

April 11, 1950

R. A. CHRISTIAN

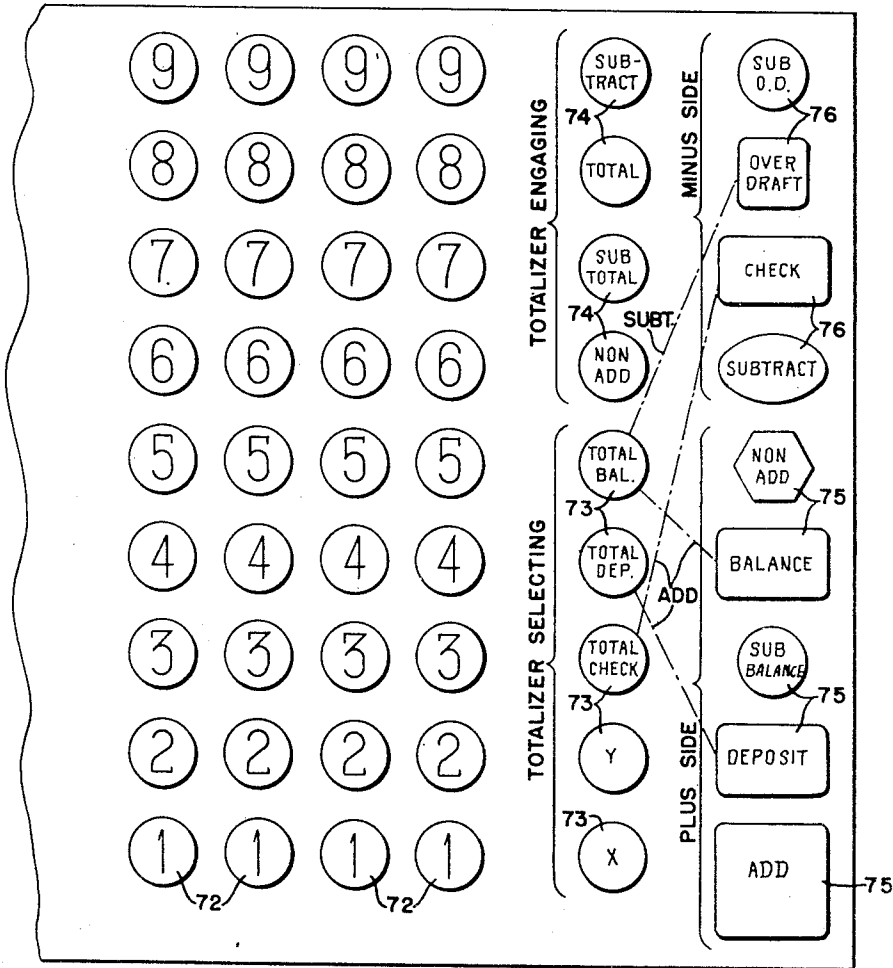
2,503,865

DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

Filed July 21, 1944

17 Sheets-Sheet 1

FIG. 1



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April 11, 1950

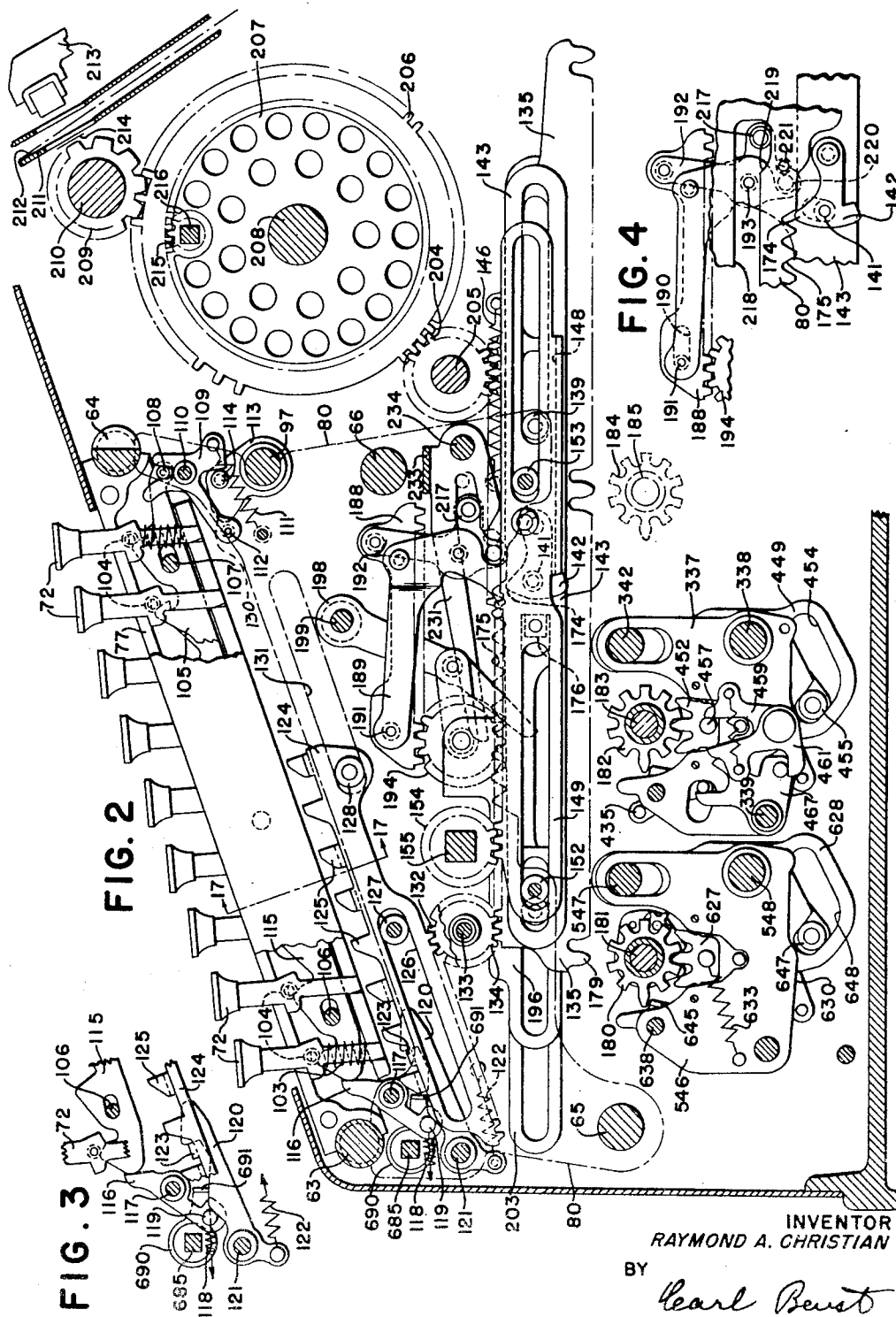
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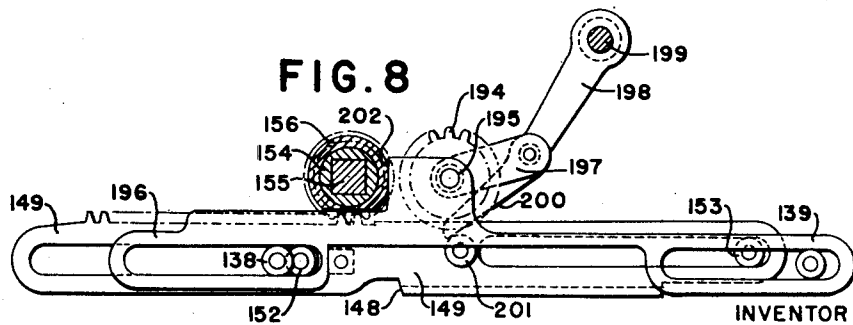
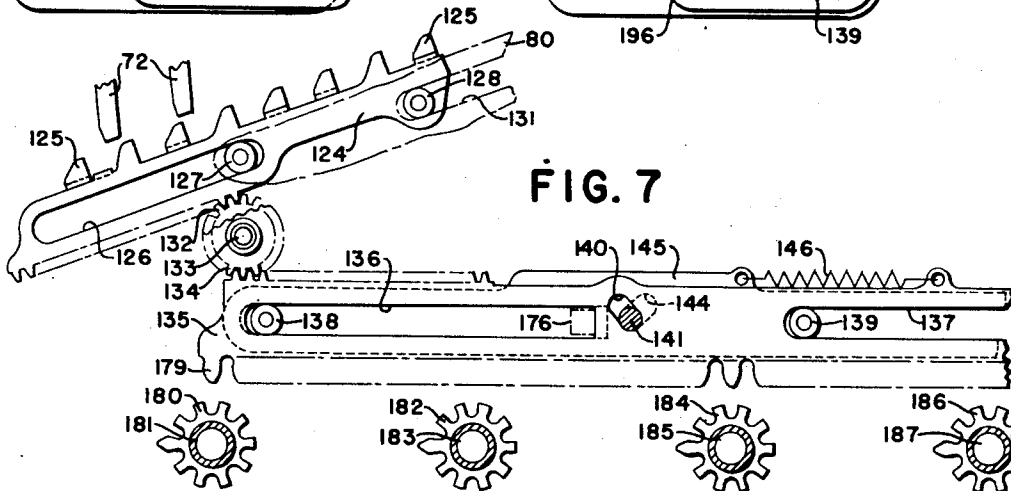
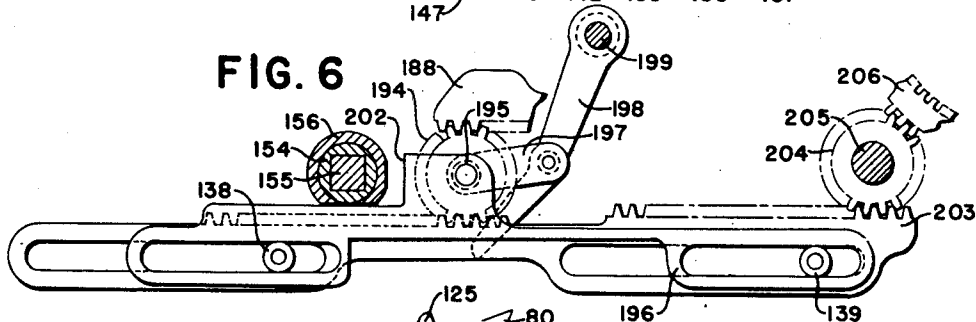
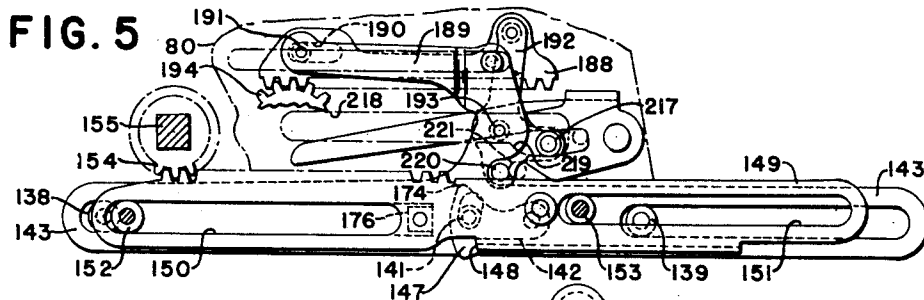
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DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

17 Sheets-Sheet 3



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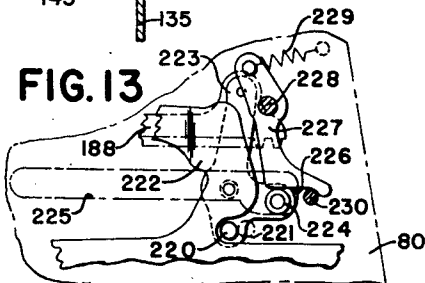
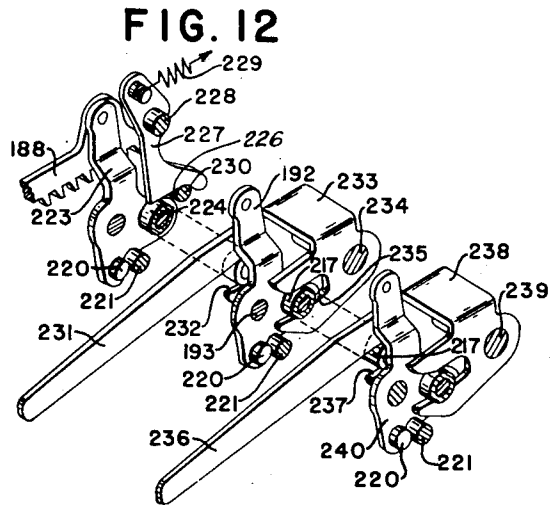
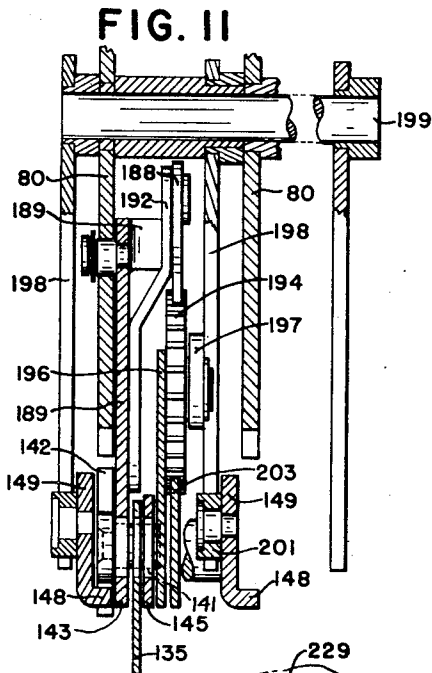
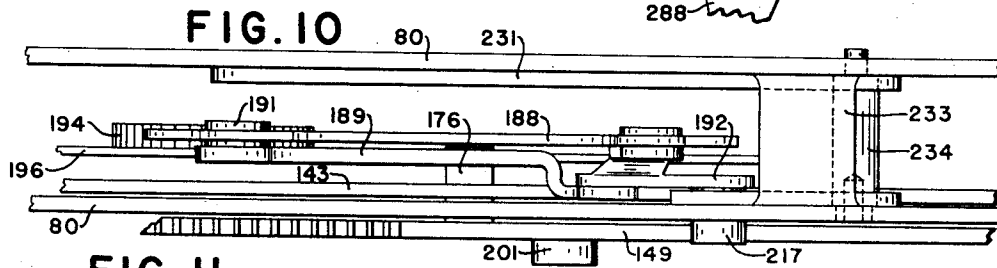
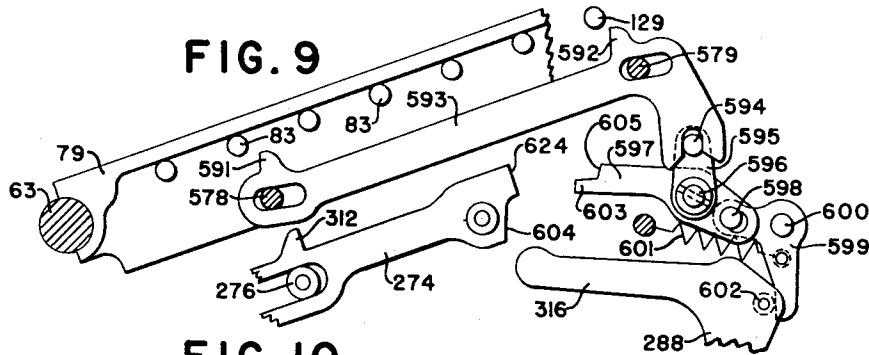
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DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

Filed July 21, 1944

17 Sheets-Sheet 4



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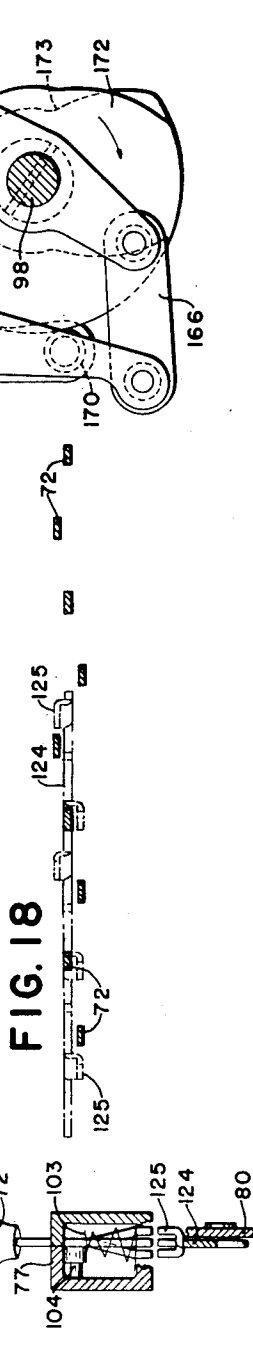
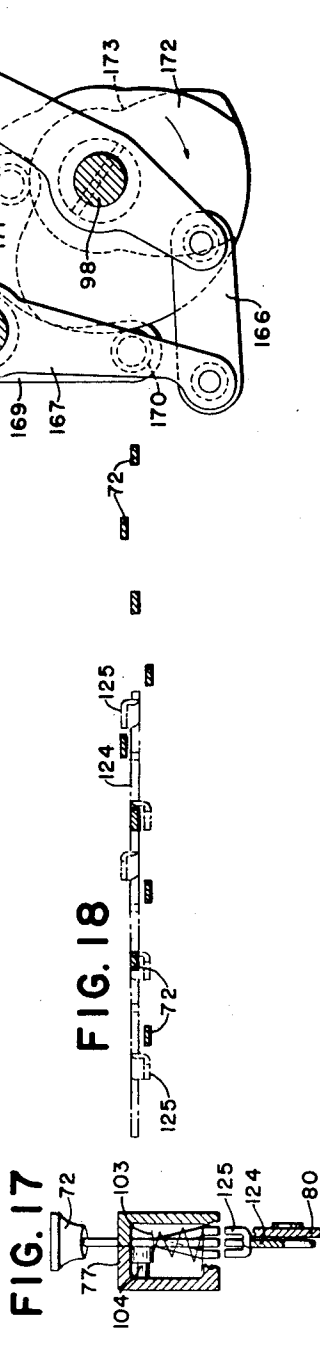
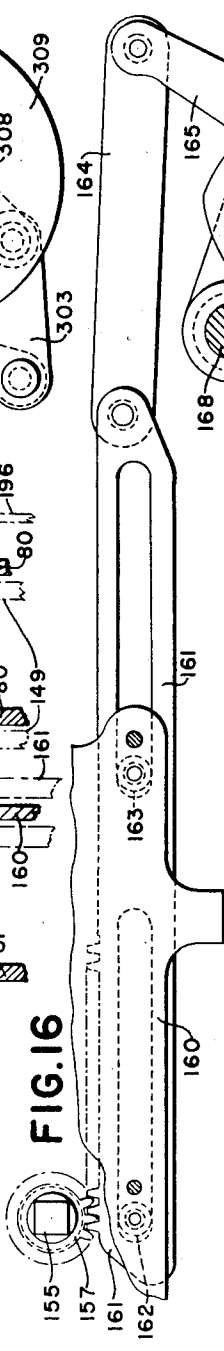
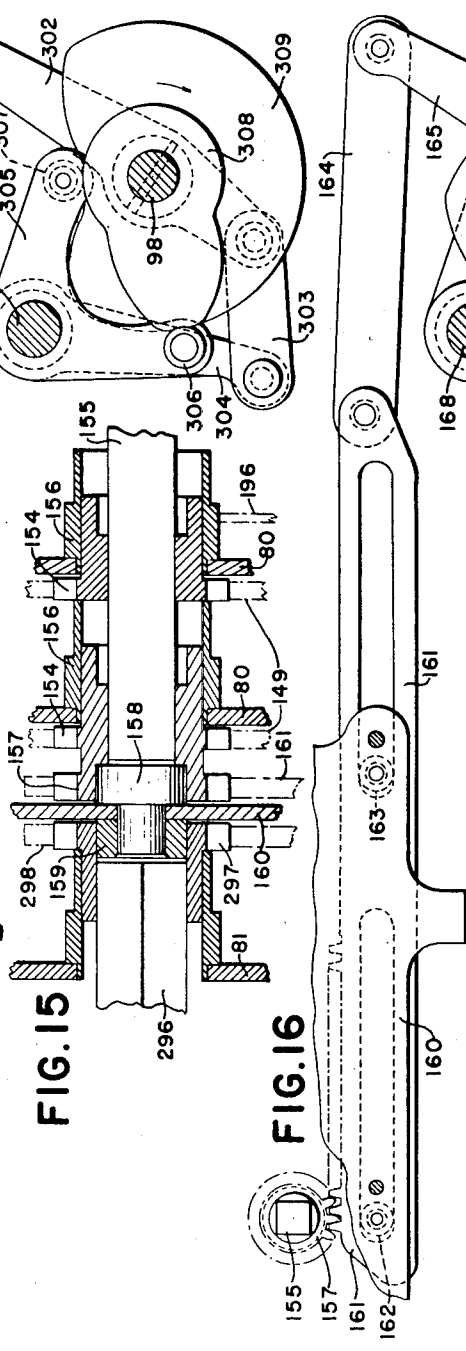
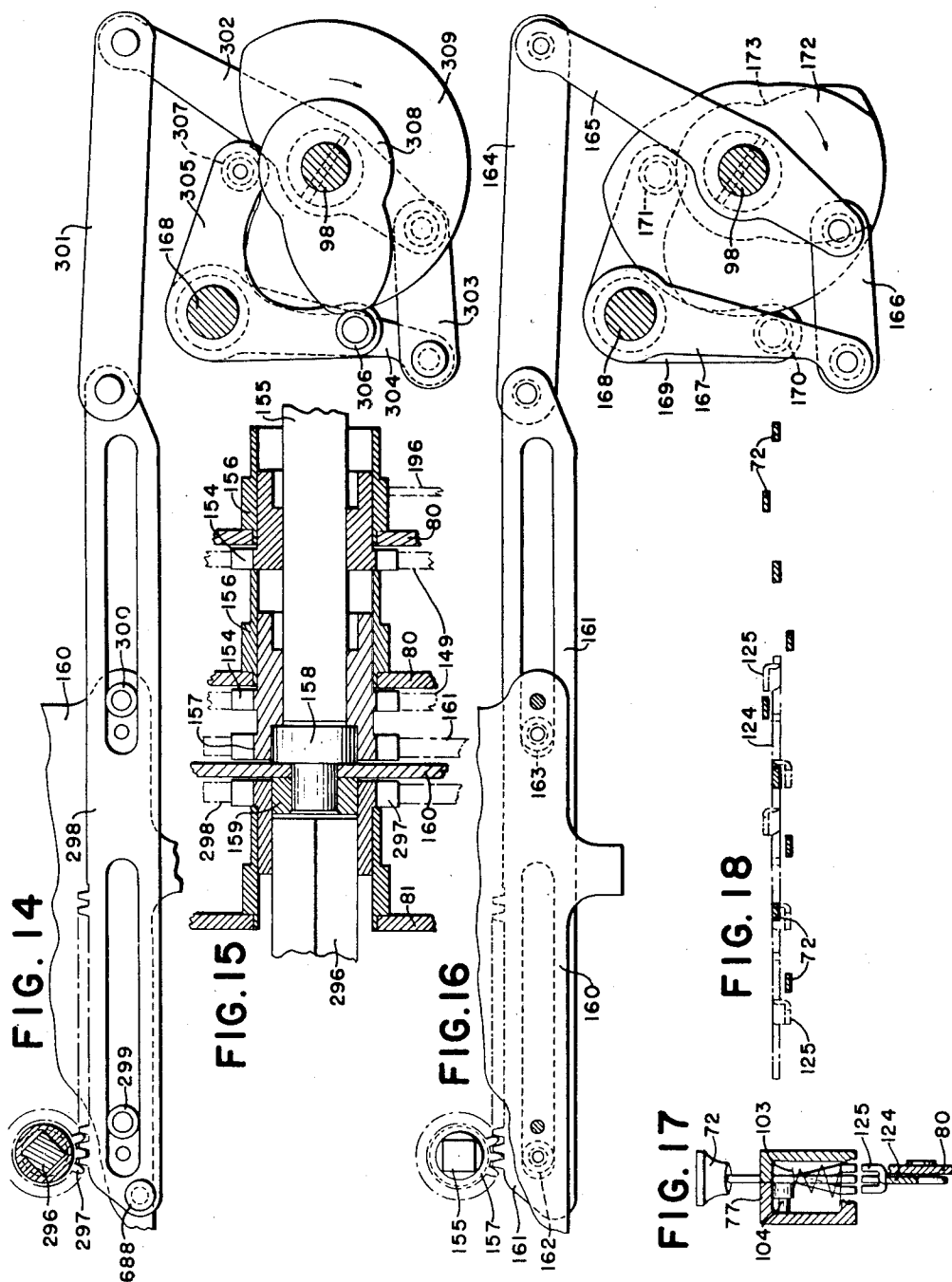
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DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

Filed July 21, 1944

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DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

