1947

FOREIGN PATENTS

Number	Country	Date
112,677	Australia	Dec. 9, 1949
244,013	Germany	June 8, 1909