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FIG. 19

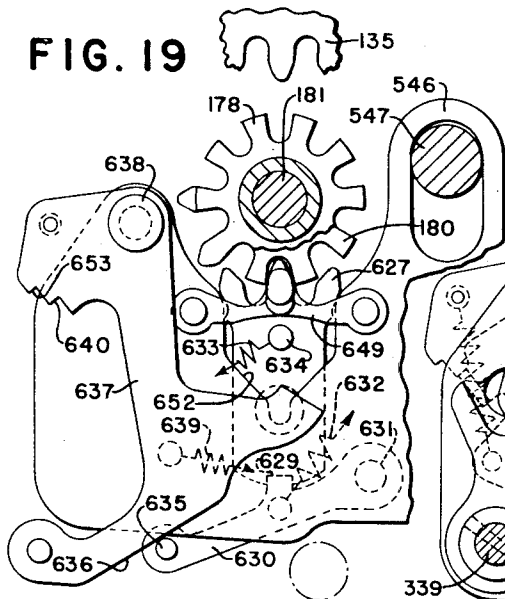


FIG. 20

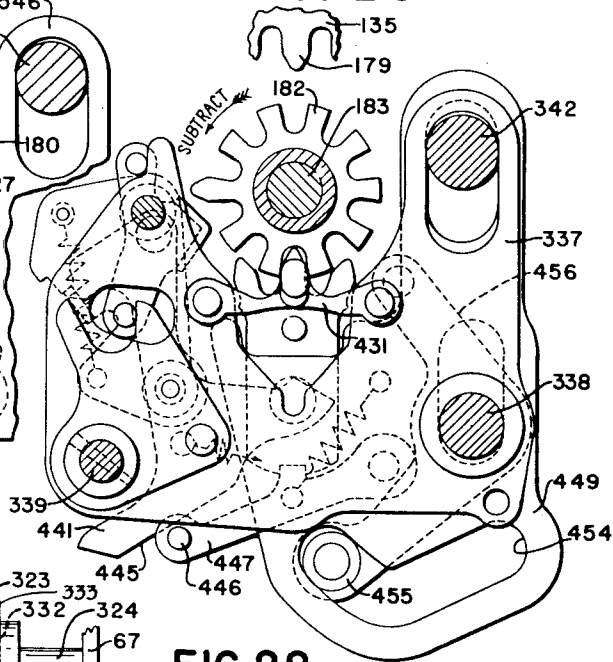


FIG. 21

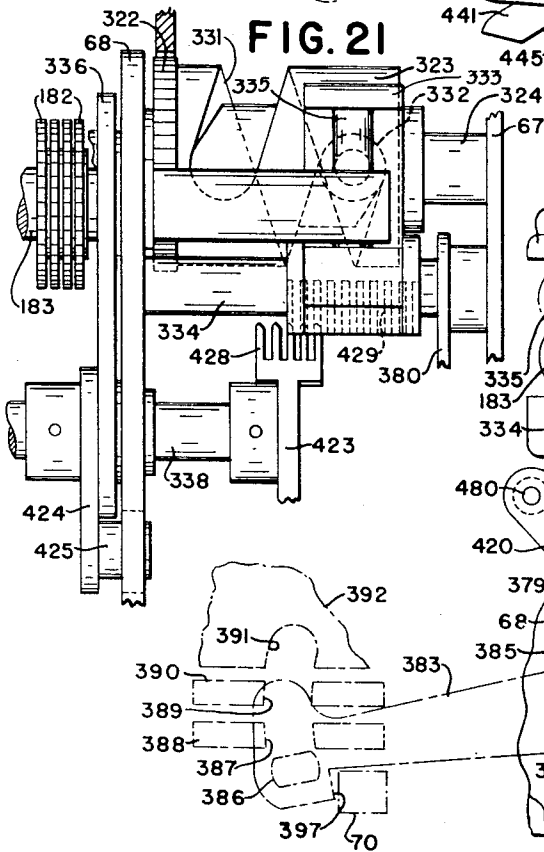
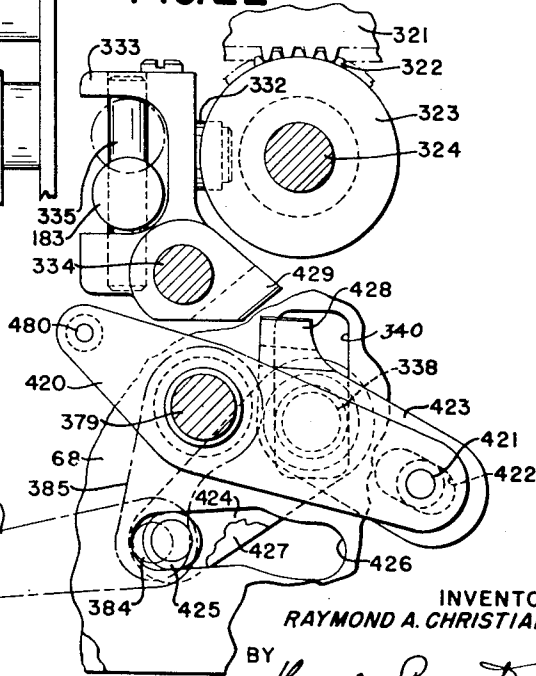


FIG. 22



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FIG. 23

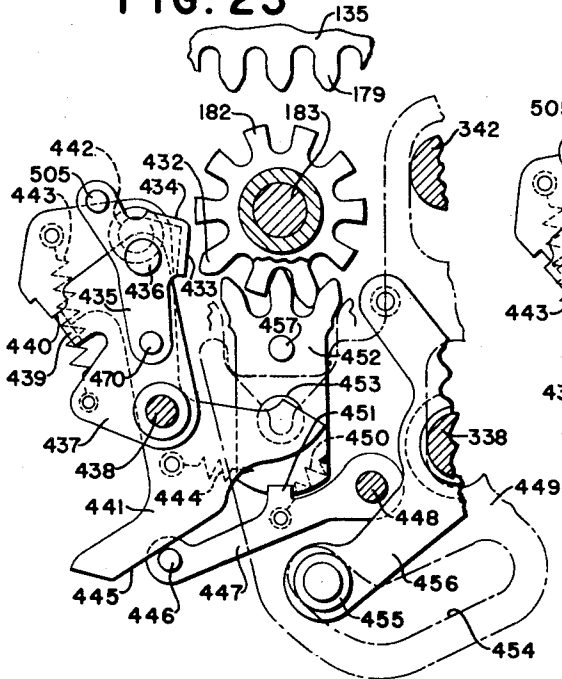


FIG. 24

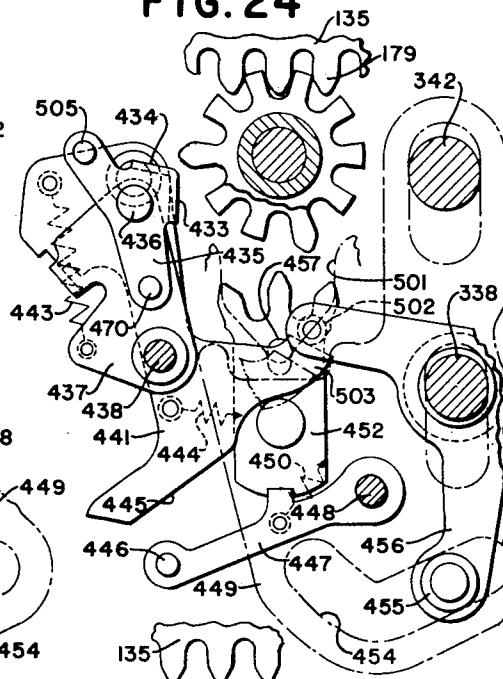


FIG. 25

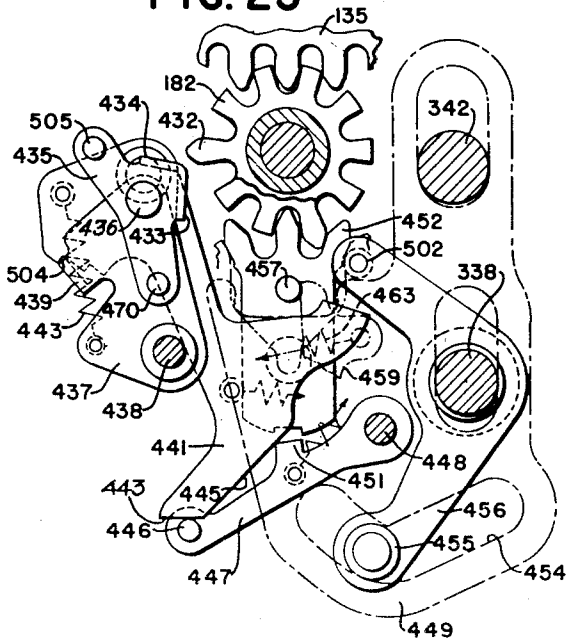
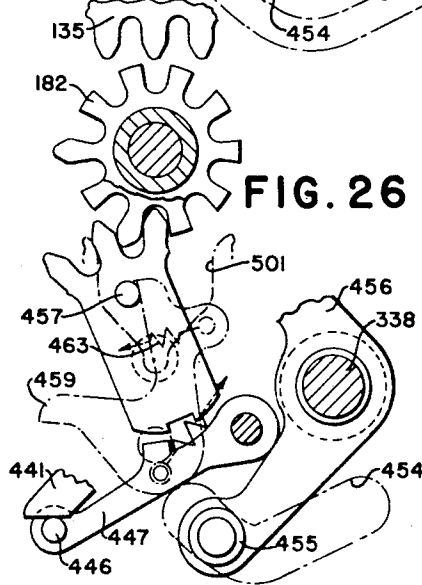


FIG. 26



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DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

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FIG. 31

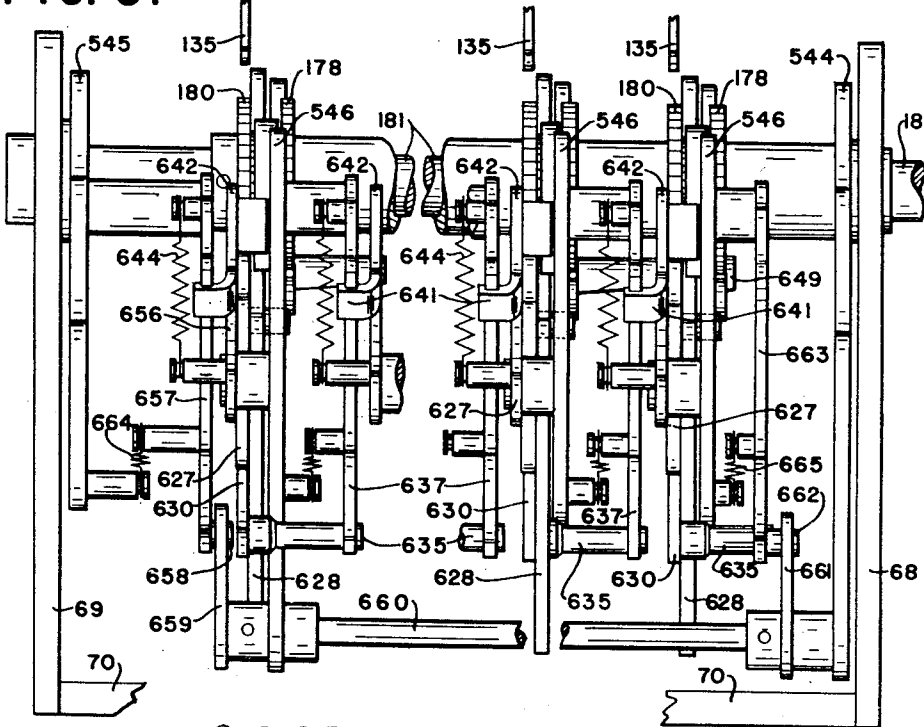


FIG. 32

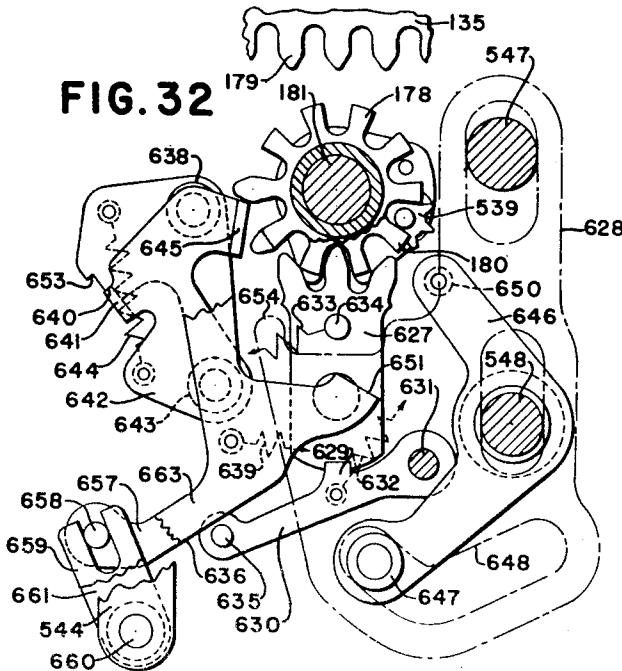
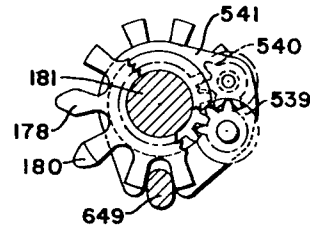


FIG. 33



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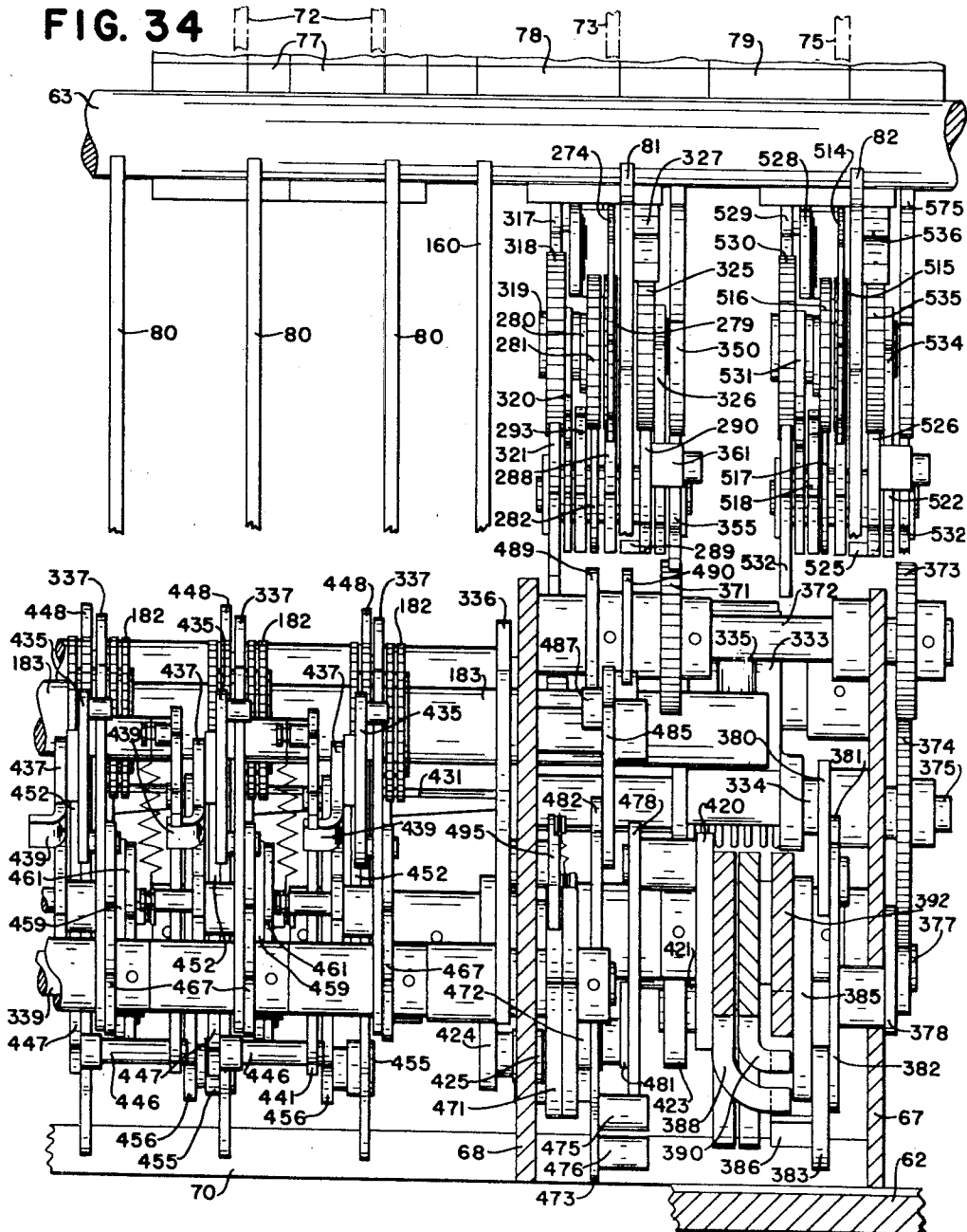
DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

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DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

Filed July 21, 1944

17 Sheets-Sheet 10



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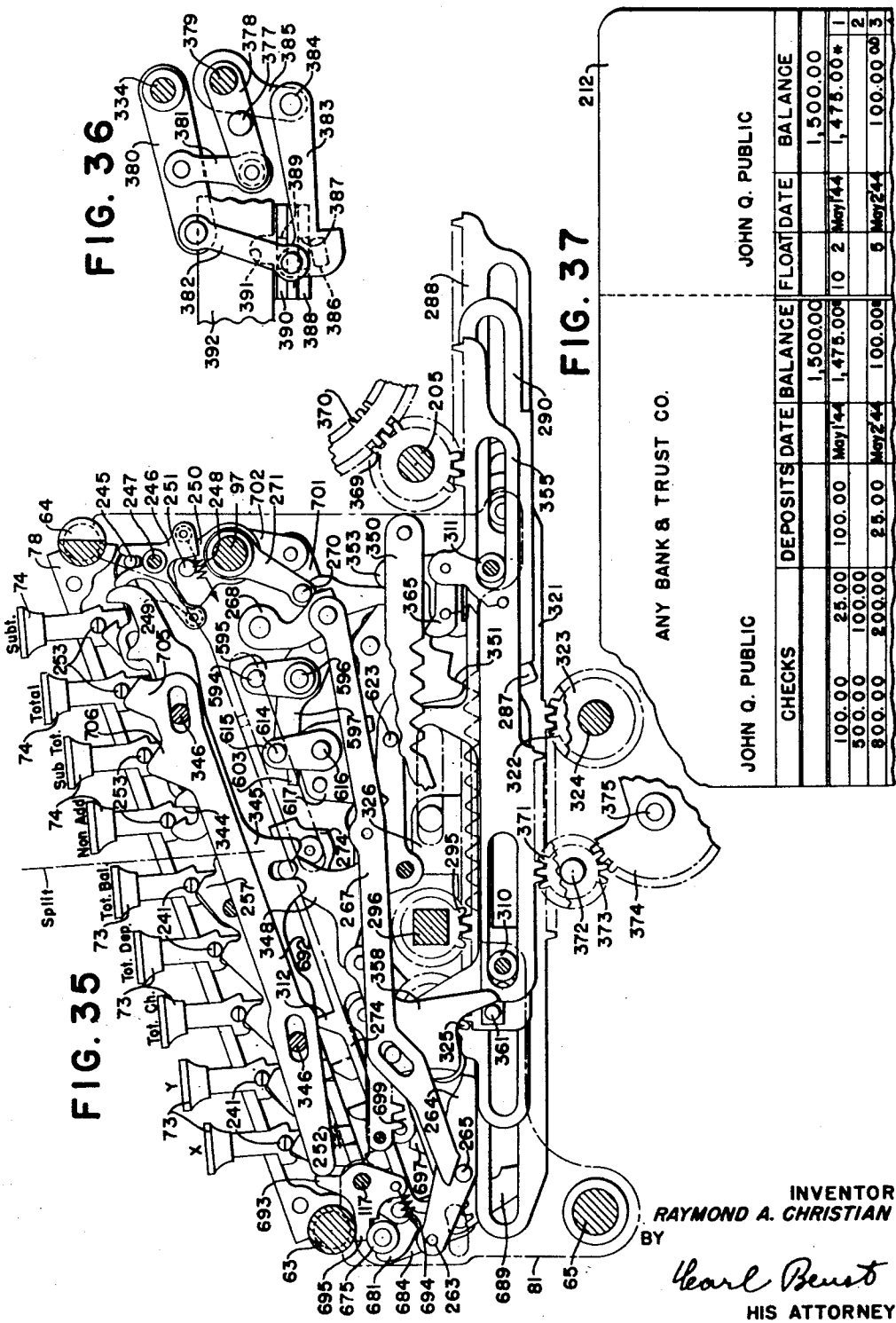
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DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

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DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

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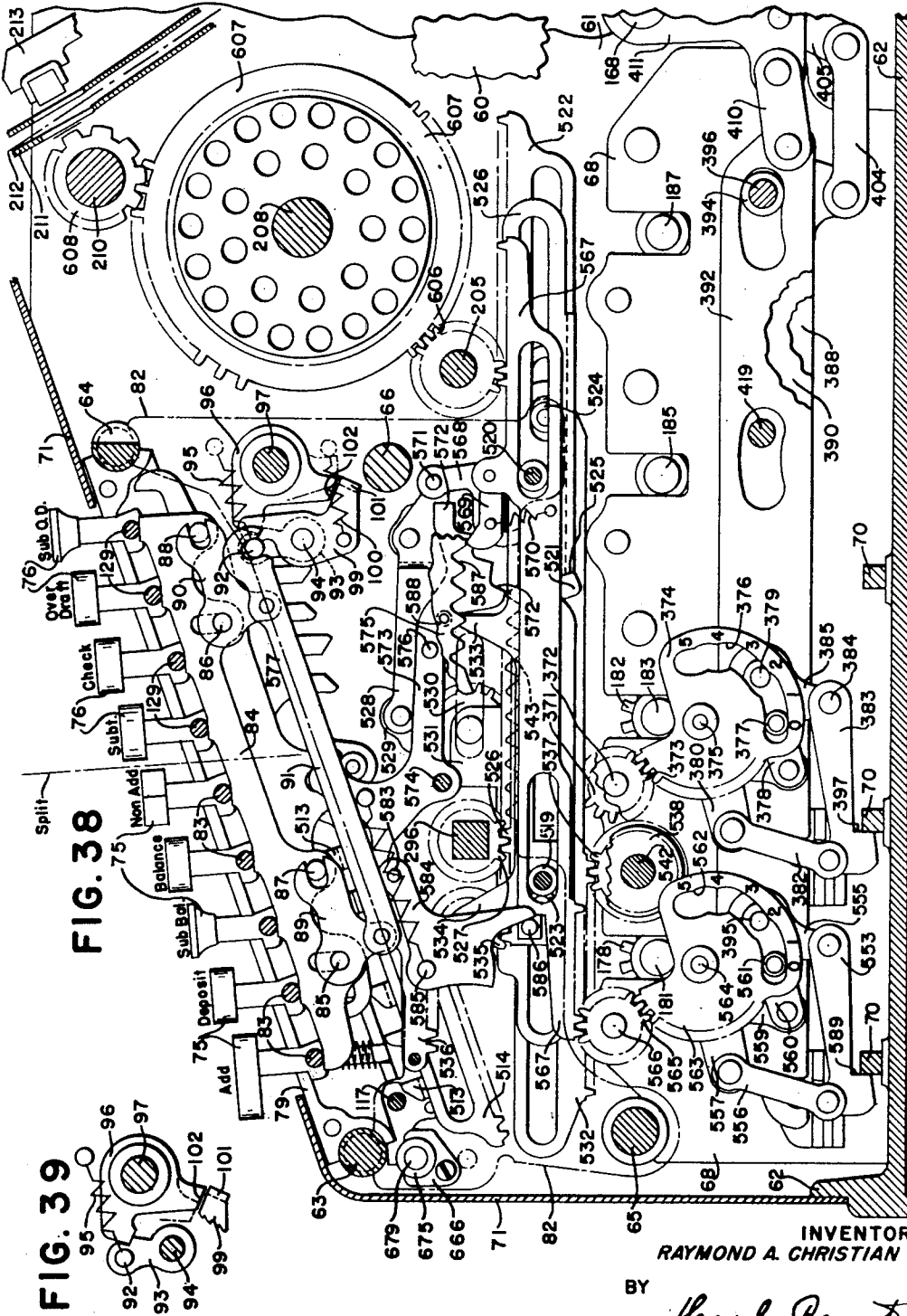


FIG. 38

FIG. 39

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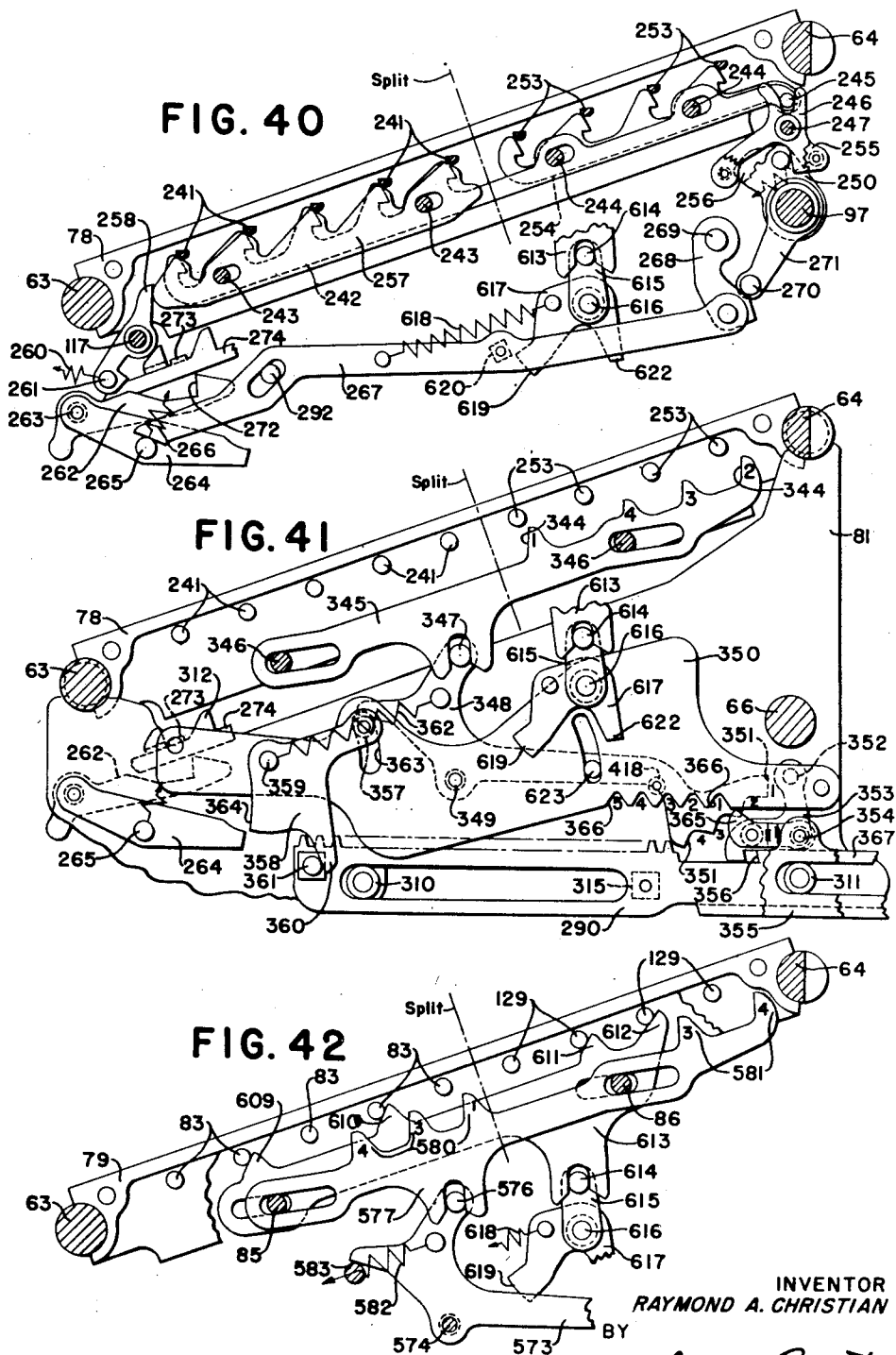
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DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

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17 Sheets-Sheet 13



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DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

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FIG. 43

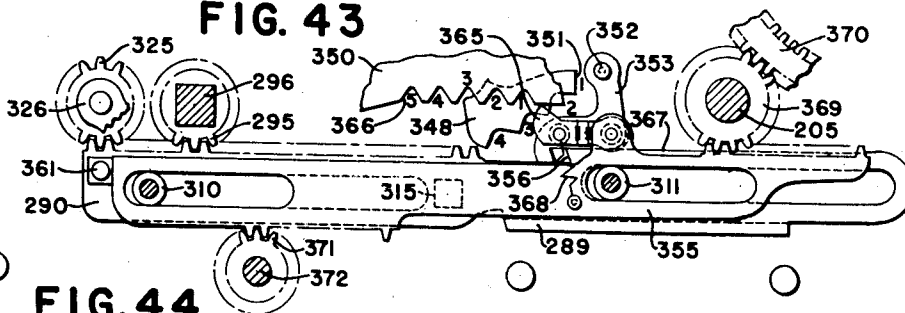


FIG. 44

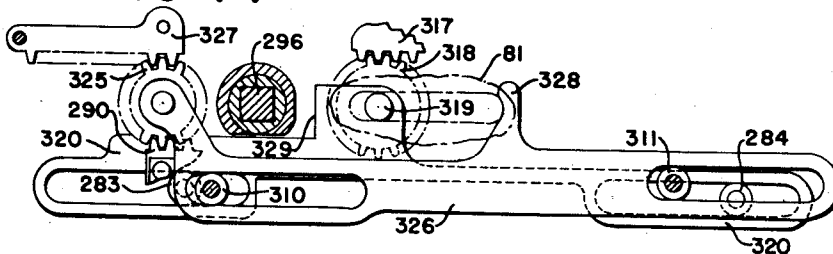


FIG. 45

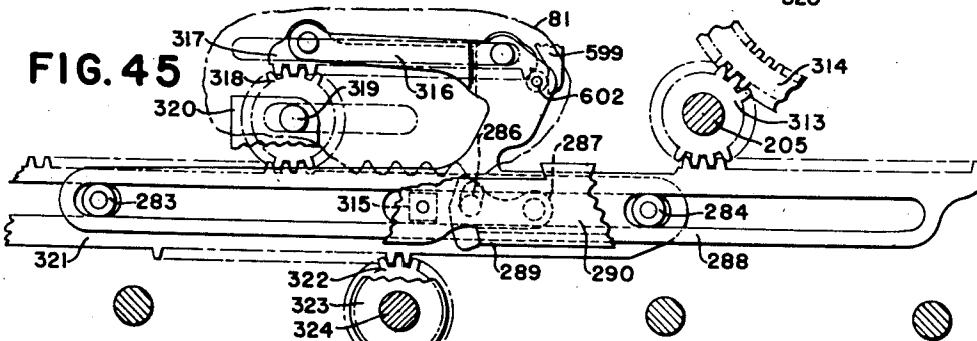
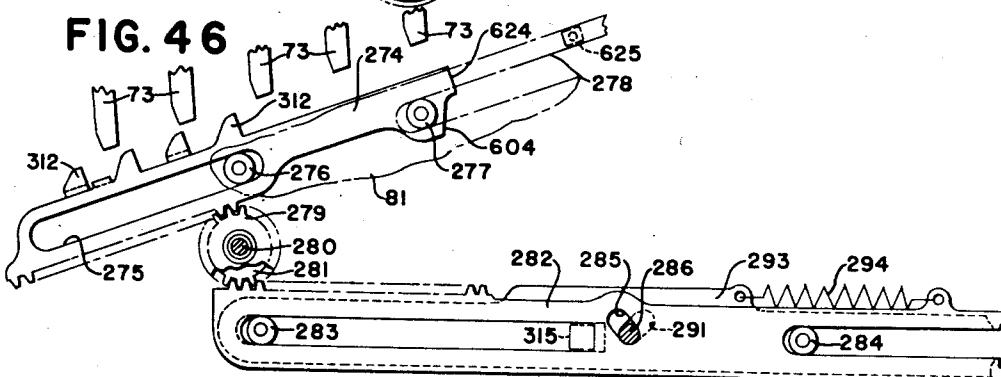


FIG. 46



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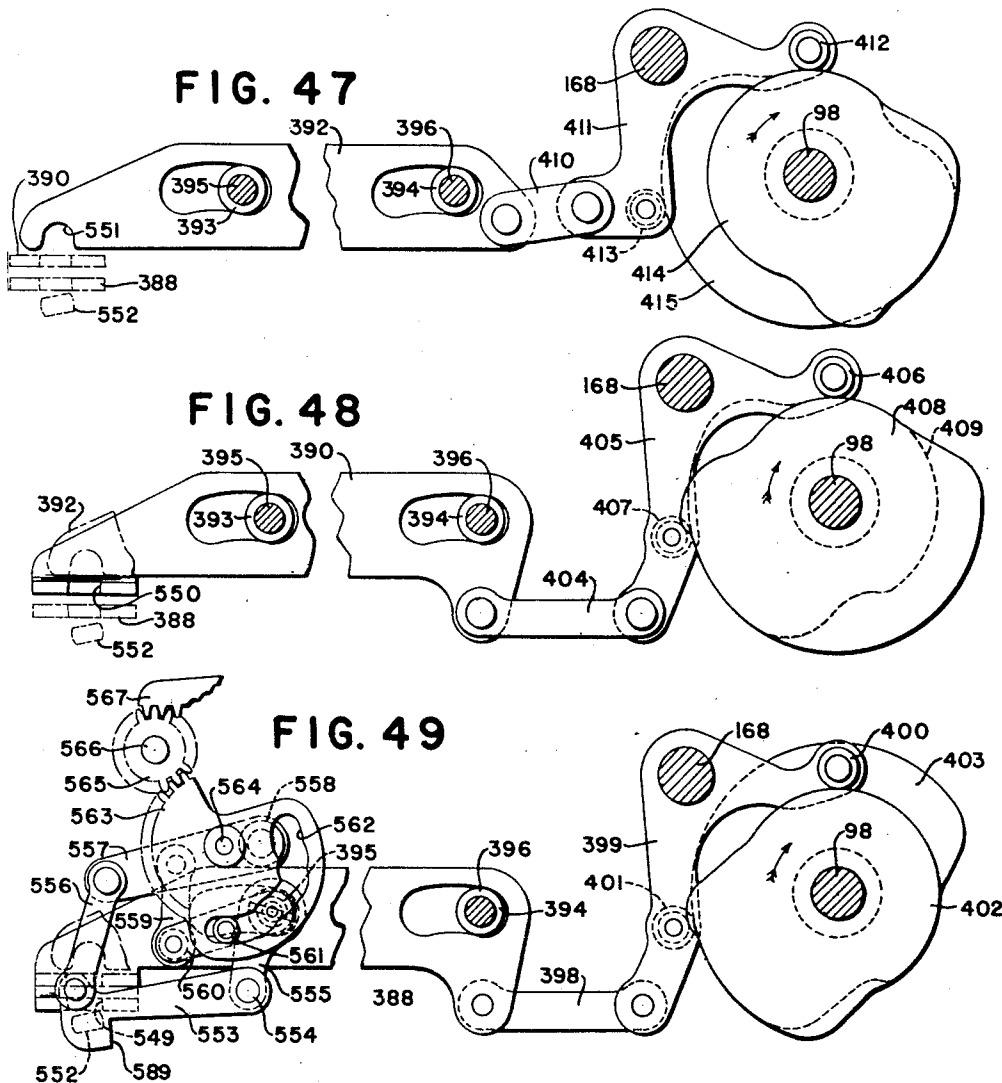
R. A. CHRISTIAN

2,503,865

DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

Filed July 21, 1944

17 Sheets-Sheet 15



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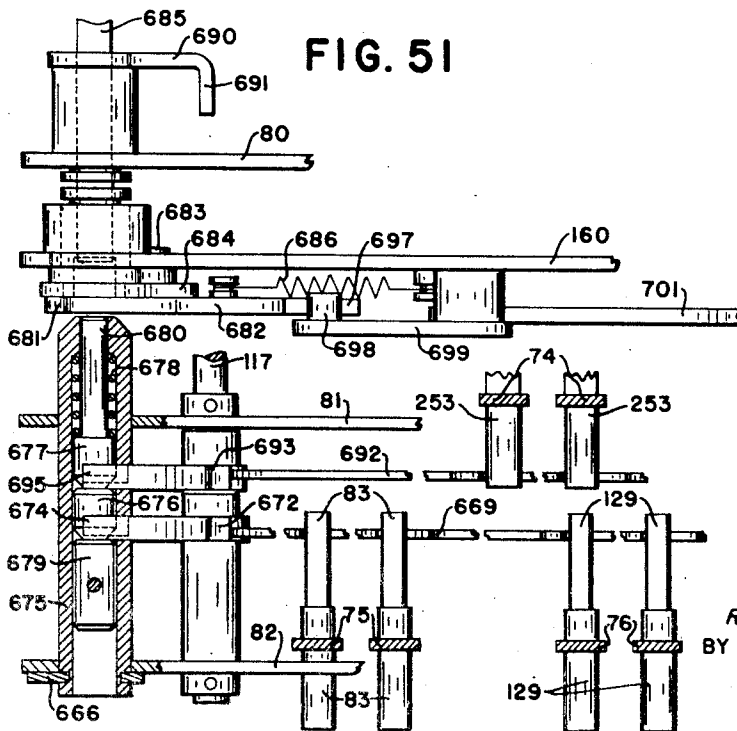
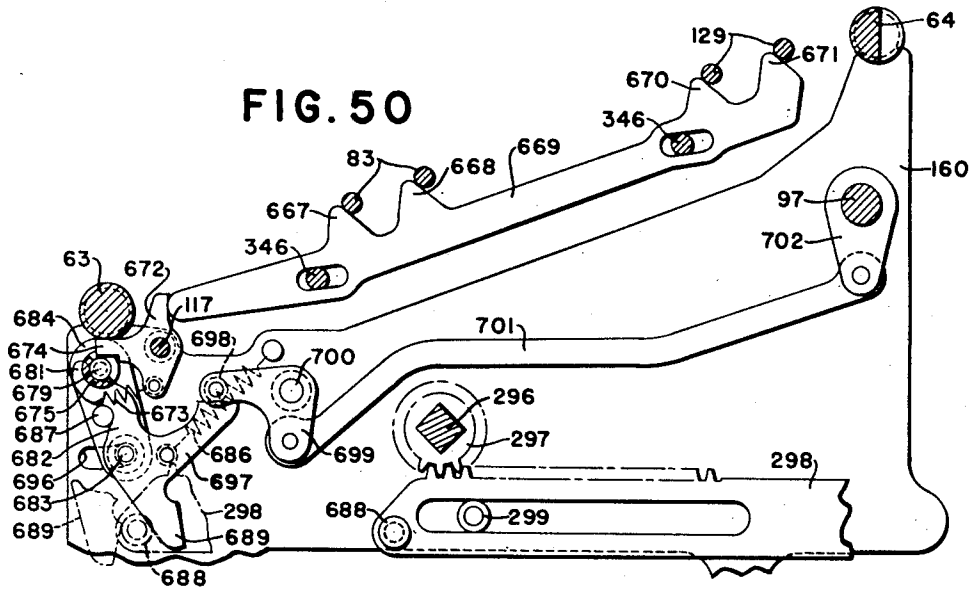
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DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

Filed July 21, 1944

17 Sheets-Sheet 16



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DIFFERENTIAL SETTING MECHANISM FOR PRINTING MACHINES

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FIG. 52

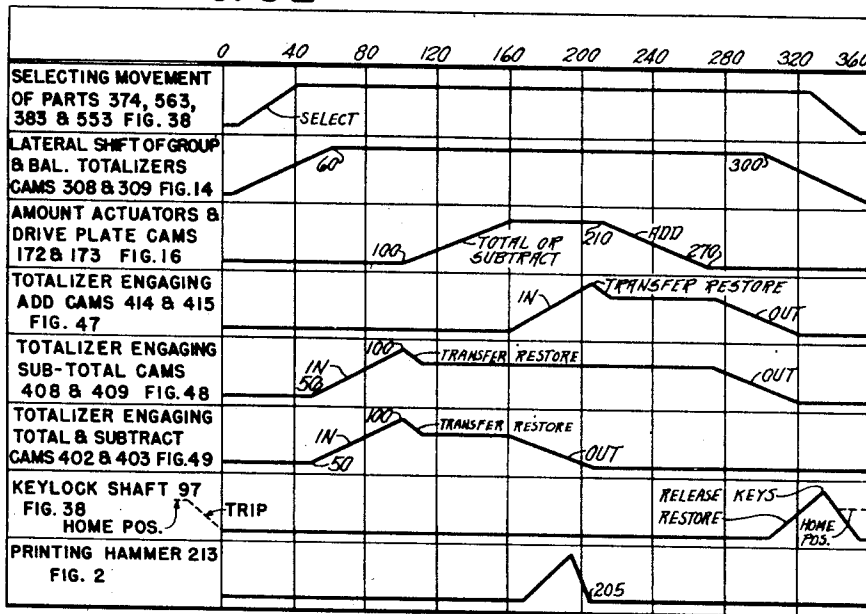


FIG. 53

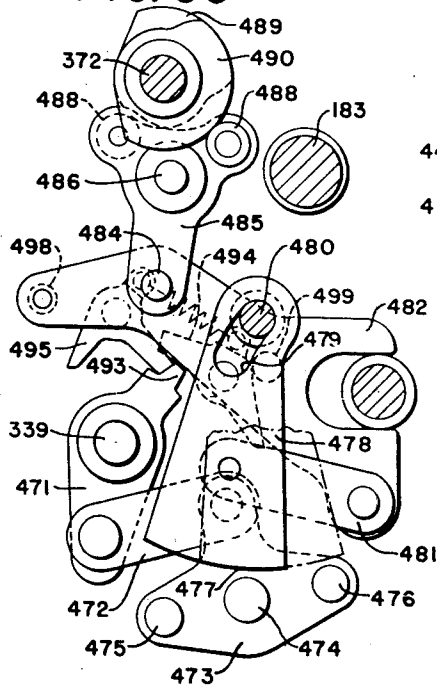
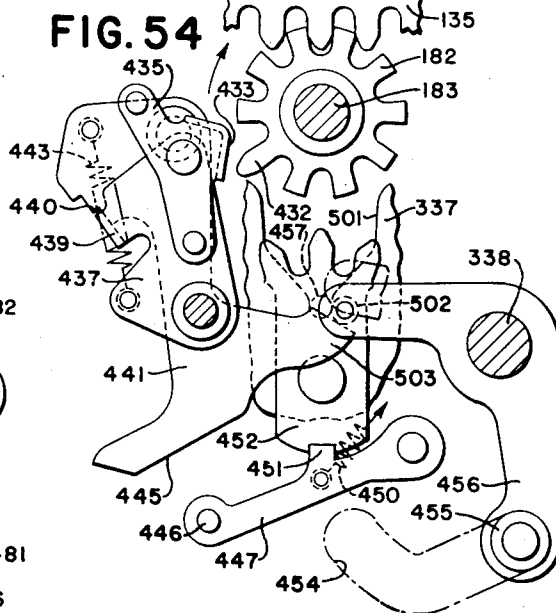


FIG. 54



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UNITED STATES PATENT OFFICE

2,503,865

DIFFERENTIAL SETTING MECHANISM FOR
PRINTING MACHINES

Raymond A. Christian, Dayton, Ohio, assignor to
The National Cash Register Company, Dayton,
Ohio, a corporation of Maryland

Application July 21, 1944, Serial No. 545,952

31 Claims. (Cl. 101-93)

1

The following invention is directed to cash registers, accounting machines, and the like, and is particularly directed to improvements in the differential mechanism of such machines.

One object of the present invention is the provision of an improved differential mechanism for cash registers and accounting machines.

Another object of the present invention is to provide a so-called flat differential mechanism for use in cash registers and accounting machines.

Still another object is the provision of an in-line differential mechanism for use in connection with a flat keyboard.

Still another object is to provide a reciprocal differential mechanism which, through the medium of a disengageable latch mechanism, is positively driven in both positioning and return directions.

Still another object is the provision of a novel zero elimination mechanism which is incorporated in the differential mechanism rather than in the printing mechanism.

A further object is to provide an improved mechanism for controlling the printing of zeros, said mechanism being an integral part of the differential mechanism rather than a part of the printing mechanism.

Another object is to supply a novel in-line or linear differential mechanism for use in connection with a flat keyboard, said differential mechanism being of the minimum-movement type and having mechanism incorporated therein for controlling the printing of the zeros.

Another object is to provide a novel mechanism for transferring tens digits from lower to higher denominations in adding operations and from higher to lower denominations in subtracting operations, said mechanism being incorporated in the totalizer mechanism.

A further object is to provide an improved type of linear differential mechanism which is adaptable for use in connection with split key banks where part of the keys are used for one purpose and part for another purpose.

A further object is the provision of various control mechanisms for insuring proper operation of the machine.

With these and incidental objects in view, the invention includes certain novel features of construction and combinations of parts, the essential elements of which are set forth in appended claims and a preferred form or embodiment of which is hereinafter described with reference to the drawings which accompany and form a part of this specification.

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In the drawings:

Fig. 1 is a fragmentary plan view of the keyboard.

Fig. 2 is a cross-sectional view taken just to the right of one of the amount banks and showing in particular the differential mechanism associated therewith.

Fig. 3 is a detail view of the zero latch mechanism associated with the amount bank shown in Fig. 2.

Fig. 4 is a detail view of a part of the zero elimination mechanism for the amount bank shown in Fig. 2.

Fig. 5 is a detail view of the differential drive plate and the corresponding latch slide for one of the amount banks.

Fig. 6 is a detail view of the beam mechanism for one of the amount differentials for controlling the positioning of the corresponding printing and/or indicating mechanism.

Fig. 7 is a detail view of the key stop mechanism for one of the amount differentials and the totalizer acuator associated therewith.

Fig. 8 is a detail view of the beam operating mechanism for one of the amount differentials.

Fig. 9 is a detail view of a part of the mechanism for controlling the selection of certain of the group totalizers.

Fig. 10 is a top plan view of the differential mechanism for one of the amount banks, showing in particular the zero elimination mechanism associated therewith.

Fig. 11 is an enlarged cross-sectional view, as observed from the rear of the machine, of the differential mechanism for one of the amount banks.

Fig. 12 is a perspective view of a part of the zero elimination mechanism for several of the amount banks.

Fig. 13 is a detail view of the mechanism for controlling the printing of zeros in the highest order amount bank.

Fig. 14 is a detail view of the mechanism for driving the differential mechanism for the group totalizer selecting and control keys and for driving the differential mechanism for the balance totalizer control keys.

Fig. 15 is an enlarged sectional view of a portion of the driving mechanism for the amount and control differential mechanisms.

Fig. 16 is a detail view of the driving mechanism for the amount differential mechanisms.

Fig. 17 is a cross-sectional view of one of the amount banks and the key stop slide associated therewith.

Fig. 18 is a top plan view showing the arrangement of the key stems of one of the amount banks and the arrangement of the corresponding projections on the key stop slide associated therewith.

Fig. 19 is a detail view of a part of the transfer mechanism for one order of the balance totalizer.

Fig. 20 is a right side elevation of the group totalizer line showing the transfer mechanism associated with one denominational order thereof.

Fig. 21 is a detail view of the drum-type selecting cam for the group totalizer line.

Fig. 22 is a right side elevation of a part of the mechanism for shifting the group totalizer line to engage and disengage the sets of totalizer wheels thereon and the amount actuators.

Fig. 23 is a right side elevation of one denominational order of the group totalizer line, showing said line in disengaged position and showing the transfer mechanism therefor in adding position.

Fig. 24 is a right side elevation of one denominational order of the group totalizer line, showing one set of totalizer wheels engaged with the amount actuators and the transfer mechanism in tripped position.

Fig. 25 is a right side elevation showing the group totalizer line partially disengaged and showing the detent for the transfer operating segment disengaged.

Fig. 26 shows the selected set of wheels on the group totalizer line disengaged from the actuators and shows the transfer operating segment in operated position, after having advanced the next higher order wheel one step to effect a tens transfer.

Fig. 27 is a right side elevation of the group totalizer line, showing the mechanism for shifting the transfer mechanism from adding position to subtracting position and vice versa.

Fig. 28 is a detail view of the transfer mechanism for one denominational order of the group totalizer line, showing said transfer mechanism in subtract position.

Fig. 29 is a detail view of the mechanism shown in Fig. 28 in adding position.

Fig. 30 is a detail view of a part of the mechanism shown in Fig. 27, for shifting the transfer trip pawls from adding position to subtracting position and vice versa.

Fig. 31 is a fragmentary front elevation of the balance totalizer, showing in particular the "fugitive 1" mechanism.

Fig. 32 is a detail view, as observed from the right, showing the highest order transfer mechanism for the balance totalizer.

Fig. 33 is a detail view showing the manner in which the positive and negative wheels of one denominational order of the balance totalizer are geared together for reverse rotation.

Fig. 34 is a fragmentary front elevation, partially sectioned, showing the differential mechanisms for the group totalizer and the balance totalizer, a portion of the group totalizer line, and a part of the operating and controlling mechanism associated therewith.

Fig. 35 is a right side elevation of the keyboard portion of the machine, showing the selecting and control keys for the group totalizer line and the differential and controlling mechanisms associated therewith.

Fig. 36 is a detail view of a portion of the engaging and disengaging mechanism for the group totalizer line.

Fig. 37 is a facsimile of a fragmentary portion of a statement slip prepared on the machine of this invention.

Fig. 38 is a right side elevation of the machine, showing the control keys for the balance totalizer line and the differential mechanism and printing mechanism associated therewith. Likewise the mechanisms for controlling the engaging and disengaging movements of the group and balance totalizer lines are shown here.

Fig. 39 is a detail view of a part of the key lock shaft releasing mechanism.

Fig. 40 is a detail view of the bank of selecting and control keys for the group totalizer line and a part of the mechanism associated therewith.

Fig. 41 is a right side elevation of the mechanism controlled by the four upper keys of the group totalizer bank for controlling the engaging and disengaging movement of the group totalizer line.

Fig. 42 is a cross-sectional view of the control bank for the balance totalizer line, showing a part of the mechanism for controlling the engaging and disengaging movement of said totalizer line.

Fig. 43 is a detail view showing in particular the driving mechanism for the group totalizer differential mechanism.

Fig. 44 is a detail view of the beam mechanism for the group totalizer line.

Fig. 45 is a detail view of the printer positioning portion of the group totalizer differential mechanism.

Fig. 46 is a detail of the key stop mechanism for the group totalizer differential mechanism.

Fig. 47 is a detail view of the add engaging mechanism.

Fig. 48 is a detail view of the sub-total engaging mechanism.

Fig. 49 is a detail view of the subtract and total engaging mechanism and the engaging control mechanism for the balance totalizer line.

Fig. 50 is a right side elevation of a portion of the zero latch throwout mechanism.

Fig. 51 is a top plan view of the zero latch throwout mechanism.

Fig. 52 is a time chart depicting graphically the timing of the various mechanisms of the machine embodying the present invention.

Fig. 53 is a detail view showing the transfer shifting mechanism in adding position.

Fig. 54 is a detail view showing the transfer mechanism in fully restored position.

GENERAL DESCRIPTION

Experience has taught that the flat type of keyboard for accounting machines, such as that disclosed in the United States Patent No. 2,189,851, issued February 13, 1940, to Paul H. Williams et al., has certain advantages over the curved type of keyboard such as that used in the type of accounting machine disclosed in the United States Patent No. 1,747,397, issued February 18, 1930, to B. M. Shipley. Among the advantages of the flat type of keyboard over the curved type are its compactness, its adaptability to the touch system of operation, and its improved visibility.

One of the disadvantages of the type of machine embodying the flat keyboard in the past has been in the use of non-positively driven differential mechanisms therefor, said differential mechanisms as a rule being spring-driven in an initial or locating direction and positively driven in a return direction. Another disadvantage of the former machines having flat keyboards is

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that the differential mechanisms for these machines were not of the minimum movement type, in which the portion of the differential mechanism which positions the printing mechanism and/or the indicator mechanism remains in set position at the end of machine operation and in the succeeding operation is moved directly from its old position to its new position without having to return to a neutral or home position.

The minimum movement type of differential mechanism is not necessary in accounting machines in which the printing mechanism is returned to a normal or home position near the end of each operation in order to render the printing line visible. However, in case it is desirable to use the machine as a cash register and provide it with mechanism for indicating amounts and other data, it is then essential to employ the minimum movement type of differential mechanism, so that the indicating mechanism will remain in set position at the end of machine operations.

The machine having the curved type of keyboard, such as that disclosed in the Shipley patent referred to above, is provided with a positively-operating type of rotary differential mechanism embodying improvements in the latch mechanism which make the latch much easier to disengage and more positive in action, said improvements being disclosed in the United States Patent No. 2,176,561, issued October 17, 1939, to Everett H. Placke.

In the present invention, the features of the rotary differential mechanism disclosed in the above-referred-to Placke patent have been incorporated in a linear type of reciprocating differential mechanism for use in connection with machines of the type disclosed in the above-referred-to Williams patent having flat keyboards. In addition to the improvements in the differential mechanism, the present machine also embodies improvements in the totalizer selecting and engaging and disengaging mechanisms.

The present machine is provided with a plurality of denominational rows of amount banks, each of which contains nine amount keys numbered from 1 to 9. In the present arrangement there is no zero key, the normal or home position of the amount differential mechanism for each amount bank being zero, in which it is retained by a zero latch mechanism when no key is depressed in said amount bank.

Depression of any one of the amount keys in any denominational row moves its lower end into the path of a corresponding upward projection on a key stop slide mounted to reciprocate in parallel relationship to the lower ends of the amount keys. The key stop slide has on its lower edge teeth which mesh with a gear integral with another gear which meshes with rack teeth on the upper edge of an amount actuator rack mounted for horizontal reciprocating movement in relation to the wheels of the various totalizers. The amount actuator rack has therein an angular slot, through which extends a stud in a differential latch carried by a latch slide mounted for horizontal reciprocating movement in exactly the same manner as the actuator rack. The stud in the latch also extends through an angular slot in a latch retaining plate which is mounted to reciprocate in unison with the actuator rack and is connected thereto by a spring which urges said plate and said rack in opposite directions, causing the scissors action of the angular slots therein to normally retain the latch in engagement

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with a shoulder formed on the lower edge of a differential drive plate also mounted for horizontal reciprocating movement. The differential drive plate has on its upper edge teeth which are engaged by the teeth of a drive gear secured on a square shaft in turn connected to an amount differential operating cam, which drives the differential drive plate first forwardly and then back to normal position each machine operation to actuate the corresponding amount differential mechanism.

Initial forward movement of the differential drive plate causes the shoulder thereon, in cooperation with the latch, to carry the latch slide forwardly in unison therewith. Likewise the stud carried by the latch, in cooperation with the angular slots in the actuator rack and the corresponding retaining plate, carries said rack and said retaining plate also forwardly in unison therewith. Forward movement of the actuator rack, through the gears connecting said rack to the key stop slide, shifts said slide rearwardly until the corresponding projection thereon contacts the lower end of the stem of the depressed amount key, which obstructs any further movement of the connected parts, including the actuator rack having the angular slot therein. Inasmuch as further forward movement of the actuator rack is obstructed, the angular slot therein, in cooperation with the stud in the latch, shifts said latch upwardly out of engagement with the shoulder on the differential drive plate while said plate continues the extent of its forward movement without interruption. Disengagement of the latch, as explained above, positions the actuator rack in accordance with the value of the depressed amount key and simultaneously engages an aliner tooth on said latch with a corresponding notch in an alining plate to aline and retain the actuator mechanism in set position.

As explained previously, the actuator rack has on its lower edge teeth which are engageable by the teeth of the corresponding totalizer wheels of one or more of the plurality of totalizer lines with which the present machine is equipped. One of the chief advantages of the linear type of differential mechanism over the rotary type is that the actuator rack may be readily lengthened to accommodate any number of totalizer lines with which it is desired to equip the machine.

In adding operations, after the actuator rack has been positioned, as explained above, in relation to the depressed amount key, the corresponding wheel or wheels of the selected totalizer line or lines are engaged with said actuator rack, and, upon return rearward movement of the differential drive plate, the shoulder thereon moves beyond the differential latch, which immediately drops therebehind, and a square stud carried by said drive plate engages the rearward end of a slot in the actuator rack to positively return said rack and connected parts rearwardly to normal position. Rearward movement of the actuator rack causes the wheels of the selected totalizer or totalizers to be rotated in an additive direction to enter therein the value of the depressed amount key.

Immediately after the actuator rack has completed its rearward movement, the corresponding wheel of the selected totalizer is disengaged therefrom. In subtract operations, the corresponding wheel of the selected totalizer is engaged with the amount actuator rack prior to its initial forward movement, which movement rotates said wheel in a reverse or subtractive

direction to subtract therefrom the value of the depressed amount key.

Each amount bank has a corresponding printing wheel for recording the value of the depressed amount keys upon suitable record material. In the present adaptation, it was desirable that the printing wheels remain in set position at the end of machine operation rather than being restored to a normal or neutral position, and this was accomplished by the provision of a minimum movement mechanism which remains in set position at the end of machine operation and, in the next operation, is moved directly from said set position to its new position without having to return to a normal or home position. This mechanism accomplishes the same result as the beam mechanism disclosed in the above-referred-to Shipley Patent No. 1,747,397 and for simplicity and clearness will be referred to herein as the beam mechanism, although the term as applied to this type of minimum movement mechanism may not be exactly appropriate.

The beam mechanism for each order comprises a beam rack carried by the corresponding latch slide and having teeth which engage teeth in a beam gear pivotally mounted on a beam slide in turn mounted for horizontal shifting movement. The teeth of the beam gear also mesh with teeth in the upper edge of a printer positioning rack mounted for horizontal reciprocating movement and having in its upper edge teeth which engage a gear in turn meshing with a printer ring gear which drives the corresponding printing wheel or wheels for this particular order. The beam gear is connected by a link to a beam having a downward extension engageable by a roller carried by the differential drive plate during forward movement of said drive plate, which positions said beam gear and the beam slide in a neutral or forward position.

Forward positioning movement of the latch slide, through the beam rack, rotates the beam gear in relation to the positioning movement of said latch slide. After the latch slide has been positioned in accordance with the value of the depressed amount key and aligned in said position, the roller carried by the differential drive plate, in cooperation with the lower end of the beam, moves the beam gear and the beam slide to their neutral positions, causing said gear, which forms a connecting medium between the beam rack and the printer positioning rack, to position said rack in accordance with the position of the beam rack. The printer positioning rack in turn, through the gearing explained above, positions the corresponding type wheels in accordance with the value of the depressed amount key. Return movement of the differential drive plate, the latch slide, and the beam rack causes said beam rack to rotate the beam gear idly over the teeth of the printer positioning rack without disturbing the set position of said rack and the corresponding printer wheel. In the succeeding operation, the beam mechanism, as explained above, moves the printer positioning rack directly from its preset position to its new position.

The minimum movement differential mechanism saves wear and tear upon the differential mechanism and permits the printing wheels and/or the indicators to remain positioned at the end of machine operation, which is very important when the machine is used as a cash register and is provided with indicating mecha-

nism for informing the customer of the amount registered and other essential data.

As explained previously, in certain types of accounting machines not having an indicating mechanism and where it is desirable that the printing mechanism return to a normal or zero position so that the printing line will be visible, the printing mechanism is directly connected to the actuator rack and is positioned thereby, as also are the totalizer wheels.

Accounting machines of the type referred to above are generally provided with a so-called zero eliminating mechanism, which prevents the printing of zeros in the higher denominations. Ordinarily this mechanism is a part of the printing mechanism, which it usually complicates extensively. The present machine is provided with an improved type of zero eliminating mechanism, which is a part of the differential mechanism and is in no way dependent upon and does not in any way interfere with the printing mechanism.

The beam rack is mounted on the latch slide to shift in relation thereto the equivalent of one position of said latch slide, said mounting comprising a slot in the forward end of the beam rack which engages a stud carried by an upward extension of the latch slide, the other end of said rack being pivotally connected to a lever which is in turn pivotally mounted on the latch slide. The lever carries a roller which extends through a cam slot in the partition plate for the particular denomination, said roller also arranged to engage a slot in the right-hand arm of an elimination yoke when the latch slide and the beam rack are in home position. The roller carried by the lever likewise moves beneath a forwardly-extending arm on the elimination yoke of the next lower order.

When the latch slide is in home position, the roller carried by the lever is moved into an enlarged portion of the cam slot, and a stud on the lower end of said lever, in cooperation with a stationary stud, retains the lever and the beam rack in their rearward positions, which is the equivalent of one step beyond the zero position of said beam rack, and positions the printer positioning rack in relation thereto to cause the corresponding printing wheel to be positioned in eliminated position, in which no zero will be printed upon operation of the machine.

Movement of the latch slide away from normal or home position causes the roller, in cooperation with the camming slot, to rock the lever and the beam rack forwardly the equivalent of one step from eliminated position to zero position. The rocking movement imparted to the lever as the latch slide moves out of home position causes the roller carried by said lever, in cooperation with the forward extension of the zero elimination yoke for the next lower order, to rock said yoke clockwise. This causes the slot in the right-hand extension of said yoke, in cooperation with the roller in the lever for the next lower order, to rock said lever in a counter-clockwise direction, which movement shifts the beam rack for said next lower order forwardly from eliminated position to zero position, so that the zero of the next lower order will be recorded. In a similar manner, zero printing movement is imparted to the levers and the beam racks for all the lower denominations so that, when a key is depressed in a higher denomination, all the zeros of the lower denomination will be recorded, while the zeros of the higher denominations will be eliminated.

As previously stated, contrary to the usual practice, the zero elimination mechanism is an integral part of the differential mechanism for each denominational order rather than a part of the printing mechanism. This inclusion of the zero elimination mechanism as an integral part of the differential mechanism makes for completeness and compactness of structure and simplifies to a marked degree the assembly and construction of printing arrangements to meet the particular needs of various business systems.

The actuator rack for each denominational order has on its lower edge gear teeth arranged to be engaged by the teeth of corresponding totalizer gears on the various lines of totalizers with which the machine is provided. The number of totalizer lines with which the machine is provided may vary, depending upon the demands of the business system to which the machine is being adapted, and, if necessary or desirable, ten lines of totalizers may be incorporated in the machine by lengthening the actuator racks and providing teeth on the lower edge thereof for actuating the wheels of said ten totalizer lines. However, for clearness and convenience, only two totalizer lines have been shown in detail herein, both of said totalizer lines supporting totalizers of the add-subtract type. One of the totalizer lines which is often referred to as the balance totalizer or crossfooter has a plus wheel and a minus wheel for each denominational order, said plus and minus wheels being geared together for reverse rotation, and is substantially the same type of totalizer as that disclosed in the Arnold Patent No. 1,873,733, dated August 23, 1932.

In adding operations, the plus side of the balance totalizer is engaged with the amount actuators, and, in subtract operations, the minus side of said balance totalizer is engaged with the actuators, the timing of engagement being the same in both cases. This type of construction for the balance totalizer provides a convenient means for securing a positive recording of the overdraft whenever desirable by totalizing or sub-totalizing the minus side of said balance totalizer. In this type of balance totalizer, a positive recording of the overdraft may be obtained in one cycle of operation of the machine, instead of the usual multi-cycles required with other types of totalizers.

A split bank of control keys for the balance totalizer controls the selection of the plus or minus side thereof and likewise controls the timing of the engaging and disengaging movement of said balance totalizer.

The other line of totalizers with which the machine is provided is of the same general construction as the totalizers disclosed in the Williams Patent No. 2,189,851 and in the present arrangement has five sets of interspersed totalizer wheels for the storing of group totals. As previously stated, the group totalizer line is of the add-subtract type, and, in adding operations, the selected set of wheels is engaged with the amount actuator racks after said racks have been positioned under influence of the depressed amount keys, and return movement of said racks rotates said wheels in an additive direction to register the value of the depressed amount keys. In subtract operations, the selected set of totalizer wheels is engaged with the amount actuators prior to initial movement thereof, which movement reversely rotates said wheels in accordance with the value of the depressed amount keys.

A split bank of selecting and control keys controls the selection and the functions of the group totalizers, said bank comprising five selecting keys which control the lateral shifting of the group totalizer line to select the various sets of interspersed wheels thereon for engagement with the amount actuators, and four control keys which control the timing of the engaging and disengaging movement of the selected set of totalizer wheels with and from the amount actuators to effect the desired type of operation.

The group totalizer line is provided with a transfer mechanism which is in operative communication with the selected set of totalizer wheels, said transfer mechanism being automatically shifted from adding position to subtracting position, depending upon the type of operation being performed. Each of the totalizer wheels has thereon a long tooth corresponding to the zero position of said wheel, and, when a lower order totalizer wheel passes through zero while traveling in an additive direction, the long tooth thereon trips the transfer mechanism and causes one to be added in the next higher order. Likewise, in subtract operations, when a lower order totalizer wheel passes through zero while traveling in a subtractive direction, the long tooth thereon trips the transfer mechanism and causes one to be borrowed from the next higher order.

The bank of control keys for the balance totalizer line and the bank of control keys for the line of group totalizers each has a linear type of differential mechanism similar in many respects to the amount differential mechanism, with the exception that the differential mechanism for the balance and group totalizer banks each has two differential elements with a common driver, to accommodate the split construction of the corresponding control banks.

In the ensuing pages, the mechanism outlined in general above and pertinent to the present invention will be described in detail.

DETAILED DESCRIPTION

Framework

Referring to Figs. 31, 34, and 38, the framework of the machine embodying this invention includes a right main frame 60 and a left main frame 61 secured to a machine base 62, said main frames being retained in spaced relationship to each other by rods 63, 64, 65, and 66 and by various other rods, bars, and cross frames. The machine framework also includes a totalizer engaging frame 67 and right- and left-hand totalizer support plates 68 and 69 maintained in fixed relationship to each other by bars 70 secured therebetween and in turn secured to the machine base 62, and by means of the rod 65, which is slotted to receive the upper ends of the plates 68 and 69, as shown in Fig. 38. The mechanism of the machine is enclosed in a suitable case or cabinet 71, which is secured to the machine base 62.

Keyboard in general

By referring to Fig. 1, which is a diagrammatic view of a portion of the keyboard of the machine embodying the present invention, it will be seen that said machine is provided with a plurality of rows of amount keys 72, a split row of group totalizer selecting and control keys 73 and 74, and a split row of balance totalizer control keys 75 and 76. Each row of amount keys is mounted in a key bank framework 77 (Figs. 2 and 17). The keys 73 and 74 are mounted in a similar key frame 78 (Fig. 35), and the keys 75 and 76 are mounted

in a similar key frame 79 (Fig. 38), said key frames being removably mounted in the machine by means of half-round notches in each end thereof, which are engaged by the rods 63 and 64. Any or all of the key frames 77, 78, and 79 may be removed by turning the rod 64 (Figs. 2, 35, and 38) one-half revolution so that a cut-away portion thereof provides clearance for the notched upper ends of the key frames so that said key frames may be readily swung upwardly and removed from the machine.

Each amount bank is provided with a partition plate 80 (Figs. 2 and 34), which supports the corresponding differential mechanism for said banks. The group totalizer control bank is provided with a partition plate 81, which supports the differential mechanism therefor (Figs. 34 and 35), and the balance totalizer control bank is provided with a partition plate 82 (Figs. 34 and 38) for supporting the differential mechanism therefor. The partition plates 80, 81, and 82 are similar in outline and are supported by the rods 63, 64, 65, and 66.

Machine releasing mechanism

The balance totalizer control keys 75 and 76 (Fig. 38) are all so-called motorized keys, in that depression of any one of these keys initiates operation of the machine.

Each of the selecting keys 75 (Fig. 38) carries a stud 83, and each of the control keys 76 carries a stud 129, which overlies a corresponding flat surface on the upper edge of a machine release bar 84 depressibly mounted by means of slots therein in cooperation with studs 85 and 86 secured in the key frame 79. The bar 84 carries studs 87 and 88, which engage similar notches in rearward ends of machine release arms 89 and 90, pivotally supported, respectively, by the studs 85 and 86. The arms 89 and 90 are connected for unitary movement by a link 91 having in its rearward end a notch which engages a stud 92 in a release pawl 93 (see also Fig. 39) free on a stud 94 secured in the partition plate 82. A spring 95, tensioned between the stud 92 and a stationary stud, urges the release pawl 93 clockwise to normally maintain a shoulder thereon in engagement with a corresponding shoulder on a machine release arm 96 secured on a key lock shaft 97 journaled in the partition plates 80, 81, and 82.

Depression of any one of the keys 75 or 76 (Fig. 38) causes the stud 83 or 129 therein to shift the bar 84 downwardly to rock the arms 89 and 90 clockwise to in turn shift the link 91 forwardly. Forward movement of the link 91 causes the notch therein, in cooperation with the stud 92, to rock the pawl 93 counter-clockwise, against the action of the spring 95, to disengage the shoulder on said pawl from the shoulder on the arm 96 to release said arm and the key lock shaft 97 to the action of a spring (not shown), which immediately rocks said key lock shaft counter-clockwise.

While the operating connections of the key lock shaft 97 are not shown here, they are similar to those disclosed in United States Patent No. 1,817,883, issued August 4, 1931, to Bernis M. Shipley, to which reference may be had for a complete disclosure of the machine releasing and operating mechanism, including the key lock shaft and the operating motor.

Counter-clockwise movement of the key lock shaft 97 (Fig. 38) closes a switch mechanism (not shown) which closes the electrical circuit to the operating motor and simultaneously engages a clutch mechanism which clutches the motor to a

main cam shaft 98 (Figs. 14 and 15) journaled in the main framework of the machine, and drives said shaft one revolution clockwise. After the main shaft 98 has made one clockwise revolution, the key lock shaft 97 is restored in the manner explained in the above-referred-to Shipley patent, and this restoring disengages the motor clutch mechanism and opens the switch to terminate operation of the machine. The releasing and restoring movement of the key lock shaft 97 is depicted graphically in space 7 of the time chart (Fig. 52).

It was unnecessary to provide a cycle-controlling mechanism for the present machine, as all operations, including add, subtract, total, subtotal, overdraft, and sub-overdraft operations, are performed in one cycle of operation of said machine, which is effected by one clockwise revolution of the main shaft 98.

Nonrepeat mechanism

Forward tripping movement of the link 91 (Figs. 38 and 39) and counter-clockwise movement of the release pawl 93 withdraw the stud 92 from the upper end of a non-repeat pawl 99, free on the stud 94, and releases said pawl to the action of a spring 100, which urges said pawl counter-clockwise until a bent-over ear 101 thereon contacts an arcuate surface on a downward projection 102 of the arm 96. Full counter-clockwise releasing movement of the key lock shaft 97 and the arm 96 is indicated by dot-and-dash lines in Fig. 38, from which it will be seen that the arcuate surface on the projection 102 does not move beyond the bent-over ear 101. When the key lock shaft 97 and the arm 96 are restored to untripped position, they are restored slightly beyond home position, as shown in dot-and-dash lines in Fig. 39, so that the rearward edge of the projection 102 of said arm is beyond the ear 101.

In case one of the keys 75 or 76 (Fig. 38) is retained depressed at the end of machine operations, the release pawl 93 will also be retained in its counter-clockwise position so that the shoulder thereon is beyond the shoulder on the arm 96, thus permitting repeat operations of the machine if there was nothing to retain the shaft 97 against releasing movement. However, such repeat operations are prevented by the non-repeat pawl 99, which, when the release pawl 93 is retained in counter-clockwise position by the inadvertent holding down of one of the keys 75 or 76 at the end of machine operation, is free to move counter-clockwise, under influence of the spring 100, when the rearward edge of the projection 102 moves beyond the ear 101, as shown in dot-and-dash lines in Fig. 39, whereupon said ear, in cooperation with said rearward edge of the projection 102, holds the shaft 97 in restored position to prevent repeat counter-clockwise releasing movement of said key lock shaft 97.

When pressure is removed from the depressed key 75 or 76, return rearward movement of the release pawl 93, under influence of the spring 95, causes the stud 92, in cooperation with the upward extension of the pawl 99, to rock the bent-over ear 101 out of the path of the projection 102, as the shoulder on said release pawl 93 moves beneath the corresponding shoulder on said arm 96 to condition the machine for a subsequent operation.

Interlocks are provided between the amount keys 72 and the key lock shaft 97, and between

the group totalizer selecting and control keys 73 and 74 and said key lock shaft, to prevent releasing movement of said shaft when any one of said amount keys or said group totalizer keys is partially depressed, and to lock said keys against depression and releasing while the key lock shaft is in tripped position and the machine is operating. These interlocking mechanisms will be explained later in connection with the detailed description of the amount bank and the group totalizer bank.

Amount keys and amount differential mechanisms

Inasmuch as the construction of all of the amount banks and their associated differential mechanisms is exactly the same, it is believed that a description of the amount bank shown in Fig. 2, which is one of the intermediate orders, and its associated differential mechanism will be sufficient for the purpose of this specification.

By observing Fig. 2, it will be noted that the amount of key frames 77 are mounted on an angle in the machine so that the top surfaces thereof form a flat keyboard, which is inclined from front to rear for convenience of operation and for improved visibility of the keyboard. It will likewise be noted that the keys 72 are depressibly mounted in corresponding vertical slots in the upper and lower edges of the key frames 77 and that a compressible spring 103 encircles the lower ends of the stems of each of the keys and urges said keys upwardly to undepressed positions, which is determined by shoulders thereon, in cooperation with the lower surface of the upper edges of the key frames 77.

Each of the amount keys 72 carries a stud 104, which cooperates with the angular nose on a corresponding upwardly-extending hook-shaped projection on a flexible detent 105 shiftably mounted by means of parallel slots therein, in cooperation with studs 106 and 107 secured in the key frame 77. The detent 105 carries, at its rearward end, a stud 108, which engages a slot in the upper end of a key release arm 109 free on a stud 110 in the partition plate 80. A spring 111, tensioned between the arm 109 and a stationary stud, urges said arm clockwise to normally maintain the flexible detent 105 in its rearward position, as shown here, which position is determined by the slots in said detent, in cooperation with the studs 106 and 107.

Depression of any one of the amount keys 72 causes the stud 104 therein, in cooperation with the angular nose on the corresponding projection on the detent 105, to shift said detent forwardly to simultaneously rock the arm 109 counter-clockwise against the action of the spring 111. Counter-clockwise movement of the arm 109 causes a stud 112, secured in a forward extension thereof, to move into the path of a forward surface on an arm 113, secured on the key lock shaft 97, to obstruct counter-clockwise releasing movement of said shaft, when an amount key is partially depressed. Full depression of an amount key 72 moves the flat upper edge of its stud 104 beyond the shoulder formed on the corresponding hook of the detent 105, whereupon the spring 111 returns the arm 109 and said detent rearwardly to normal positions, as shown here, to latch the depressed amount key in depressed position and to move the stud 112 out of the path of the forward surface of the

arm 113 so that the key lock shaft 97 is free for releasing movement counter-clockwise.

Counter-clockwise releasing movement of the key lock shaft 97 and the arm 113 (Fig. 2) causes an arcuate surface 130 on the upper edge of said arm to move beneath the stud 112 to lock the depressed amount key 72 in depressed position and to lock all other amount keys in this bank against depression during machine operation. Full restoring movement of the key lock shaft 97 and the arm 113 near the end of machine operation, as explained in connection with Figs. 38 and 39, causes a stud 114 carried by said arm, in cooperation with a shoulder on a downward extension of the key release arm 109, to rock said arm 109 counter-clockwise to shift the detent 105 forwardly to move the shoulder on the hook out of the path of the corresponding stud 104 to release the depressed amount key 72 to the action of the spring 103, which immediately returns said key upwardly to undepressed position.

Each amount bank is provided with a zero latch mechanism which, when no amount key is depressed, latches the corresponding key stop slide and differential mechanism in zero position, as will be explained in detail presently.

Depression of any one of the amount keys 72 (Figs. 2, 3, 17, and 18) causes the stud 104 therein, in cooperation with a camming surface formed on a corresponding upwardly-extending portion of a control plate 115, shiftably mounted by means of parallel slots therein in cooperation with the studs 106 and 107, to shift said control plate forwardly. Forward movement of the control plate 115 causes a rounded nose on the forward end thereof, in cooperation with an upward extension of a zero latch operating lever 116, free on a shaft 117 journaled in the plates 80, 81, and 82 (Fig. 51), to rock said lever counter-clockwise against the action of a spring 118, which is tensioned to retain said lever and the control plate 115 in their clockwise and rearward positions, respectively. Counter-clockwise movement of the lever 116 causes a stud 119 in a downward extension thereof, in cooperation with a camming node formed on the upper edge of a zero latch 120 free on a stud 121 secured in the partition plate 80, to rock said latch clockwise against the action of a spring 122. Clockwise movement of the zero latch 120 moves a latching shoulder formed thereon out of the path of a bent-over ear 123 on a key stop slide 124 for this particular denomination, to free said slide for rearward positioning movement under influence of the corresponding amount differential mechanism, as will be explained presently.

Depression of any one of the amount keys 72 (Figs. 2, 3, 17, and 18) moves the lower end of its stem into the path of a corresponding stop lug 125 on the key stop slide 124, which slide is mounted for reciprocating movement in parallel relationship to the amount bank by means of a slot 126 therein, in cooperation with a roller 127 mounted on the partition plate 80, and by means of a roller 128 carried by said slide, in cooperation with a slot 131 in said partition plate 80. The key stop slide 124 (Figs. 2 and 7) has on its lower edge teeth which mesh with a gear 132 secured on a short shaft 133 journaled in the partition plate 80 and having also secured thereon another gear 134 meshing with teeth in the upper edge of an actuator 135 mounted to reciprocate horizontally by means of parallel slots 136 and 137 therein, in cooperation with corresponding rollers 138 and 139 free on studs in the parti-

tion plate 80. The actuator 135 has an angular slot 140, through which extends a stud 141 in a differential latch 142 (Figs. 2 and 5) pivotally mounted on a stud in a latch slide 143 mounted for horizontal reciprocating movement by means of parallel slots therein in cooperation with the rollers 138 and 139. The latch stud 141 also extends through an angular slot 144 (Fig. 7) in a latch retaining plate 145 mounted for horizontal reciprocating movement by means of parallel slots therein in cooperation with the rollers 138 and 139. A spring 146, tensioned between the actuator 135 and the retaining plate 145, urges said parts in opposite directions, causing the angular slots 140 and 144 therein, which are inclined in opposite directions, to yieldingly urge the stud 141 and the latch 142 downwardly or counterclockwise to normally maintain a tooth 147 of said latch in engagement with a shoulder 148 (Fig. 5) formed by a bent-over portion of a differential drive plate 149 mounted for horizontal reciprocating movement by means of parallel slots 150 and 151 therein in cooperation with corresponding rollers 152 and 153 free on studs secured in the partition plate 80 for the next lower order.

The differential drive plate 149 (Figs. 2, 5, and 15) has in its upper edge teeth which mesh with teeth in a differential drive gear 154 having a square hole which engages a square shaft 155, said shaft and said gear being rotatably supported in the keyboard framework by means of the outside circumference of a sleeve portion of said gear 154 in cooperation with a boring in a hub 156 secured in the partition plate 80. The square drive shaft 155 also engages a square hole in a sleeve portion of a drive gear 157 (Figs. 15 and 16), the periphery of said sleeve portion being free in a boring in a hub in the lowest order partition plate 80 to rotatably support said gear 157 and to assist in supporting the shaft 155. A counter-boring in the sleeve portion of the drive gear 157 bears on a trunnion stud 158, which, together with a companion collar 159, is secured to an intermediate support plate 160, similar to the partition plate 80 and supported in a similar manner, to assist in rotatably supporting the drive gear 157 and the right-hand end of the square shaft 155.

The gear 157 (Figs. 15 and 16) meshes with teeth in the upper edge of an amount differential drive rack 161 mounted for horizontal reciprocating movement by means of parallel slots therein in cooperation with corresponding rollers 162 and 163 carried by the plate 160. A link 164 pivotally connects the rearward end of the rack 161 with the upper end of a lever 165 free on the main drive shaft 98. A link 166 pivotally connects the lower end of the lever 165 to an arm 167 free on a rod 168 supported by the main framework of the machine, said arm being connected by a hub to a cam lever 169 carrying rollers 170 and 171, which cooperate, respectively, with the peripheries of companion plate cams 172 and 173 secured on the main cam shaft 98. The cams 172 and 173 function according to the time given in space 3 of the time chart (Fig. 52) to reciprocate the rack 161 back and forth, which, through the gear 157, the shaft 155, and the gear 154, reciprocates the differential drive plate 149 (Fig. 5) first forwardly and back to normal position according to the time given in the time chart.

Initial forward movement of the drive plate 149 (Figs. 2, 5, and 7) causes the shoulder 148, in co-

operation with the tooth 147 of the latch 142, to carry the latch slide 143 forwardly in unison therewith, said latch 142, by means of the stud 141, also carrying the actuator 135 and the retaining plate 145 forwardly in unison with it. Forward movement of the actuator 135, through the gear 134, the shaft 133, and the gear 132, drives the key stop slide 124 rearwardly until the corresponding one of the lugs 125 engages the lower end of the stem of the depressed amount key 72. This interrupts further movement of the key stop slide 124, the actuator 135, and the retaining plate 145, thus causing the camming slot in said actuator rack 135, in cooperation with the stud 141, to shift the latch clockwise or upwardly to disengage the tooth 147 from the shoulder 148 to disconnect said latch and connected parts from the drive plate 149 whereupon said parts are set in accordance with the value of the depressed amount key 72.

Clockwise disengaging movement of the latch 142 (Fig. 4) causes a tooth 174 formed on the upper edge thereof to engage a corresponding one of a series of alining notches 175 formed in the lower edge of the corresponding partition plate 80 to aline and hold the differential mechanism in set position. After the latch 142 has been disengaged, as explained above, the drive plate 149 (Figs. 2 and 5) completes its forward movement, during which the upper surface of the bent-over portion 148 moves beneath the tooth 147 of the latch 142 to lock the tooth 174, on said latch, in the alining notch 175 to insure that the differential mechanism is held in set position during the period that the selected totalizer is engaged and while the printing mechanism functions, as will be explained later.

After the wheels of the selected totalizer have been actuated, and after the printing mechanism has functioned, return movement of the differential drive plate 149, according to the time given in space 3 of the chart (Fig. 52) causes a stud 176 (Fig. 5), carried by said drive plate, to engage the rearward end of the slot in the forward end of the latch slide 143 at the same time the shoulder 148 moves beyond the tooth 147 of the latch 142, to cause said drive plate to pick up said latch slide 143 and connected parts and return them to normal positions.

The latch 142 (Figs. 5 and 7) and the stud 176 form a positive means for driving the actuator 135 in both positioning and return directions, and, as explained before, this latch mechanism functions similarly, in many respects, to the mechanism disclosed in the Placke Patent No. 2,176,561.

The actuator 135 (Figs. 2 and 7) has on its lower edge a series of large gear teeth 179 arranged to be engaged by the corresponding plus or minus wheels 178 (Figs. 19, 31, and 32) or 180 of a balance totalizer line 181, and corresponding wheels 182, 184, and 186 of respective group totalizer lines 183, 185, and 187. The above four totalizer lines are the maximum permissible with the machine as presently constructed; however, only two of these—the balance totalizer line 181 and the group totalizer line 183—have been shown in detail herein, as it is believed that a description of these two totalizer lines will be sufficient for a complete disclosure, as the group totalizer lines 185 and 187 are constructed similarly in every respect to the group totalizer line 183.

As mentioned previously, it is but a matter of lengthening the actuators 135 either forwardly or

rearwardly in order to accommodate additional totalizer lines. Therefore it is not the intention to limit the machine of this invention to any particular number or kind of totalizer lines, as it is but a comparatively simple matter to increase or decrease the number of totalizer lines necessary to meet the needs of the particular business system to which the machine is being applied.

In adding operations, after the actuators 135 (Figs. 2 and 5) have been positioned under influence of the depressed amount keys 72, the wheels of the selected totalizer or totalizers, as the case may be, are engaged with the teeth 179, and return rearward movement of said actuators 135 rotates said wheels in an additive direction to add therein the value of the depressed amount keys. After the actuators have completed their final or return movements to the rear, the wheels of the selected totalizer are disengaged therefrom.

In subtract operations, the wheels of the selected totalizer are engaged with the teeth 179 of the actuators 135 prior to initial forward movement of said actuators, which movement rotates said wheels in a reverse or subtractive direction to subtract therefrom the value of the depressed amount keys 72. After the actuators 135 have completed their forward movements, the wheels of the selected totalizer are disengaged therefrom so that return movement of said actuators will not disturb the setting of said totalizer wheels.

In total recording or resetting operations, the wheels of the selected totalizer are engaged with the actuators 135 exactly the same as in subtract operations—that is, prior to initial forward movement of said actuators—which movement reversely rotates said wheels until long teeth thereon engage corresponding denominational transfer trip pawls to stop said wheels in zero position. Termination of the reverse rotation of the totalizer wheels, in total recording operations, obstructs further movement of the actuators 135, thus causing the corresponding latches 142 to be disengaged from their respective drive plates 149 in exactly the same manner as that explained in connection with the disengaging of said latches under influence of the depressed amount keys 72. This positions the actuators 135 in accordance with the value of the amount on the wheels of the selected totalizer, and this positioning is transmitted to the corresponding type carriers so that the amount standing on the selected totalizer wheels will be recorded. Prior to return rearward movement of the actuators 135, the wheels of the selected totalizer are disengaged therefrom so that said wheels will remain in a zeroized condition at the end of machine operation.

Sub-total recording or reading operations are similar in every respect to total recording operations with the exception that the selected totalizer wheels remain in engagement with the teeth 179 of the actuators 135 during return rearward movement of said actuators, which movement restores said wheels to their original positions.

Mechanism for controlling the selection of the two totalizer lines 181 and 183, and the various sets of totalizer wheels on said lines, and the mechanism for controlling the engaging and disengaging movement of said totalizer lines will be explained in detail later herein.

In an adding or subtracting operation in which

no amount key 72 is depressed, the zero latch 120 (Figs. 2, 3, 5, and 7) retains the key stop slide 124 and the actuator rack 135 in home or zero position. This causes the latch 142 to be disengaged from the shoulder 148 immediately to position the latch slide 143 and connected parts in zero position.

Printer positioning by differential mechanism

The amount differential mechanism for each denominational order is connected to a corresponding printing element through the medium of a minimum movement device which permits the printing elements to remain in set positions at the end of machine operations and causes said elements to be moved directly from their former positions to their new positions without having to return to a zero or normal position. This type of construction eliminates considerable wear and tear on the differential mechanisms and, in case the machine is provided with indicators for displaying the registered amount, permits said indicators to remain positioned at the end of machine operation so that the amount of the transaction may be conveniently discerned.

The printer positioning mechanism for the denomination being described in detail includes a beam rack 188 (Figs. 2, 4, 5, and 6) shiftably supported on an extension 189 of the latch slide 143 by means of a slot 190 in the rack 188 in cooperation with a stud 191 secured in said extension 189 and by means of a lever 192 pivoted on a stud 193 in said extension 189, the upper end of said lever being pivotally connected to said beam rack 188. The beam rack 188 has on its lower edge teeth which mesh with teeth on a beam gear 194 (Figs. 5, 6, 8, 10, and 11) free on a stud 195 in a beam slide 196 mounted for horizontal reciprocating movement by means of parallel slots therein in cooperation with the rollers 138 and 139.

The beam gear 194 and the slide 196 are pivotally connected by a link 197 to a beam 198 free on a rod 199 (Figs. 6, 8, and 11) supported by the main frames of the machine and in turn assisting in supporting the partition plates 80, 81, 82, and 160 (Fig. 34). The beam 198 has a downward extension with an angular surface 200 arranged to be engaged by a roller 201 mounted on the differential drive plate 149 for the next higher order (Fig. 8). Initial forward movement of the drive plate 149 causes the roller 201, in cooperation with the surface 200, to move the beam 198, the slide 196, and the gear 194 to their extreme forward positions, which are determined by a perpendicular surface 202 on said slide engaging a flat surface on the hub 156 (Figs. 6, 8, and 15) for this particular denomination.

The beam gear 194 meshes with one section of teeth on the upper edge of a printer positioning rack 203 (Figs. 2 and 6) mounted for horizontal shifting movement by means of parallel slots therein in cooperation with the rollers 138 and 139. The rack 203 has on its upper edge another section of teeth which mesh with a printer intermediate gear 204 free on a rod 205 supported by the keyboard framework, said gear 204 in turn meshing with the external teeth on a ring gear 206 having internal teeth which form a bearing on the periphery of a disk 207 supported by a rod 208 in turn supported by the main framework of the machine. A series of equally spaced gear teeth on the outer edge of the ring gear 206 mesh with a type wheel 209 for this particular denomination, said type wheel being

free on a rod 210 secured in the main framework of the machine.

A record material guide chute 211 (Figs. 2 and 38) guides record material such as a statement sheet 212 (Fig. 37) into printing relationship with the type wheel 209 and a corresponding printing hammer 213. Corresponding openings in the front and back plates of the chute 211 permit the hammer 213, which operates according to the timing given in space 8 of the time chart (Fig. 52), to carry the statement sheet 212 and an inking ribbon 214 into contact with the type wheel 209 to record the value of the depressed amount key 72 upon said statement sheet. The internal teeth of the ring gear 206 (Fig. 2) drive a pinion 215 journaled in a corresponding opening in the disk 207, said pinion in turn driving a square shaft 216, which, through pinions similar to the pinion 215 and ring gears similar to the ring gear 206, drives type wheels corresponding to the type wheel 209 for the various columnar divisions of the statement sheet 212.

This type of driving mechanism for column printing machines is fully disclosed in United States Patent No. 1,693,279, issued November 27, 1928, to Walter J. Kreider, and, as said mechanism is well known in the art, further description thereof is believed unnecessary.

The lever 192 (Figs. 2, 4, 5, and 12) has a rearward extension carrying a roller 217, which extends through a slot 218 in the partition plate 80, the rearward end of said slot being enlarged to provide clearance for said roller and to form a camming surface 219. When the latch slide 143 is in home position, as shown in Figs. 4 and 5, a stud 220 in the lower end of the lever 192 engages a stationary stud 221 in the partition plate 80, to return and retain said lever 192 and the beam rack 188 in their rearward positions. When no amount key 72 is depressed and the zero latch 120 (Figs. 2, 3, 5, and 7) holds the key stop slide 124 and the actuator 135 in zero positions, the latch slide 143 travels forwardly from home to zero position, under influence of the drive plate 149, such movement being necessary to disconnect the latch 142 from the shoulder 148. This movement of the slide 143 withdraws the stud 220 from the stud 221 (Fig. 4) to free the lever 192 and the beam rack 188 for zero printing movement when an amount key is depressed in a higher order, as will be explained presently. When no amount key is depressed in the order being described or in a higher order, the beam gear 194 and the beam mechanism shown in Figs. 6 and 8 and explained above position hold the printer rack 203 and the corresponding type wheel 209 (Fig. 2) in a neutral or non-printing position, which is one position beyond zero, so that nothing will be recorded upon the statement sheet 212 under these conditions.

When an amount key 72 is depressed and the latch slide 143 (Fig. 5) moves forwardly beyond home and zero positions, the roller 217 climbs up the inclined camming surface 219 to rock the lever 192 counter-clockwise, in relation to said slide 143, to in turn shift the beam rack 187 forwardly. Forward movement of the beam rack 188 advances or rotates the beam gear 194 one step from non-printing position into proper relationship with the printer positioning rack 203, and the narrow portion of the slot 218, in cooperation with the roller 217, maintains said beam gear in proper relationship with said printer rack during the remainder of machine operation.

After the latch 142 has been disengaged and the latch slide 143 has been positioned in accordance with the position of the actuator 135 (Fig. 7) and the depressed amount key 72, continued movement of the differential drive plate 149 for the next higher order (Fig. 8) causes the roller 201, in cooperation with the camming surface 200 on the beam 198, to move said beam, the slide 196, and the beam gear 194 to their extreme forward positions, as shown here. Inasmuch as the slide 143 and the beam rack 188 are retained in a position corresponding to the value of the depressed amount key, the beam gear 194 rolls over the teeth of said rack 188 and, in cooperation with the teeth on the printer positioning rack 203, positions said rack and the corresponding type wheel 209 also in accordance with the value of the depressed amount key. After the type wheel 209 has thus been positioned, the printing hammer 213 (Fig. 2) functions as explained before, to record the value of the depressed amount key upon the statement sheet 212.

Return rearward movement of the differential drive plate 149 (Fig. 5) causes the stud 176 to engage the rearward end of the slot in the latch slide 143 and return said slide rearwardly in unison therewith to normal position. Rearward movement of the latch slide 143 causes the rack 188 to roll the gear 194 idly over the teeth in the printer positioning rack 203 without disturbing the positioning of said rack. Therefore it is evident that the rack 203 and the corresponding type wheel 209 (Fig. 2) remains positioned at the end of machine operation, and in the next machine operation are moved directly from their old position to their new position.

As the latch slide 143 (Fig. 5) nears home position, the roller 217 on the lever 192 rides down the camming surface 219 into the enlarged clearance portion of the slot 218 and the stud 220 engages the stationary stud 221 to rock said lever and the rack 188 rearwardly in relation to the slide 143, to non-printing position.

45 Mechanism for controlling the printing of zeros

The present machine is provided with a mechanism for controlling the printing of zeros. This mechanism is often referred to as "zero elimination" mechanism and is effective, when no amount key is depressed, to eliminate the printing of zeros in all denominational orders beginning with the highest and continuing through the lower denominations when no keys are depressed in those successive lower orders. Likewise, the zero printing control mechanism is effective, when an amount key is depressed in an intermediate order, to cause the printing of the zeros in all lower orders and to eliminate the printing of zeros in all higher orders. The zero printing control mechanism is normally effective to eliminate the printing of a zero in the highest order, and this action progresses through all the lower denominations in which no amount key is depressed. Obviously, the depression of an amount key in a lower order interrupts the progressive action of the zero elimination or printing control mechanism for the order in which the key is depressed and for all lower orders, thus causing the zeros to be printed in the lower orders, which is the result desired.

It has been the practice in the past to include the zero printing control or elimination mechanism as an integral part of the printing mechanism, and this often resulted in considerable inconvenience when it was necessary to rearrange

the printing mechanism to meet the particular needs of various business systems. However, in the present machine this defect has been overcome by the inclusion of the zero printing control mechanism as an integral part of the corresponding amount differential mechanism, and, as a result, said mechanism does not interfere in any way with the rearranging of the keyboard and/or the printing mechanism to meet the particular requirements of practically any type of business system.

The zero printing control mechanism begins to function in the highest order amount bank and operates progressively through the lower orders. The highest order amount bank has a latch slide 222 (Fig. 13), similar in every respect to the latch slide 143 (Fig. 5), said latch slide 222 having pivotally connected thereto a lever 223, (Fig. 12) similar to the lever 192, said lever in turn carrying a roller 224, which extends through a camming slot 225 in the partition plate 80 for the highest order, said slot being similar in every respect to the slot 218 (Fig. 4). The upper end of the lever 223 is pivotally connected to the rearward end of a beam rack 188 for the highest order, the forward end of said beam rack being shiftably connected to a hook-shaped extension of the highest order latch slide 222. When the highest order latch slide 222 is in either home or zero position, the roller 224 underlies a surface 226 on a latch 227 free on a stud 228 in the partition plate 80. A spring 229 urges the latch clockwise to normally maintain a finger thereof in engagement with a stop stud 230 secured in the partition plate 80. A stud 220 in the lower end of the lever 223 cooperates with a stud 221 in the partition plate 80 to return and retain said lever and the corresponding beam rack 188 in non-printing position when the latch slide 222 is returned to home position.

When no amount key 72 is depressed in the highest order, the latch slide 222 moves a slight distance forwardly, under influence of the corresponding differential drive plate, from home position to zero position. This movement withdraws the stud 220 from the stationary stud 221 but in this case does not withdraw the roller 224 from beneath the surface 226 on the latch 227; therefore, said latch retains the lever 223 and the corresponding beam rack 188 in their non-printing positions, so that the printing of zeros is always eliminated in the highest order, which is the desired result.

Assuming that the amount bank shown in Fig. 2 and described in detail herein is adjacent to the highest order amount bank the roller 224 on the lever 223 for the highest order (Figs. 12 and 13) extends within a slot 232 in a left arm 231 of a yoke 233 free on a stud 234 supported by the partition plates 80 for the highest order and the adjacent order. The right arm of the yoke 233 (Figs. 10, 12, and 13) has a slot 235, which engages the roller 217 for the lever 192 for the second highest order amount bank, and said roller 217 in turn engages a slot 237 in a left arm 236 of a yoke 238 for the third highest order, said yoke being free on a stud 239 secured between the partition plates 80, said yoke 238 being similar in every respect to the yoke 233. The yoke 238 has in its right arm a slot which engages a roller on a lever 240 for the third highest order, said lever being similar in every respect to the levers 223 and 192 for the two higher orders. Similar connections are provided for each of the succeeding lower orders.

When no amount key 72 is depressed in any of the three highest orders (Figs. 12 and 13), the latch 227, in cooperation with the roller 224, retains the lever 223 and its corresponding beam rack 188 in their rearward or non-printing position, as shown here. The roller 224, in moving from home to zero position, as explained above, does not move out of the slot 232 in the left arm 236 of the yoke 233, and, as the roller 217 for the lever 192 does not move out of the slot 235 in the right arm of said yoke 233, said lever 192 and its corresponding beam rack 188 (see also Figs. 2 and 5) are retained in their rearward or non-printing positions. This action progresses on down through the lower orders in which no amount key is depressed, to eliminate the printing of zeros in said lower denominations.

Depression of an amount key 72 in the highest order releases the latch slide 222 (Figs. 12 and 13) for forward positioning movement, and, as said slide moves beyond zero position, the roller 224 on the lever 223 moves from beneath the surface 226 on the latch 227 and rides up the inclined portion of the camming surface in the slot 225 to rock said lever 223 counter-clockwise to shift the corresponding beam rack 188 forwardly from non-printing position to printing position. Forward positioning movement of the latch slide 222 beyond zero position likewise disengages the roller 224 from the slot 232 in the yoke 233 and causes said roller 224, in cooperation with the inclined camming surface on the forward extension of arm 231, to rock said yoke clockwise. When no amount key 72 is depressed in the adjacent or second lower order, the roller 217 carried by the lever 192 therefor (Figs. 2, 4, 5, 10, 12, and 13) moves from home to zero position, as explained before, but this movement is not sufficient to disengage said roller 217 from the slot 235 in the right arm of the yoke 233. Consequently clockwise movement of said yoke 233, under influence of the lever 223, rocks the lever 192 counter-clockwise to move the corresponding beam rack 188 from non-printing position to printing position, whereupon forward movement of the differential drive plate 149 (Fig. 8) for the highest order causes the roller 201 therein, in cooperation with the surface 200, to shift the beam 198, the beam slide 196, and the beam gear 194 forwardly, which movement causes said beam gear 194, in cooperation with the beam rack 188 and the teeth in the upper edge of the printer positioning rack 203 to position the corresponding type wheel 209 (Fig. 2) in zero position, so that, when an amount key is depressed in the highest order, the zero will print in the next lower order. The above-described zero printing action is transmitted from one order to another through all the lower orders in which no amount key is depressed.

Depression of an amount key 72 in the second highest order causes the cam slot 218 in the partition plate 80, in cooperation with the roller 217 carried by the corresponding lever 192, to rock said lever counter-clockwise, as explained above, when the corresponding latch slide 143 moves beyond zero position. This counter-clockwise movement of the lever 192, through the roller 217, in cooperation with the forward extension of arm 236, rocks the yoke 238 in the next lower order clockwise, causing said yoke in turn to rock the lever 240 and the corresponding beam rack 188 forwardly from non-printing position to zero printing position. This printing movement of the yoke 238 progresses through all the

lower denominations in which no amount key 72 is depressed, so that, when an amount key is depressed in a higher order, the zeros will print in all the lower orders in which no amount key is depressed. The beam rack 188 in the highest denomination is retained in non-printing position by the action of the latch 227 (Figs. 12 and 13), as explained before, so that, when no amount key is depressed in the highest order, the zero will not be recorded.

Group totalizer key bank

A differential mechanism similar in many respects to the amount differential mechanism explained above is provided for the bank of selecting and control keys 73 and 74 (Figs. 1 and 35) for the group totalizer line.

As explained previously, the group totalizer line has five sets of interspersed totalizer wheels thereon which are selected for engagement with the amount actuators by the five selecting keys 73, while the control keys 74 (with the exception of the Non-Add key) control the timing of the engaging and disengaging movement of the selected set of group totalizer wheels. Therefore the key bank for the group totalizer selecting and control keys is of split construction, inasmuch as it is necessary to depress one of the keys 73 to select the desired set of totalizer wheels, and it is also necessary to depress one of the keys 74 in the same operation, to control the engaging and disengaging movement of the selected set of totalizer wheels. The Non-Add key 74 always prevents engaging and disengaging movement of the group totalizer line and therefore is seldom used in conjunction with the selecting keys 73 but is principally for use in conjunction with the selecting and control keys 75 and 76 (Figs. 1 and 38) for the balance totalizer to nullify any control which these keys may have over the group totalizer, as will be explained later.

Depression of any one of the selecting keys 73 (Figs. 35 and 40) causes a stud 241 carried thereby, in cooperation with a camming surface on the nose of a corresponding upwardly-extending hook on a flexible detent 242 shiftably mounted by means of parallel slots therein in cooperation with studs 243 and 244 in the key frame 78, to shift said detent 242 forwardly. Forward movement of the detent 242 causes a stud 245 (Fig. 35) in a rearward extension thereof, in cooperation with a slot in the upper end of a key release arm 246 free on a stud 247 in the key frame 78, to rock said arm counter-clockwise against the action of a spring 248, which is tensioned to urge said arm clockwise and the detent 242 rearwardly. Counter-clockwise movement of the arm 246 causes a stud 249 in a forward extension thereof to move into the path of a forward surface on an arm 250 secured on the key lock shaft 97, to obstruct counter-clockwise releasing movement of said shaft, so that the machine cannot be released for operation when one of the selecting keys 73 is partially depressed.

Full depression of any one of the keys 73 causes the flat upper end of the corresponding stud 241 thereof to move beyond a tooth or shoulder formed on the corresponding hook of the flexible detent 242 (Figs. 35 and 40) to permit said detent and the arm 246 to be restored rearwardly and clockwise, respectively, to cause said hook to latch the depressed key in depressed position and to cause the stud 249 to move out of the path of the forward surface on the arm 250, to permit

counter-clockwise releasing movement of said arm and the key lock shaft 97.

Depression of a second selecting key 73 causes the flexible detent 242 to release the previously depressed selecting key, to provide what is termed "flexible key action." The amount banks of keys 72 and the control keys 75 and 76 (Fig. 1) are also provided with "flexible key action."

Near the end of machine operation, key releasing movement clockwise of the key lock shaft 97, according to the time given in space 7 of the chart, Fig. 52, causes a stud 251 (Fig. 35) in the arm 250, in cooperation with a forward surface on a downward extension of the arm 246, to rock said arm counter-clockwise against the action of the spring 248, to shift the flexible detent 242 forwardly to disengage the tooth of the hook thereon from the stud 241 of the depressed selecting key 73 to release said key to the action of its corresponding compression spring 252, loosely encircling the stem thereof, which spring immediately restores said key upwardly to undepressed position.

Each of the four control keys 74 (Figs. 1, 35, and 40) carries a stud 253, which cooperates with a corresponding upwardly-extending hook on a flexible detent 254 shiftably mounted by means of parallel slots therein, in cooperation with the studs 244. The flexible detent has in its rearward end a stud which engages a slot in the upper end of a release arm 255, similar in every respect to the arm 246 and cooperating with an arm 256 secured on the key lock shaft 97 in exactly the same manner as said arm 246 cooperates with its corresponding arm 250, to prevent releasing movement of the key lock shaft 97 when any one of said control keys 74 is partially depressed, and to shift the detent 254 forwardly near the end of machine operation to release any depressed control key 74.

The studs 241 in the keys 73 (Figs. 35 and 40) cooperate with corresponding camming projections on a control plate 257 shiftably mounted by means of parallel slots therein in cooperation with the studs 243. A rounded nose on the forward end of the plate 257 cooperates with an upward extension of a lever 258 free on the shaft 117, said lever and the plate 257 being urged clockwise and rearwardly, respectively, by a spring 260, one end of which is connected to a stud 261 in the lower end of said lever. The stud 261 cooperates with a camming node on a zero latch 262 free on a stud 263 and having integral therewith an arm 264 with a stud 265 normally maintained in yielding contact with a downward extension of a bar 267 by a spring 266 tensioned to urge said arm 264 and the zero latch 262 in a counter-clockwise direction. The bar 267 is shiftably mounted by means of a slot in the forward end thereof, in cooperation with a stud 292 in the partition plate 81, the rearward end of said bar being pivotally connected to an arm 268 free on a stud 269 in the plate 81. An arcuate surface on the arm 268 cooperates with a stud 270 in a crank 271 secured on the key lock shaft 97.

When the key lock shaft 97 is in home position, as shown in Fig. 40, the stud 270, in cooperation with the arcuate surface on the arm 268, retains the bar 267 in its forward position to cause the downward extension of said bar, in cooperation with the stud 265, to retain the arm 264 and the zero latch 262 in their clockwise or ineffective positions, as shown here, against the action of the spring 266, to retain a latching shoulder 272

on said latch out of the path of a bent-over ear 273 on a key stop slide 274 for the totalizer selecting keys 73. The key stop slide 274 (Figs. 35 and 46) is mounted to shift parallel in relation to the lower ends of the stems of the keys 73 by means of a slot 275 therein, in cooperation with a roller 276 mounted on the plate 81, and by means of a roller 277 carried by said slide, in cooperation with a slot 278 in said plate 81.

Counter-clockwise releasing movement of the key lock shaft 97 (Fig. 40) withdraws the stud 270 from the arm 268 to release said arm, the bar 267, the arm 264, and the zero latch 262 to the action of the spring 266. This immediately rocks the latch 262 upwardly or counter-clockwise, when no key 73 is depressed, to move the shoulder 272 into the path of the bent-over ear 273 to latch the key stop slide 274 in home or zero position, in which none of the group totalizers is selected for engagement with the amount actuators 135.

Depression of any one of the keys 73 causes the stud 241 therein, in cooperation with the corresponding camming projection on the plate 257, to shift said plate forwardly to rock the lever 258 counter-clockwise, against the action of the spring 260, to move the stud 261 into the path of the camming node on the upper edge of the zero latch 262, to retain the shoulder 272 on said latch out of the path of the bent-over ear 273, so that the key stop slide 274 is free to move rearwardly to select the set of group totalizer wheels 182 corresponding to the depressed selecting key 73, as will be explained presently.

Other means, to be described later, under control of the balance totalizer selecting and control keys 75 and 76 (Figs. 1 and 40), is provided for controlling the rearward releasing movement of the bar 267, and, when certain of said keys 75 and 76 are depressed, such movement is prevented, thereby retaining the latching shoulder 272 out of the path of the bent-over ear 273, so that the key stop slide 274 is free to move rearwardly to be positioned under the influence of said keys.

Group totalizer differential and selecting mechanisms

The keys 73 control the selecting of the five sets of totalizers on the group totalizer line, through a minimum movement portion of the group totalizer split differential mechanism. The keys 74, through the other portion of the split differential mechanism, control the timing of the engaging of the selected totalizer with the amount actuators, as will be described hereinafter.

The key stop slide 274 (Fig. 46) has on its lower edge rack teeth which mesh with a gear 279 secured, by a shaft 280 journaled in the partition plate 81, to a companion gear 281 meshing with teeth on the upper edge of a key stop rack 282 mounted for horizontal reciprocating movement by means of parallel slots therein in cooperation with rollers 283 and 284 mounted on the plate 81. The key stop rack 282 has an angular slot 285, through which extends a stud 286 in a latch 287 (Figs. 34 and 45) pivotally mounted on a latch slide 288 mounted for horizontal reciprocating movement by means of parallel slots therein in cooperation with the rollers 283 and 284. The latch 287 has a tooth arranged to engage a shoulder 289 formed on a bent-over portion of a differential drive plate 290 (Figs. 43 and 45) mounted for horizontal reciprocating movement by means of parallel slots therein in

cooperation with rollers 310 and 311 free on studs secured in the right-hand face of the partition plate 81. The stud 286 (Fig. 46) in the latch 287 likewise extends through an angular slot 291 opposed to the slot 285, said slot being formed in a retaining plate 293 mounted adjacent the key stop rack 282 for reciprocating movement in unison therewith by means of parallel slots in cooperation with the rollers 283 and 284. A spring 294, tensioned between the rack 282 and the plate 293, urges said parts in opposite directions, thereby causing the scissors action of the opposed angular slots 285 and 291 to yieldingly urge the stud 286 downwardly to normally retain the tooth of the latch 287 in engagement with the shoulder 289 to provide an operating connection between the differential drive plate 290 and the key stop rack 282.

The drive plate 290 (Fig. 43) has on its upper edge teeth meshing with a drive gear 295 operatively connected by a square shaft 296 to a companion drive gear 297 (Figs. 14 and 15) having a central boring which turnably engages the collar 159, while the periphery of a sleeve portion of said gear rotatably engages a boring in a bushing secured in the partition plate 81 to support the left-hand end of the square shaft 296. The drive gear 297 meshes with rack teeth on the upper edge of a group totalizer differential drive rack 298 mounted to reciprocate horizontally by means of parallel slots therein, in cooperation with rollers 299 and 300 free on studs secured in the plate 160. A link 301 (Fig. 14) pivotally connects the rearward end of the rack 298 to a lever 302, free on the shaft 98, connected by a link 303 to an arm 304 free on the rod 168, and secured in fixed relationship to an inverted V-shaped cam lever 305 also free on the rod 168. The lever 305 carries rollers 306 and 307, which cooperate, respectively, with the peripheries of companion plate cams 308 and 309 secured on the main shaft 98.

One counter-clockwise revolution of the shaft 98 and the cams 308 and 309 causes said cams to shift the rack 298 first forwardly and back to normal position, according to the time given in space 2 of the chart (Fig. 52).

Depression of any one of the selecting keys 73 (Figs. 1, 35, and 46), except the Total Balance key, moves the lower end of the stem thereof into the path of a corresponding projection 312 formed on the upper edge of the key stop slide 274, whereupon initial forward movement of the rack 298 (Fig. 14), through the gear 297, the shaft 296, and the gear 295, moves the drive plate 290 also forwardly. Forward movement of the drive plate 290 (Figs. 43 and 45), through the shoulder 289, in cooperation with the latch 287, carries the latch slide 288 and, through the stud 286, the retaining plate 293 (Fig. 46) and the key stop rack 282 forwardly in unison with it. Forward movement of the rack 282, through the gear 281, the shaft 280, and the gear 279, shifts the key stop slide 274 rearwardly until the projection 312 on its upper edge contacts the stem of the corresponding depressed key 73. This obstructs further movement of said key stop slide and the rack 282, whereupon the angular slot 285 in said rack, in cooperation with the stud 286, shifts the latch 287 upwardly or clockwise to disengage the tooth thereon from the shoulder 289 to disconnect said parts from the differential drive plate 290 and to position said parts in accordance with the depressed selecting key 73.

The differential positioning of the latch slide 288 (Fig. 45) is transmitted by a gear 313, free on the rod 205, to a ring gear 314 similar to the amount ring gear 206 (Fig. 2), said ring gear in turn positioning a corresponding type where similar to the amount type wheel 209 for recording a symbol characteristic of the selected group totalizer upon the statement sheet 212. The differential drive plate 290 completes its initial forward movement independently of the latch slide 288 and connected parts, and return rearward movement of said plate 290 causes a stud 315 carried thereby to engage the rearward end of the horizontal slot in the forward portion of said slide 288 to return said slide and connected parts, including the key stop slide 274 (Fig. 46), to normal or home positions. It will be understood that in this case the type wheel positioned by the latch slide 288 (Fig. 45) is returned to home position at the end of machine operation, whereas the amount type wheels (Fig. 2) remain in set positions at the end of machine operation.

By observing Fig. 46, it will be noted that the key stop slide 274 does not have a projection 312 for the Total Balance key 73; however, depression of this key releases said slide for rearward positioning movement, and in this case said slide and connected parts move full distance rearwardly until a surface 624 on the rearward end thereof contacts a square stud 625 in the plate 81 to position said slide and connected parts in accordance with the Total Balance key 73.

Referring now to Figs. 43, 44, and 45, the latch slide 288 has a hook-shaped extension 316, to which is fixed a beam rack 317 having on its lower edge teeth which mesh with a beam gear 318 rotatably supported by a stud 319 secured in an upward extension of a beam gear slide 320 mounted for horizontal shifting movement by means of parallel slots therein in cooperation with the rollers 283 and 284. The beam gear 318 also meshes with teeth on the upper edge of a totalizer selecting rack 321 mounted for horizontal shifting movement by means of parallel slots therein in cooperation with the rollers 283 and 284. Teeth on the lower edge of the rack 321 mesh with a gear 322 secured to the left-hand face of a totalizer selecting drum cam 323 free on a stud 324 (Figs. 21 and 22) supported by the frames 67 and 68.

Forward positioning movement of the latch slide 288 (Figs. 43, 44, and 45) causes the rack 317 to position the beam gear 318 in accordance with the depressed selecting key 73, as explained above. Simultaneously with the positioning of the beam gear 318, the teeth on the upper edge of the differential drive plate 290, in cooperation with the teeth of a gear 325, which also meshes with the teeth in a fixed rack 327 secured to the plate 81 (see also Fig. 34), said gear being pivotally connected to an upward extension of a slide 326 mounted for horizontal shifting movement by means of parallel slots in each end thereof, in cooperation with the rollers 310 and 311, move said slide 326 forwardly in relation to said differential drive plate 290. Forward movement of the slide 326 causes an upwardly extending finger 328 thereon (Fig. 44) to engage the stud 319 and carry the slide 320 and the beam gear 318 forwardly until a vertical surface 329 on the upward extension of said slide contacts a corresponding surface on a bushing in the plate 81.

The above forward movement of the slide 326 (Fig. 44) and the beam gear 318 causes said beam gear, in cooperation with the teeth in the

beam rack 317, to position the totalizer selecting rack 321 (Fig. 45) in accordance with the depressed totalizer selecting key 73, said rack in turn positioning the selecting cam 323 in accordance with the depressed selecting key 73 to select the set of group totalizer wheels 182 (Figs. 21 and 22), corresponding thereto, for engagement with the amount actuators 135, as will be explained presently.

The totalizer shifting cam 323 (Figs. 21, 22, 35, and 45) has a helical camming groove 331 engaged by a roller 332 free on a stud in a shiftable bracket 333 mounted to shift laterally on a stud 334 supported by the frames 67 and 68. The forward portion of the bracket 333 has an opening to receive the right-hand end of the group totalizer shaft 183, said bracket supporting a vertical pin 335, which extends through the opening and freely engages a hole in the right-hand end of said totalizer shaft 183. The group totalizer shaft 183, supporting the five sets of group totalizer wheels 182, is supported for lateral shifting movement in a totalizer framework which is shiftable vertically to engage and disengage the totalizer wheels with and from the actuators, said framework comprising right-hand and left-hand end plates 336 (only the right-hand plate being shown here) and a partition plate 337 (see also Figs. 20 and 34) for each denominational group of totalizer wheels 182. The plates 336 and 337, in addition to supporting the totalizer shaft 183 for lateral shifting movement, likewise support a totalizer engaging shaft 338 and a transfer pawl shifting shaft 339, which shafts are a part of the totalizer framework and assist in retaining the plates 336 and 337 in proper spaced relationship to each other.

The group totalizer framework is mounted for vertical shifting movement by means of a bushing on the right-hand end of the group totalizer shaft 183, in cooperation with a slot 340 (Figs. 27 and 30) in the upper edge of the plate 68, and by means of a bushing on the right-hand end of the shaft 338 (Fig. 22) in cooperation with a slot 340 in said plate 68, said shafts having, on their left-hand ends, similar bushings (not shown) which engage corresponding slots in the left-hand plate 69 (Fig. 31). Assisting the means just described in supporting the totalizer framework for vertical shifting movement are slots in each of the plates 337 (Fig. 20), which cooperate with a rod 342 supported in turn by the right-hand and left-hand plates 68 and 69.

When the group totalizer shaft 183 is in disengaged position, it is in the position shown in full lines in Fig. 22, and, when said shaft is in engaged position, it is in the position shown here in dot-and-dash lines, the shiftable connection formed by said shaft and the pin 335 permitting such movement. As explained previously, the totalizer shaft 183 is shiftable horizontally, independently of the group totalizer framework, to align the different sets of totalizer wheels 182 with the amount actuators 135. Positioning of the totalizer selecting cam 323 by the rack 321 (Figs. 45 and 46), under influence of the depressed selecting key 73, as explained above, causes the helical groove 331 in said cam (Fig. 21), in cooperation with the roller 332, to shift the bracket 333 and, through the pin 335, the totalizer shaft 183 horizontally to a position corresponding to the depressed selecting key 73, to select the set of wheels 182 corresponding to said depressed key for engagement with the amount actuators 135.

Near the end of machine operation, after the selected set of totalizer wheels have been actuated, the cams 308 and 309 (Figs. 14 and 15) return the rack 298 rearwardly, which, through the gearing and square shaft 296, returns the differential drive plate 290 (Figs. 43 and 45) also rearwardly.

Return rearward movement of the differential drive plate 290 (Figs. 43 and 45) causes the shoulder 289 thereof to move beyond the tooth of the latch 287, whereupon the spring 294 (Fig. 46) causes the angular slots 291 and 285 (Fig. 46) to return said latch downwardly so that its tooth is again in the path of said shoulder. Simultaneously with the reengaging of the latch 287, the square stud 315, carried by the plate 290, engages the rearward end of the slot in the forward portion of the latch slide 288 and returns said slide rearwardly, in unison therewith, to home position. Return rearward movement of the latch slide 288 causes the beam rack 317 to roll the beam gear 318 idly over the teeth in the upper edge of the rack 321 without disturbing the position of said side, and, as a result, the selected set of totalizer wheels remain in alinement with the amount actuators at the end of machine operation, and in the succeeding operation, the selected set of totalizer wheels are moved directly into alinement with the amount actuators without the necessity of moving said totalizer line to a neutral or home position beforehand.

Engaging and disengaging mechanism for group totalizer line

Mechanism for imparting engaging and disengaging movement to the group totalizer shaft 183 (Fig. 21) to engage and disengage the selected set of totalizer wheels 182 with and from the amount actuators will now be explained.

By referring to Fig. 1, it will be recalled that the control keys 74 of the split bank of selecting and control keys for the group totalizer line are used in conjunction with the selecting keys 73 to control the engaging and disengaging movement of the set of totalizer wheels 182 selected for engagement with the amount actuators by said selecting keys 73.

Depression of any one of the control keys 74 moves the corresponding stud 253 (Figs. 35, 41, and 43) downwardly into the path of a corresponding upward projection 344 on a control bar 345 mounted for parallel shifting movement in relation to the studs 253, by means of parallel slots therein, in cooperation with two studs 346 secured in the key frame 78. The bar 345 has a downwardly disposed slot which engages a stud 347 in an upward extension of a control lever 348 free on a stud 349 in an auxiliary plate 350 secured to the partition plate 81 for the group totalizer bank. A rearward extension of the lever 348 has formed therein four graduated steps 351 corresponding to the projections 344 and arranged to cooperate with a stud 352 in an upward arm of a latch 353 pivoted on a stud 354 in an engaging control rack 355 (Fig. 43) mounted for horizontal shifting movement by means of parallel slots therein, in cooperation with the rollers 310 and 311. The latch 353 has a downwardly projecting tooth adapted to be engaged by a shoulder 356 on the drive plate 290. A forward extension of the lever 348 (Figs. 35 and 41) cooperates with a stud 357 in a rearward extension of an arm 358 free on a stud 359 in the plate 350. The arm 358 has a downward extension 360, which co-

operates with a round portion of a square stud 361 secured in the forward end of the differential drive plate 290. A spring 362, tensioned between the stud 359 and a stud in the lever 348, urges said lever counter-clockwise to normally maintain the forward extension thereof in contact with the stud 357, which extends through an arcuate slot 363 in the plate 350.

When none of the group totalizer selecting keys 73 is depressed (Figs. 1, 40, and 41), counter-clockwise movement of the zero latch 262 and the arm 264, upon counter-clockwise releasing movement of the key lock shaft 97, as explained above, causes the rear end of said arm 264 to move into the path of a forward wall 364 on the arm 358. This obstructs clockwise movement of the arm 358 when forward movement of the differential drive plate 290 withdraws the stud 361 from the downward extension 360, thereby locating the control lever 348 in its first or non-add position, so that, when none of the selecting keys 73 is depressed, no engaging and disengaging movement will be imparted to the group totalizer line, irrespective of whether or not a control key 74 is depressed.

Depression of any one of the selecting keys 73 causes the lever 258 (Fig. 40) to retain the zero latch 262 and the arm 264 in their downward positions, so that the arm 358 (Fig. 41) will be free to move clockwise upon forward movement of the plate 290. Clockwise movement of the arm 358, through the stud 357 in cooperation with the forward extension of the lever 348, permits said lever to move counter-clockwise in unison therewith under influence of the spring 362. Counter-clockwise movement of the lever 348 shifts the bar 345 forwardly until the corresponding projection 344 contacts the stud 253 of the depressed control key 74 to position the corresponding step 351 on said lever opposite the stud 352 in the latch 353.

By referring to Fig. 41, it will be noted that the stud 352 is a sufficient distance from the first or non-add step 351 on the lever 348, and that the shoulder 356 on the differential drive plate 290 is a sufficient distance from the tooth on the latch 353 to permit said plate 290 to position said lever 348, under influence of the depressed control key 74, without danger of interference between said lever 348 and said stud 352.

Initial forward movement of the differential drive plate 290 (Figs. 41 and 43), as explained above, causes the shoulder 356 to engage the tooth of the latch 353 to carry said latch and the rack 355 forwardly in unison therewith until the stud 352 contacts the step 351 corresponding to the depressed control key 74, to rock said latch clockwise out of engagement with the shoulder 356 and simultaneously to engage a tooth on an aligning pawl 365, secured to said latch 353, with the corresponding one of a series of aligning notches 366 in the plate 350, to position the rack 355 in accordance with the depressed control key 74. After the latch 353 has been disengaged, continued forward movement of the drive plate 290 causes an upward surface 367 on said plate to pass beneath the tooth of said latch 353 to lock the pawl 365 in the corresponding aligning notch 366 to align and retain said latch and connected parts in set positions. A spring 368 (Fig. 43), tensioned between the latch 353 and a stud in the rack 355, urges said latch counter-clockwise to normally maintain the tooth thereon in the path of the shoulder 356.

The rack 355 (Fig. 43) has, on its upper edge,

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teeth meshing with teeth in a gear 369 free on the rod 205, said gear in turn meshing with the external teeth of a ring gear 370 similar in every respect to, and functioning exactly like, the ring gear 206 (Fig. 2) for the amount bank shown here, to position a corresponding type wheel having thereon symbols corresponding to the control keys 74, so that said symbols may be recorded upon the statement sheet 212 during machine operation to identify the type of operation being performed.

The rack 355 (Figs. 34, 35, 38, and 43) has, on its lower edge, teeth meshing with the teeth of a gear 371 secured on one end of a short shaft 372 journaled in the frames 67 and 68. Also secured on the shaft 372 is a gear 373 meshing with teeth in a segment 374 free on a stud 375 in the frame 67. The segment 374 (Fig. 38) has a camming slot 376, into which extends a roller 377 carried by an arm 378 (Fig. 36) free on a totalizer engaging shaft 379 extending between the frames 67 and 68. A link 381 pivotally connects the forward end of the arm 378 to a lever 380 free on the stud 334 (see also Fig. 21) in the frame 67. The forward end of the lever 380 is pivotally connected by a link 382 to a totalizer engaging arm 383 free on a stud 384 in a crank 385 secured on the shaft 379. Secured in the forward end of the arm 383 (Figs. 22 and 36) is a flattened stud 386, which cooperates with a notch 387 in a bent-over extension of a subtract and total engaging bar 388, with a notch 389 in a bent-over extension of a sub-total engaging bar 390, and with a notch 391 in the lower edge of an add engaging bar 392. The engaging bars 388, 390, and 392 (Figs. 38, 47, 48, and 49) are shiftably mounted by means of arcuate slots therein in cooperation with rollers 393 and 394 rotatably supported, respectively, by shafts 395 and 396 for the No. 1 and No. 4 totalizer lines, said shafts being similar in every respect to the totalizer engaging shaft 379 for the No. 2 or group totalizer line now being described.

As previously explained, near the end of each machine operation, the stud 361 in the differential drive plate 290 (Fig. 43) engages the forward end of the rack 355 and returns said rack rearwardly to normal position, as shown here, to in turn position the segment 374 in home or neutral position, as shown in Fig. 38. When the segment 374 is in home position, the slot 376, cooperating with the roller 377 and through the linkage shown in Fig. 36 and explained above, locates the engaging arm 383 in its extreme downward position, in which the stud 386 is beneath the notch 387 in the bar 388, as shown in Fig. 22, and therefore out of the operating range of all of the engaging bars. This extreme downward position of the arm 383 is termed its "non-add" position, and, when it is in this position, a shoulder 397 on said arm (Figs. 22 and 38) is in the path of the central one of the tie bars 70, to obstruct rearward or engaging movement of said arm and connected parts.

Depression of the non-add key 74 (Figs. 1, 35, 41, and 43) causes its stud 253, in cooperation with the corresponding projection 344 on the bar 345, to position the control lever 348 in its first or non-add position, in which the first step 351 on said lever, in cooperation with the stud 352, disengages the latch 353 from the shoulder 356 and simultaneously engages the tooth of the aligning pawl 365 with the first notch 366 to position the rack 355 in its first or non-add position. Movement of the rack 355 to non-add position,

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through the gears 371 and 373, rotates the segment 374 (Figs. 34 and 38) to its first position, the positions of said segment being indicated by the small numerals 0 to 5 along the camming slot 376. During this movement of the segment 374, a concentric portion of the slot 376, in cooperation with the roller 377, retains the engaging arm 383 in its extreme downward position, as shown in Fig. 22, so that no engaging movement will be imparted to the group totalizer shaft 183. Movement of the rack 355 (Figs. 35 and 43), through the gear 369 and the ring gear 370, positions the type wheel for the non-add key 74, to cause the impression mechanism to record a non-add character upon the record material.

The non-add key 74 may be used alone or in conjunction with any of the selecting keys 73. However, in either case, the ultimate result is the same; that is, the group totalizer line receives no engaging and disengaging movement. In operations in which no selecting keys 73 or control key 74 are depressed, the normal result is the same as if the non-add key had been depressed. However, there are certain inter-controls between the bank of balance totalizer control keys 75 and 76 (Figs. 1, 35, and 38) and the group totalizer bank, which may alter or vary this result, as will be explained later. In this latter case, the non-add key 74 may be used in conjunction with the control keys 75 and 76 to nullify any control which these keys may have over the group totalizers, and this is probably the principal use of said non-add key.

Depression of the subtract key 74 in conjunction with one of the selecting keys 73 (Figs. 1 and 35) causes the rack 355 to be positioned in its second or subtract position, which movement of said rack, through the gears 371 and 373, rotates the segment 374 (Fig. 38) to its second position, causing the cam slot 376, in cooperation with the roller 377, and through the linkage shown in Fig. 36, to raise the engaging arm 383 to its subtract position, in which the stud 386 is engaged with the notch 387 (Figs. 22 and 38) in the subtract and total engaging bar 388. The engaging bar 388 (Fig. 49) is connected by a link 398 to a lever 399 free on the rod 168. The lever 399 carries rollers 400 and 401, which cooperate, respectively, with the peripheries of companion plate cams 402 and 403 secured on the main cam shaft 98. Revolution of the main cam shaft 98 and the cams 402 and 403 during machine operation causes the engaging bar 388 to be shifted first rearwardly and then back to normal position, according to the time given in space 5 of the time chart (Fig. 52) to cause the selected set of group totalizer wheels corresponding to the depressed key 73 to be engaged with and disengaged from the amount actuators 135 in subtract timing. Positioning of the rack 355 under influence of the subtract key 74, through the gear 369 and the ring gear 370 (Fig. 35), causes the type wheel for the control keys 74 to be located in subtract position to record a subtract character upon the record material, upon operation of the impression mechanism.

Depression of the total key 74 in conjunction with one of the keys 73 (Figs. 35 and 41) causes the rack 355 to be located in its third position, which movement of said rack, through the gears 371 and 373 (Fig. 38), positions the segment 374 in its third position, thereby causing the camming slot 376, in cooperation with the roller 377 and the connecting linkage, to position the engaging arm 383 exactly the same as in sub-

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tract operations, to engage the stud 386 (Fig. 22) with the notch 387 in the total and subtract engaging bar 388. It is therefore evident that in total recording operations the set of totalizer wheels 182 corresponding to the depressed key 73 will be engaged with and disengaged from the amount actuators 135 in exactly the same timing as in subtract operations. Movement of the rack 355 to total position, through the gear 369 and the ring gear 370 (Fig. 35), positions the type carrier for the control keys 74 so that a symbol representing a total recording operation will be recorded upon the record material upon operation of the impression mechanism.

Depression of the sub-total key 74 in conjunction with one of the keys 73 (Figs. 35 and 41), through the control lever 348, causes the rack 355 to be located in its fourth position, said rack in turn moving the segment 374 (Fig. 38) to its fourth position. Movement of the segment 374 to its fourth position causes the slot 376, in cooperation with the roller 377 and the linkage connecting said roller to the engaging arm 383, to move said arm upwardly to a position where the stud 386 engages the notch 389 in the sub-total engaging bar 390. The sub-total engaging bar 390 (Fig. 48) is connected by a link 404 to a lever 405 free on the rod 168, said lever carrying rollers 406 and 407, which cooperate, respectively, with the peripheries of companion plate cams 408 and 409 secured on the main shaft 98.

Rotation of the main shaft 98 and the cams 408 and 409 causes the engaging bar 390 to be shifted first rearwardly and back to normal position, according to the time given in space 5 of the time chart (Fig. 52) to engage and disengage the set of totalizer wheels 182 corresponding to the depressed key 73 with and from the amount actuators in sub-total timing. Positioning of the rack 355 under influence of the sub-total key 74 (Fig. 35), through the gear 369 and the ring gear 370, positions the type wheel for the control keys 74 so that a sub-total character will be recorded upon the record material, upon operation of the impression mechanism.

When the zero latch 262 for the keys 73 is rendered ineffective by depression of any one of the group totalizer selecting keys 73 (Figs. 35 and 40), as explained above, and when no control key 74 is depressed, the bar 345 (Fig. 41) and the control lever 348 are free to move full distance forwardly and counter-clockwise, respectively, which movement is determined by the stud 357 in the arm 358 contacting the bottom of the slot 363. Full movement of the control lever 348 moves all of the steps 351 out of the path of the stud 352, and in this case the rack 355 moves forwardly under influence of the differential drive plate 290 until the upward extension of the latch 353 engages a stud 418 in the plate 350 and is rocked clockwise thereby to disengage the tooth thereon from the shoulder 356 and simultaneously to engage the pawl 365 with the fifth notch 366 to position said rack 355 in adding position.

Forward movement of the rack 355 to adding position, through the gears 371 and 373 (Fig. 38), rotates the segment 374 clockwise to its fifth or adding position. When the segment 374 is in adding position, the camming slot 376 therein, in cooperation with the roller 377 and the linkage connecting said roller to the engaging arm 383, rocks said engaging arm full distance clockwise or upwardly (Fig. 22) to engage the

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stud 386 with the notch 391 in the lower edge of the add engaging bar 392. The add engaging bar 392 (Fig. 47) is connected by a link 410 to a lever 411 free on the rod 168, said lever carrying rollers 412 and 413, which cooperate, respectively, with the peripheries of companion plate cams 414 and 415 secured on the main shaft 98. Rotation of the main shaft and of the cams 414 and 415 causes said cams to shift the add engaging bar 392 first rearwardly and back to normal position according to the time given in space 4 of the time chart (Fig. 52) to engage and disengage the set of group totalizer wheels 182 corresponding to the depressed key 73 with and from the amount actuators in adding time.

By referring to Fig. 38, it will be noted that arcuate clearance slots are provided in the bars 388, 390, and 392 for the engaging shaft 379 for the No. 2 or group totalizer line and for an engaging shaft 419 for the No. 3 totalizer line, which is similar in every respect to the shaft 379.

By referring to Figs. 22, 34, and 36, it will be recalled that the engaging arm 383 for the group totalizer line is pivotally connected to the crank 385 secured on the shaft 379. The shaft 379 also has secured thereon a lever 420 carrying a stud 421, which engages a slot 422 in an arm 423 secured on the shaft 338. Also secured on the right-hand end of the shaft 338 is a crank 424 carrying a roller 425, which engages a camming slot 426 in the plate 68. Secured on the left-hand end of the shaft 338 is a crank 427, similar in every respect to the crank 424 and carrying a roller, similar to the roller 425, which engages a slot similar to the slot 426 in the left-hand plate 69.

Rearward movement of the engaging arm 383 under influence of the engaging bars 388, 390, or 392, as explained above, rocks the crank 385, the shaft 379, and the lever 420 counter-clockwise (Figs. 22, 27, 30, 34, and 36), causing said lever 420 to rock the arm 423, the shaft 338, and the cranks 424 and 427 also counter-clockwise. Counter-clockwise movement of the cranks 424 and 427 causes the rollers 425 carried thereby, in cooperation with the corresponding slots 426, to shift the shaft 338 and the group totalizer framework, comprising said shaft, the plates 336 and 337, the shaft 339, and the group totalizer shaft 183, upwardly to engage the selected set of wheels 182 on said group totalizer line with the amount actuators 135. Return forward movement of the engaging bars 388, 390, or 392 reverses the procedure outlined above to shift the group totalizer framework downwardly to disengage the selected set of wheels 182 from the amount actuators 135. The shifting movement of the engaging bar 388, 390, or 392 with which the stud 386 (Fig. 22) is engaged determines the timing of the engaging and disengaging movement of the group totalizer line 183.

In adding operations, the stud 386 in the engaging arm 383 (Fig. 22) is engaged with the notch 391 in the add engaging bar 392, which bar operates according to the time given in space 4 of the chart (Fig. 52) to engage the wheels 182 of the selected totalizer with the amount actuators 135 after said actuators have completed their initial movements and have been positioned under influence of the depressed amount keys 72. Compare spaces 3 and 4, Fig. 52. The selected set of totalizer wheels remain in engagement with the amount actuators 135

during their return movement, which movement rotates said wheels in an additive or clockwise direction to add therein the value of the depressed amount keys. After the amount actuators have completed their return movement, the add engaging bar 392 moves forwardly to shift the group totalizer framework downwardly to disengage the selected set of totalizer wheels from said amount actuators 135.

In subtract operations, the stud 386 (Fig. 22) is engaged with the notch 387 in the engaging bar 388, and initial rearward movement of said bar shifts the group totalizer framework upwardly, according to the time given in space 6 of the chart (Fig. 52), to engage the wheels 182 of the selected group totalizer with the amount actuators 135 prior to initial forward movement of said actuators (compare spaces 3 and 6, Fig. 52). Initial movement of the actuators in subtract operations reversely rotates the selected set of totalizer wheels 182 (Figs. 28 and 34) to subtract therefrom the value of the depressed amount keys. After the amount actuators 135 have completed their initial movement, the engaging bar 388 (Fig. 22) shifts the engaging arm 383 forwardly to move the group totalizer framework downwardly to disengage the selected set of totalizer wheels from the amount actuators prior to return rearward movement of said actuators.

The engaging bar 388 also imparts the engaging and disengaging movement to the group totalizer line 183 in total operations, and, as in subtract operations, the wheels 182 of the selected totalizer are engaged with the amount actuators prior to initial movement of said actuators, which movement reversely rotates said wheels to zero position, which is determined by a long tooth on each wheel contacting the corresponding transfer pawls, in a manner to be described later. This locates the selected wheels in zero position, and said wheels in turn position the amount actuators 135 and the corresponding amount printing wheels in accordance with the value of the amount thereon. Prior to return movements of the amount actuators 135, and while the selected set of totalizer wheels are at zero, return movement of the engaging bar 388 disengages said totalizer wheels from the amount actuators 135, so that said wheels will remain in a zeroized condition.

In sub-total operations, the stud 386 (Fig. 22) is engaged with the notch 389 in the sub-total engaging bar 390, and, as in subtract and total-recording operations, initial movement of said bar engages the selected set of totalizer wheels 182 with the amount actuators 135 prior to initial movement of said actuators, which movement reversely rotates the selected set of wheels to zero position, in exactly the same manner as explained for total-recording operations. In sub-total recording operations, the selected set of totalizer wheels remains in engagement with the amount actuators 135 during their return rearward movement, which movement restores said wheels to their original positions.

An upward extension of the arm 423 (Figs. 21, 22, and 34) has thereon a plurality of aligning teeth 428, which, upon counter-clockwise engaging movement of said arm, engage corresponding teeth 429 in the bracket 333 to align the selected set of totalizer wheels 182 with the amount actuators 135, and to lock said wheels in aligned position during engaging and disengaging movement of the group totalizer line 183.

Transfer mechanism for group totalizers

As mentioned previously, each denominational unit of the group totalizer line is provided with a transfer mechanism for transferring tens digits from lower to higher denominational orders in adding operations, and for transferring tens digits from higher to lower denominations in subtracting operations. In adding operations, when a totalizer wheel 182 in a lower order passes through zero, the long tooth thereon trips the transfer mechanism. This releases the transfer segment in the next higher order, and, when the totalizer wheels are disengaged from the amount actuators, the released transfer segment rotates the next higher order wheel one tooth space or step in an additive direction to transfer the tens digits thereto. In subtracting operations, the direction of movement of the transfer segments is changed to drive said segments in a subtractive direction instead of in an additive direction, and, when a lower order wheel passes through zero, the long tooth thereon trips the transfer mechanism as before, and, immediately after the selected totalizer is disengaged from the amount actuators, the transfer segment for the next higher order rotates the next higher order totalizer wheel one step in a subtractive direction to transfer a tens digit to the next higher denomination.

Inasmuch as the transfer mechanism is substantially duplicated for each denominational order, it is believed that a description of the transfer mechanism for the amount bank shown in Fig. 2 will be sufficient.

Each of the totalizer wheels 182 (Figs. 20, 23, 24, 25, 26, 28, 29, and 34) has a long tooth 432, which cooperates with an add tripping surface 433 and a subtract tripping surface 434 on a transfer tripping pawl 435 pivoted on a stud 436 in a corresponding latch 437 free on a stud 438 in the corresponding partition plate 337. The latch 437 has a bent-over ear 439, the upper edge of which cooperates with a shoulder 440 on a transfer segment release arm 441 free on a stud 442 in the next higher order partition plate 337 (Fig. 34). A spring 443, tensioned between the arm 441 and the latch 437, urges said latch clockwise to normally maintain the upper edge of the ear 439 in engagement with the shoulder 440 to retain said arm 441 against the action of a spring 444 tensioned to urge said arm counterclockwise. The arm 441 has a camming surface 445, which cooperates with a stud 446 in a detent arm 447 free on a stud 448 in a transfer segment support plate 449 for the next higher order, said plate being mounted for vertical shifting movement in relation to the totalizer framework by means of parallel slots therein in cooperation with the stationary rod 342 and the totalizer engaging shaft 338, respectively.

A spring 450 urges the detent 447 clockwise to normally maintain a tooth 451 thereon engaged with a notch in the lower edge of a transfer segment 452 for the next higher order, free on a stud 453 in the plate 449, to normally hold said segment in neutral or untripped position. There is a plate 449 for each denominational order, and each of said plates has a camming slot 454 engaged by a roller 455 in a corresponding operating bell crank 456 secured on the totalizer engaging shaft 338.

Each of the segments 452 is in alignment with the corresponding amount actuator 135 (Fig. 34), and each of said segments has teeth which mesh with the teeth of the selected set of group totalizer wheels 182, when the group totalizer line

is in disengaged position and when said line is moving to and from engaged position, to retain the selected set of wheels 182 in alinement. Thus the segments 452 serve in a dual capacity as aliners and transfer media. The other four sets of wheels 182 are retained in alinement by fixed alining bars 431 (Figs. 20 and 34), one of which is secured to each of the partition plates 337.

The transfer segment 452 (Figs. 28, 29, and 34) carries a stud 457, which cooperates with an operating surface 458 on an add operating arm 459, and with a similar surface 460 on a subtract operating arm 461, both of said arms being pivoted on a stud 462 in the partition plate 337. A spring 463, tensioned between the arms 459 and 461, urges said arms in opposite directions—that is, counter-clockwise and clockwise, respectively, to cause said arms to actuate the transfer segment 452, as will be explained presently, and to cause corresponding extensions 464 and 465 of said arms to cooperate with a stud 466 in a control arm 467 secured on the shaft 339. A notch in the upper end of the arm 467 forms surfaces 468 and 469, which cooperate with a stud 470 in the lower end of the trip pawl 435, to shift said trip pawl from adding position to subtracting position and vice versa, depending upon the type of operation being performed.

Also secured on the shaft 339 (Figs. 27, 28, 29, 30, and 34) is a transfer shaft operating arm 471 pivotally connected by a link 472 to a lever 473 free on a stud 474 in the frame 68. The lever 473 has symmetrical extensions supporting studs 475 and 476, which cooperate with an arcuate surface 477 on a segment 478 having, in its upper end, a slot 479, which engages a stud 480 in a forward extension of the lever 420. The segment 478 is shifted in relation to the studs 475 and 476 through a link 481, which pivotally connects said segment to a shifting pitman 482 having, in its rearward end, a slot 483 shiftably engaging a bushing on the shaft 379. The pitman 482 carries a stud 484, which freely engages a hole in a downward extension of a Y-shaped cam lever 485 free on a stud 485 in the frame 68. The lever 485 carries rollers 487 and 488, which cooperate, respectively, with the peripheries of companion plate cams 489 and 490 secured on the shaft 372 (Figs. 27 and 34).

The shaft 339 and the arms 471 and 467 have two positions; namely, subtract position, as shown in Figs. 27, 28, and 30, and adding position, as shown in Figs. 29 and 53. The shaft 339 and parts secured thereon are retained in subtract position by a tooth 493 formed on the upper end of the arm 471, in cooperation with a subtract retaining pawl 494, and said parts are retained in adding position by said tooth in cooperation with an add retaining pawl 495, said pawls having tensioned therebetween a spring 496, which urges them into engagement with said tooth 493. The pawls 494 and 495 are pivotally mounted on their respective studs secured in the right-hand plate 336, and said pawls extend through a clearance opening 497 in the frame 68, so as to cooperate with the tooth 493 on the arm 471, which arm, it will be seen by referring to Figs. 27 and 34, is also located to the right of the frame 68 on the right-hand end of the shaft 339, which also extends through said opening 497.

The cams 489 and 490 (Figs. 27 and 53), under influence of the keys 73 and 74, position the lever 485 and the pitman 482 in either of two positions (add and subtract) to cause said pitman in turn

to control the positioning of the shaft 339 accordingly.

By referring to Figs. 35, 38, and 43, it will be recalled that the shaft 372 is positioned at the beginning of machine operation (space 2, Fig. 52) by the rack 355 under influence of the control keys 74 in any one of four positions—namely, non-add, subtract, total, and sub-total—and, when no key 74 is depressed and one of the keys 73 is depressed, said shaft is positioned in add position. At the end of each machine operation, the rack 355 and the shaft 372 are returned to home or zero position, as shown in Figs. 38 and 43, by the stud 361 in the differential drive plate 290, in the manner explained previously.

When the shaft 372 and the cams 489 and 490 are positioned under influence of the non-add or subtract control keys 74, in either non-add or subtract position, said cams in turn position the lever 485 in subtract position, as shown in Fig. 27, to shift the pitman 482 rearwardly. Rearward shifting of the pitman 482, through the link 481, rocks the segment 478 counter-clockwise, so that the arcuate surface 477 is directly above the stud 476 in the lever 473, as shown in full lines in Fig. 27.

With the shaft 339 and the arm 471 in adding position, as shown in Fig. 53, in which they are retained by the pawl 495 and the tooth 493, and with the segment 478 in subtract position, as shown in full lines in Figs. 27 and 30 and as shown in dot-and-dash lines in Fig. 53, upward engaging movement of the totalizer framework, including the plates 336 and 337, the shaft 339, and the transfer mechanism supported by said plate 337, under influence of the mechanism shown in Fig. 22 and explained earlier, causes an extension of the pawl 495 to engage a stud 498 in the forward end of the pitman 482 to rock said pawl counter-clockwise against the action of the spring 496 out of engagement with the tooth 493. While the pawl 495 is being disengaged, the slot 479 in the segment 478 permits the lever 420 and the stud 480 to move counter-clockwise independently of said segment, and, immediately after said pawl is disengaged, said lever shifts the segment 478 downwardly, causing the arcuate surface 477, in cooperation with the stud 476 (Fig. 53) to rock the lever 473 clockwise to the position shown in Fig. 30. Clockwise movement of the lever 473, through the link 472, rocks the arm 471 and the shaft 339 counter-clockwise from adding position, as shown in Figs. 29 and 53, to subtracting position, as shown in Figs. 27 and 30. During counter-clockwise movement of the arm 471, the tooth 493 by-passes the end of the subtract retaining pawl 494, whereupon the spring 496 moves said pawl into the path of said tooth to secure said arm 471 and the shaft 339 in subtract position.

In operations in which none of the selecting keys 73 or the control keys 74 is depressed, the shaft 372 is positioned in its first or non-add position, in which the cams 489 and 490 (Fig. 27) position the lever 485 and the pitman 482 in subtract position. However, in all non-add operations, no engaging or disengaging movement is imparted to the totalizer framework, the lever 420, and the segment 478; therefore the lever 473 is not shifted, and, under these conditions, the position of the shaft 339 is not disturbed, and consequently said shaft remains in the position which it occupied prior to the non-adding operation.

By referring to Figs. 35 and 43, it will be re-

called that, when one of the selecting keys 73 is depressed and none of the control keys 74 is depressed, the rack 355 is free to move full distance forwardly to adding position, to position the shaft 372 and the cams 489 and 490 in their fifth or adding position, as shown in Fig. 53. Movement of the cams 489 and 490 to adding position rocks the lever 485 clockwise to shift the pitman 482 forwardly to adding position, said pitman in turn rocking the segment 478 clockwise from subtracting position, as shown in dot-and-dash lines (Fig. 53), to adding position, as shown here in full lines.

Assuming that the shaft 339 and the arm 471 are in subtracting position, as shown in Figs. 27 and 30, and that the pitman 482 is in the add position shown in Fig. 53, upward engaging movement of the totalizer framework causes a stud 499, carried by the pitman 482, to be engaged by an extension of the pawl 494 to rock said pawl clockwise out of engagement with the tooth 493. After the pawl 494 has been disengaged, continued counter-clockwise movement of the lever 420 shifts the segment 478 downwardly, causing the arcuate surface 477 to engage the stud 475 and rock the lever 473 counter-clockwise. This movement of the lever 473, through the link 472, rocks the arm 471, the shaft 339, and the arm 467 clockwise from subtracting position, as shown in Fig. 28, to adding position, as shown in Figs. 29 and 53, in which positions said arms and said shaft are retained by the pawl 495 in cooperation with the tooth 493.

The sub-total and total control keys 74 (Fig. 35) cause the cams 489 and 490 (Fig. 27) to be positioned in their third and fourth positions, respectively, thereby causing said cams to position the lever 485 in its fifth or adding position, in exactly the same manner as explained above in connection with adding operations.

As explained previously, clockwise movement of the shaft 339 and the arm 467 to adding position, as shown in Figs. 29 and 53, causes the surface 468 on said arm to engage the stud 470 and rock the transfer pawl 435 counter-clockwise to adding position, and likewise causes the stud 466 in said arm 467 to engage the extension 465 to move the subtract operating arm 461 to ineffective position and simultaneously releasing the add operating arm 459 for operation, to drive the transfer segment 452 in an additive direction, as will be explained presently. Counter-clockwise movement of the shaft 339 and the arm 467 from adding position (Fig. 29) to subtracting position (Fig. 28) causes the surface 469 in the notch in the upper end of said arm 467, in cooperation with the stud 470, to rock the transfer pawl 435 clockwise from adding position to subtracting position.

When the group totalizer line 183 (Figs. 22 and 23) is in disengaged position, the transfer segments 452 are in engagement with the teeth of the corresponding selected set of totalizer wheels 182. During engaging movement of the shaft 338 (Figs. 22 and 23), the contour of the slots 454 in the plates 449, in cooperation with the rollers 455 on the bell cranks 456, causes said plates 449 and the segments 452 to move upwardly in unison with the totalizer shaft 183, as shown in Fig. 25, to retain the selected set of totalizer wheels in aligned position until they are fully engaged with the teeth of the amount actuators 135. After the selected set of totalizer wheels 182 have been engaged with the

corresponding amount actuators 135, continued counter-clockwise movement of the shaft 338 and the bell cranks 456 causes the rollers 455, in cooperation with the slots 454, to shift the plates 449 downwardly in relation to the totalizer shaft 183 to disengage the teeth of the transfer segments 452 from the corresponding totalizer wheels, as shown in Fig. 24, so that said wheels may be actuated in the manner explained above.

As the plate 449 for the order being described moves full distance downwardly (Fig. 54) under influence of the bell crank 456, the stud 457 in the segment 452, in cooperation with a camming slot 501 in the plate 337, having symmetrical opposed camming surfaces, restores said segment 452 from operated position, in either an additive or a subtractive direction, back to its central or unstripped position, as shown here. Simultaneously with the restoring of the segment 452, full movement counter-clockwise of the bell crank 456 causes a stud 502 therein, in cooperation with a rearward extension 503 of the arm 441 to restore said arm clockwise until the shoulder 440 thereon moves beyond the upper edge of the bent-over ear 439 on the latch 437, whereupon the spring 443 restores the latch 437 clockwise into the path of said shoulder 440. Immediately after the transfer mechanism has been restored, the bell crank 456 is returned a slight distance clockwise from the position shown in Fig. 54 to the position shown in full lines in Fig. 24 and to the position shown in dot-and-dash lines in Fig. 54, so that the stud 502 is removed a slight distance from the extension 503 to provide room for tripping counter-clockwise movement of the arm 441 when the transfer mechanism is tripped, as will be explained presently.

When the transfer segment 452 (Fig. 54) is restored to its central or untripped position, as shown here, and the arm 441 has been restored clockwise to normal position, so that the surface 445 thereon is out of the path of the stud 446 in the detent 447, the spring 450 returns said detent clockwise to engage the tooth 451 thereon with the notch in the lower edge of the transfer segment 452, to retain said segment in restored position.

Transfer mechanism in adding operations

With the transfer mechanism restored and with the transfer pawl 435 in adding position, as shown in Fig. 54, rotation of the totalizer wheel 182 in an additive direction, by the amount actuator 135, from 9 position to 0 position, causes the long tooth 432 on said wheel, in cooperation with the surface 433 on the pawl 435, to rock said pawl counter-clockwise about a pivot formed by the surface 468 (Fig. 29) and the stud 470. This movement of the pawl 435 in turn rocks the latch 437 also counter-clockwise to disengage the ear 439 from the shoulder 440 to release the arm 441 to the action of the spring 444 (Fig. 24), which immediately rocks said arm counter-clockwise until the extension 503 contacts the stud 502, as shown here. After the actuator 135 has completed actuating movement to enter in the corresponding totalizer wheel 182 an amount corresponding to the value of the depressed amount key (compare spaces 3 and 4 of the time chart, Fig. 52), return clockwise movement of the bell crank 456 causes the roller 455, in cooperation with the slot 454, to move the plate 449 and the segment 452 upwardly to engage said segment with the teeth of the corresponding totalizer

wheel 182, as shown in Fig. 25. Clockwise movement of the bell crank 456 likewise withdraws the stud 502 from the extension 503 of the arm 441, thus permitting the spring 444 to rock said arm full distance counter-clockwise, thereby causing the surface 445 to engage the stud 446 and rock the detent 447 downwardly to disengage the tooth 451 from the notch in the segment 452 for the next higher order, as shown in Fig. 25.

This releases the transfer segment 452 for the next higher orders to the action of the spring-actuated operating arm 459 (Fig. 29), and, as soon as the teeth of the corresponding totalizer wheel 182 are disengaged from the corresponding amount actuator 135, said arm 459, through the action of the spring 463, rocks said segment counter-clockwise from the position shown in Fig. 25 to the position shown in Fig. 26 to advance the next higher order wheel 182 one tooth space to transfer a tens digit from the next lower denomination. It will be noted, by referring to Fig. 25, that full tripped position of the arm 441 is determined by a shoulder 504 thereon coming into contact with the upper edge of the ear 439 on the latch 437.

The transfer segment 452 remains in operated position, as shown in Fig. 26, at the end of machine operation and also during engaging movement of the group totalizer line in the succeeding operation, to hold the corresponding totalizer wheel 182 in advanced position while totalizer selection takes place and until the selected set of totalizer wheels are engaged with the amount actuators 135. After the selected totalizer has thus been engaged with the amount actuators, continued counter-clockwise movement of the bell crank 456 shifts the plate 449 and the segment 452 downwardly, as explained in connection with Fig. 54, causing the slot 501, in cooperation with the stud 457, to restore the segment 452 from operated position to its central or untripped position, as shown here, and the stud 502 simultaneously restores the arm 441 to untripped position, as shown here, to move the surface 445 out of operating range of the stud 446, so that the spring 450 may again engage the tooth 451 with the notch in the lower edge of the segment 452 to retain said segment in untripped position.

By referring to Fig. 22, it will be seen that the contour of the slot 426 in the plate 68 is such that the upward or engaging movement of the shaft 338 and the totalizer framework is completed during approximately one-half of the initial or counter-clockwise rotative movement of said shaft 338 under influence of the lever 420, as explained above. The remainder of the rotary movement of said shaft 338 and the bell crank 456, from the position shown in Fig. 24 to the position shown in Fig. 54, is utilized, as explained above, to restore the segments 452 and the arms 441 to untripped positions. Likewise it will be seen, by referring to space 4 of the time chart (Fig. 52), which gives the engaging and disengaging movement of the group totalizer line in adding operations, that a slight over-movement is imparted to the shaft 338 and the bell cranks 456 to restore the tripped segments 452 and the arms 441, after which said shaft and said bell cranks 456 are returned a slight distance to the position shown in Fig. 24, and remain in this position until disengaging movement is imparted to the totalizer framework.

Transfer mechanism in subtract operations

In subtract operations, the shaft 339 (Fig. 28) is rocked counter-clockwise from adding position to subtracting position, as shown here, and the arm 467 moves in unison therewith, causing the surface 469 in the notch in the upper end of said arm, in cooperation with the stud 470, to rock the pawl 435 clockwise from the position shown in Fig. 29 to the position shown here, in which a stud 505 in the upper end of said pawl 435 is moved into contact with an upwardly-extending finger 506 on the plate 337. Counter-clockwise movement of the arm 467 also causes the stud 466 to be withdrawn from the extension of the subtract operation arm 461 and to simultaneously engage the extension 464 of the add operating arm 459 to rock said arm clockwise from effective position to ineffective position, as shown in Fig. 28.

Rotation of the selected totalizer wheel 182 by the corresponding amount actuator 135 (Fig. 28) in a subtractive or counter-clockwise direction, from zero position to 9 position, causes the long tooth 432, in cooperation with the surface 434, to rock the pawl 435 clockwise against the fulcrum formed by the stud 505 and the finger 506. Clockwise movement of the pawl 435 rocks the latch 437 counter-clockwise to disengage the ear 439 from the shoulder 440 to trip the release arm 441, in the manner explained in connection with adding operations. Upon return upward movement of the plate 449 (Fig. 25) to engage the transfer segment 452 for the next higher order with the corresponding totalizer wheel, the arm 441 disengages the tooth 451 of the detent 447 from the notch in said segment 452 to release said segment to the action of the subtract operating arm 461 (Fig. 28). As soon as the teeth of the selected totalizer wheel 182 are disengaged from the teeth of the corresponding amount actuator 135, the operating arm 461, under influence of the spring 463, immediately rocks the transfer segment 452 in a clockwise or subtractive direction to move the corresponding totalizer wheel of the next higher order one tooth space in a subtractive or counter-clockwise direction to transfer a tens digit from said next higher order totalizer wheel to the next lower order totalizer wheel. The transfer mechanism is restored at the beginning of the succeeding operation in exactly the same manner as explained in connection with adding operations.

It will be noted by observing Fig. 30 that the arm 471 has in its lower end a stud 507 arranged to engage an aligning notch 508 formed in the opening 497 in the plate 68 when said arm and the shaft 339 are in subtract position, as shown here, and when the group totalizer framework is in disengaged position. It will also be noted that the stud 507 is arranged to engage an aligning notch 509 in said plate 68 when said arm and the shaft 339 are in adding position and when the totalizer framework is in disengaged position, to secure said arm and the shaft 339 against displacement at these times.

Transfer mechanism in total and sub-total recording operations

By referring to Fig. 53, it will be recalled that, in sub-total and total recording operations, the cams 489 and 490 position the lever 485 in adding position, as shown here, to cause the transfer mechanism, including the arm 471 and the shaft 339, to be rocked to adding position, in which the trip pawls 435 are disposed in relation to the

long teeth 432 of the corresponding totalizer wheels 182, as shown in Fig. 29. It will likewise be recalled that, in total and sub-total recording operations, the wheels of the selected totalizer are engaged with the amount actuators 135 prior to initial movement of said actuators, which movement rotates said wheels in a reverse or subtractive direction until such movement is terminated by the long teeth 432 engaging the surfaces 434 on the pawls 435, as shown in Fig. 29. This locates the selected set of wheels 182 in zero position and, through the actuators 135, positions the corresponding type wheels in accordance with the amount on said wheels.

In total recording operations, the wheels 182 are disengaged from the actuators 135 prior to return movement of said actuators, and consequently said wheels remain in a zeroized condition at the end of machine operation. This type of operation is often referred to as a re-setting operation as well as a total recording operation. In sub-total recording operations, the wheels 182 remain in engagement with the actuators 135, and return movement of said actuators restores said wheels to their original positions. This type of operation is often referred to as a reading operation as well as a sub-total recording operation.

Balance totalizer selecting and control keys

By referring to Figs. 1 and 38, it will be recalled that the present machine is provided with a balance totalizer, sometimes referred to as a crossfooter, having a plus wheel and a minus wheel for each denominational order, the plus wheel and the minus wheel of each order being geared together for reverse rotation, so that one wheel is always complementary to the other. This type of totalizer is necessary to provide a positive reading of an overdraft (true negative balance) in one cycle of machine operations, which, as explained previously, consists of one revolution of the main cam shaft 98.

The totalizer selecting and control keys 75 select the plus side of the balance totalizer for engagement with the amount actuators 135, and the selecting and control keys 76 select the minus side of the balance totalizer for engagement with the amount actuators. The bank of selecting and control keys for the balance totalizer is of split construction, the same as the bank of selecting and control keys 73 and 74 for the group totalizer line, and has a differential mechanism similar in every respect to the differential mechanism for said bank of group totalizer selecting and control keys, which was explained in detail earlier herein in connection with the group totalizer line.

Inasmuch as the construction and the operation of the split differential mechanisms for the two banks of totalizer selecting and control keys are so much alike, it is believed that the complete disclosure given above of the differential mechanism for the group totalizer line will suffice in many respects for both, and that a detailed description of the important mechanism of the balance totalizer selecting and control bank, which is different from that of the group totalizer selecting and control bank, together with a general description of the less important mechanism, which is substantially duplicated in the group totalizer selecting and control bank, will be sufficient.

The keys 75 and 76 (Fig. 1), unlike the keys 73 and 74, are never used in conjunction with

each other but are always used separately. In fact, it is impossible to depress more than one of the keys 75 or 76 in any one operation, as it will be recalled that depression of any one of these keys immediately initiates machine operation.

The keys 75 for the balance totalizer (Figs. 1 and 38), with the exception of the non-add key, select the plus side of the balance totalizer for engagement with the amount actuators. In addition, the deposit key simultaneously selects the total deposit totalizer on the group totalizer line for addition to store a total of the deposits, and the Balance key 75 simultaneously selects the total balance totalizer on the group totalizer line for addition to store a total of the balances. The Non-Add key is a neutral key and is used principally to initiate operation of the machine in operations not requiring selection or use of the balance totalizer, such as reading and resetting operations involving the group totalizers. The differential mechanism for the keys 75 has no zero latch, as has the differential mechanism for the keys 73 of the group totalizer selecting and control bank, and, as a result, when none of the keys 75 is depressed, the differential mechanism goes automatically to its extreme rearward position, and it is in this position that the shifting from the plus side to the minus side of the balance totalizer takes place. Consequently, when no key 75 is depressed, the minus side instead of the plus side of the balance totalizer is aligned with the amount actuators 135 for engagement therewith. Each of the five keys 75 controls the positioning of a corresponding type wheel to print characters representative of the type of operation being performed upon the record material for identification purposes. The keys 75, with the exception of the Non-Add key, in addition to selecting the plus side of the balance totalizer, also control the timing of the engaging and disengaging movement of the balance totalizer to effect the type of operation corresponding to said keys.

As explained above, when none of the keys 75 is depressed, the differential mechanism for said keys moves full distance to shift the balance totalizer from plus position to minus position to align the minus wheels thereon with the amount actuators. Consequently, when any one of the keys 76 is depressed, the minus side of the balance totalizer will be selected automatically. In addition, the keys 76 control the timing of the engaging and disengaging movement of the balance totalizer to effect the type of operation corresponding to the depressed key. In addition, the Check key 76 also selects the total check totalizer on the group totalizer line for addition, to store in said totalizer a group total of all the check items. The Overdraft key 76 also simultaneously selects the total balance totalizer on the group totalizer line for subtraction to subtract from the total balances the amount of the overdraft.

Directing attention particularly to Figs. 1, 34, and 38, depression of any one of the selecting and control keys 75 moves the lower end of its stem into the path of a corresponding upward projection 513 on a key stop slide 514, similar in every respect to the key stop slide 274 for the selecting keys 73 (Fig. 46) and mounted to shift parallel in relation to the lower ends of the stems of said keys 75 in exactly the same manner as said slide 274. The slide 514 has on its bottom edge teeth meshing with a gear 515 (Fig. 34)

integral with a companion gear 516 free on a stud secured in the plate 82. The gear 516 meshes with teeth in the upper edge of a key stop rack 517, which, together with a companion retaining plate 518, is mounted for horizontal shifting movement by means of parallel slots therein in cooperation with rollers 519 and 520 (Fig. 38) supported by studs secured in the plate 82.

The rack 517 and the retaining plate 518 are similar in every respect to the corresponding parts 282 and 293 (Fig. 46) for the group totalizer differential mechanism, and said rack and said plate have opposed angular slots, similar to the slots 285 and 291, which engage a stud in a latch 521 (Fig. 38) carried by a latch slide 522 similar in every respect to the latch slide 288 (Fig. 45) for the group totalizer differential mechanism, and mounted for horizontal shifting movement by means of parallel slots therein in cooperation with rollers 523 and 524 supported by studs secured in the plate 82. The latch 521 cooperates with a shoulder 525 formed by a bent-over portion of a differential drive plate 526 mounted for horizontal shifting movement by means of parallel slots therein in cooperation with the rollers 519 and 520. A spring (not shown), tensioned between the rack 517 and the retaining plate 518, urges said parts in opposite directions, causing the opposed angular slots therein, in cooperation with the stud in the latch 521 (Fig. 38), to yieldingly urge said latch downwardly into the path of the shoulder 525 on the drive plate 526. The differential drive plate 526 (Figs. 14, 15, and 38) has, on its upper edge, teeth which mesh with a drive gear 527 secured on the shaft 296 and operated by the cams 308 and 309 according to the time given in space 2 of the time chart (Fig. 52) in exactly the same manner as the group totalizer differential mechanism shown in Fig. 35 and explained earlier herein.

Initial rearward movement of the key stop slide 514 (Figs. 34 and 38) is effected by initial forward movement of the differential drive plate 526, causing the corresponding projection 513 on said slide to move into contact with the lower end of the depressed key 75. This obstructs further rearward movement of the slide 514 and further forward movement of the key stop rack 517, causing the angular slot therein, in cooperation with the stud in the latch 521, to rock said latch upwardly out of engagement with the shoulder 525 of the differential drive plate 526, to position the latch carrying slide 522 in accordance with the depressed key 75. Upward disengaging movement of the latch 521 engages an alining tooth formed on the upper edge thereof with the corresponding one of a series of alining notches 543 in the lower edge of the partition plate 82, to aline the slide 522 and connected parts in set position.

The positioning of the slide 522 is transmitted by rack teeth on its upper edge, in cooperation with a gear (not shown) similar to the gear 313 (Fig. 45) for the latch slide 288, to a corresponding ring gear (not shown) which in turn positions a type wheel (not shown) for the keys 75 to print an identifying character upon the record material 212, corresponding to the depressed key 75.

The latch slide 522 (Figs. 34 and 38) has a hook-shaped extension 528 having secured thereto a beam rack 529 meshing with a beam gear 530 pivotally supported on a stud secured in an upward extension of a beam gear slide 531 mounted for horizontal shifting movement by means of parallel slots therein, in cooperation

with the rollers 519 and 520. The beam gear 530 also meshes with teeth in the upper edge of a totalizer selecting rack 532 mounted for horizontal shifting movement by means of parallel slots therein in cooperation with the rollers 523 and 524, said rack 532 being similar in every respect to the corresponding rack 321 (Fig. 45) for the group totalizer differential mechanism. The stud which supports the beam gear 530 (Figs. 34 and 38) cooperates with an upwardly extending finger 533 on a beam gear drive plate 534 mounted for horizontal shifting movement by means of parallel slots therein in cooperation with the rollers 519 and 520. An upward extension of the plate 534 rotatably supports a gear 535 meshing with teeth on the upper edge of the differential drive plate 526, said gear also meshing with teeth on a stationary rack 536 secured to the right-hand face of the plate 82. Positioning of the differential latch slide 522 (Figs. 34 and 38) under influence of the depressed selecting and control key 75, as explained above, causes the rack 529 to rotatably position the beam gear 530 in accordance with the position of said slide 522. Initial forward movement of the differential drive plate 526 causes the gear 535, in cooperation with the teeth on said plate and in cooperation with the rack 536, to move the beam plate 534 forwardly in relation thereto, causing the finger 533, in cooperation with the stud which rotatably supports the beam gear 530, to shift the slide 531 and said beam gear 530 forwardly, thereby causing the positioning of said beam gear 530, under influence of the latch slide 522, to be transmitted to the totalizer selecting rack 532. Teeth on the lower edge of the rack 532 (Figs. 31, 34, and 38), in cooperation with a gear 537 integral with a totalizer selecting drum cam 538 free on a stud 542 secured in the plate 67, position said drum cam 538 in relation to the depressed control key 75.

The balance totalizer cam 538 has therein a camming groove which is connected to the balance totalizer support shaft 181 in exactly the same manner as the camming groove in the drum cam 323 (Figs. 21 and 22) for the group totalizer line is connected to the shaft 183. The balance totalizer shaft 181 (Figs. 31 and 33) rotatably supports the series of denominational adding wheels 178 and their corresponding subtracting wheels 180. The corresponding adding and subtracting wheels of one denominational order are geared together by gear teeth formed thereon, in cooperation with corresponding pinions 539 and 540 (Fig. 33) meshing together and turnably mounted on a support plate 541 fixedly supported by the shaft 181 and a fixed aliner 649 for the wheels 178 and 180. The contour of the cam slot in the drum cam 538 is such that, when any of the selecting and control keys 75, except the Non-Add key, is depressed, the plus wheels 178 (Figs. 27 and 28) will be alined with the amount actuators 135 for actuation thereby.

By referring to Fig. 38, it will be recalled that there is no zero latch for latching the key stop slide 514 in zero position, and, as a result, this slide is free to move rearwardly in every machine operation, regardless of whether or not any one of the keys 75 is depressed. Consequently, when no one of the keys 75 is depressed, the key stop slide 514 is free to move full distance rearwardly to subtract position, thereby causing the drum cam 538 to shift the balance totalizer shaft 181 and the wheels 178 and 180 toward the right (Fig. 31) from adding position to subtracting

position, in which the subtract wheels 180 are alined with the amount actuators 135. It is therefore evident that, when any of the selecting and control keys 76 (Figs. 1 and 38) is depressed, the subtract side of the balance totalizer is automatically selected by full movement rearwardly of the key stop slide 514 to cause the amount set up on the amount keys 72 to be subtractively entered in said balance totalizer.

Return rearward movement of the differential drive plate 526 (Figs. 34 and 38) according to the time given in space 2 of the chart (Fig. 52) causes a square stud (not shown), carried by said plate, to pick up and return the key stop rack 517, the retaining plate 518, and the latch slide 522 rearwardly to normal positions near the end of machine operation. At approximately the same time as the square stud picks up the latch slide 522, the tooth of the latch 521 is disengaged from the notch 543 and said latch is reengaged with the shoulder 525 in the usual manner.

The Non-Add key 75 (Figs. 1 and 38), in cooperation with its corresponding projection 513 on the key stop slide 514, locates said slide and the latch carrying slide 522 in positions corresponding to said key, to cause a character representative of a non-add operation to be printed on the record material 212. The Non-Add key causes the drum cam 538 to shift the totalizer shaft 181 to a neutral position, in which neither the plus or minus wheels 178 or 180 (Fig. 31) are in alinement with the amount actuators 135. However, this is unimportant, because in non-add operations the totalizer engaging mechanism is rendered inoperative, as will be explained presently, and, as a result, no engaging and disengaging movement is imparted to the balance totalizer shaft 181.

Balance totalizer engaging mechanism

The balance totalizer shaft 181 (Figs. 31 and 32) is mounted in a framework which is shiftable vertically to engage and disengage the totalizer wheels 178 and 180 with and from the amount actuators 135. The shiftable totalizer framework comprises right and left end plates 544 and 545, which support the shaft 181 and an intermediate plate 546 (Figs. 19 and 31), for each denominational order, which support the transfer release arms and latches for the corresponding orders. The plates 544, 545, and 546 have slots which engage a stationary rod 547 supported between the plates 68 and 69 (Figs. 19, 31 and 32), and, in addition, said plates rotatably support a totalizer engaging shaft 548, opposite ends of which engage vertical slots in the plates 68 and 69 in exactly the same manner as the group totalizer engaging shaft 338 (Fig. 27). Likewise the balance totalizer shaft 181 has bushings on opposite ends thereof which engage corresponding vertical slots in the plates 68 and 69 in exactly the same manner as the group totalizer shaft 183 (Fig. 27) to form a framework for the balance totalizer shaft and the tripping portion of the transfer mechanism, which is shiftable vertically.

The differential mechanism for the balance totalizer, like the differential mechanism for the group totalizers shown in Fig. 35, is split in two sections, one section of which controls the positioning of the totalizer shifting cam 538 (Fig. 38) in the manner explained above, to select the plus side or the minus side of the balance totalizer. The other section of the split differential mechanism

for the balance totalizer controls the connection of the balance totalizer engaging and disengaging mechanism with the operating bars shown in Figs. 47, 48, and 49, to control the timing of the engaging and disengaging movement of the balance totalizer in exactly the same manner as explained in connection with the group totalizer.

The engaging bars 388 and 390 (Figs. 38, 47, 48, and 49) have bent-over portions on their forward ends forming engaging notches 549 and 550, and the add-engaging bar 312 has a notch 551, said notches arranged to be engaged by a stud 552 in the forward end of an engaging arm 553 free on a stud 554 in a crank 555 secured on the shaft 395.

The arm 553 is pivotally connected by a link 556 to a lever 557 free on a stud 558 supported by the frames 67 and 68 (Fig. 34). The lever 557 is pivotally connected by a link 559 to an arm 560 free on the shaft 395 and carrying a roller 561, which extends through and cooperates with a camming slot 562 in a segment 563 free on a stud 564 in the frame 67. The segment 563 has, on its upper edge, teeth meshing with a gear 565 free on a stud 566 secured in the frame 67. The gear 565 also meshes with teeth on the lower edge of a rack 567 (Figs. 38 and 49) mounted for horizontal shifting movement by means of parallel slots therein in cooperation with the rollers 519 and 520. The rack 567 pivotally supports a latch 568 having integral therewith an alining pawl 569, said pawl and said latch urged counter-clockwise by a spring 570 (Fig. 38) to normally maintain a tooth on said latch in the path of a shoulder formed on the upper edge of the differential drive plate 526. An upwardly extending arm of the latch 568 carries a stud 571, which cooperates with graduated steps 572 on the rearward end of a control lever 573 free on a stud 574 secured in a plate 575 in turn secured to the plate 82 (Fig. 34). The plate 575 and the lever 573 are similar in appearance to and function in exactly the same manner as the corresponding parts 350 and 348 (Fig. 41) for the group totalizers, the steps 572 on said lever 573 being exactly the same as the corresponding steps 351 on the lever 348 and cooperating with the stud 571 in exactly the same manner as said steps 351 cooperate with the stud 352 to control their corresponding latches 568 and 353.

The lever 573 (Fig. 38 and 42) carries a stud 576, which engages a notch in a downward extension of a control bar 577 shiftable mounted by parallel slots therein, in cooperation with the studs 85 and 86 in the key frame 79 for the keys 75 and 76 (see also Fig. 1). The bar 577 has three upward projections 580, which cooperate, respectively, with the studs 83 in the Non-Add, Balance, and Sub-Balance keys 75, and said bar has two upward projections 581, which cooperate, respectively, with the studs 129 in the Overdraft and Sub-Overdraft keys 76.

A spring 582 (Figs. 38 and 42) urges the lever 573 counter-clockwise to normally maintain a forwardly extending finger thereof in contact with a stud 583 in a control lever 584 free on a stud 585 in the plate 575. The lever 584 has a downwardly extending finger which cooperates with a round tenon on a square stud in the differential drive plate 526. When the drive plate 526 is in home position, as shown in Fig. 38, the stud 586, in cooperation with the lever 584, maintains the lever 573 and the bar 577 in normal positions, as shown here.

The selecting and control keys 75 and 76 have an interlocking mechanism (not shown) therebetween which prevents depression of any of the keys 76 when a key 75 is depressed and prevents depression of any one of the keys 75 when any key 76 is depressed. It should also be remembered that the keys 75 and 76 are all release keys, in that depression of any one of these keys will initiate machine operation, and therefore it is impossible to depress more than one of these keys in any one machine operation.

Depression of either the Non-Add, Balance, or Sub-Total keys 75 (Figs. 1, 38, and 42) moves the stud 83 therein into the path of the corresponding projection 580 on the bar 577, and depression of either the Overdraft or the Sub-Overdraft keys 76 moves the stud 129 therein into the path of the corresponding projection 581 on said bar 577.

Initial forward movement of the differential drive plate 526 withdraws the stud 586 from the finger of the lever 584, thus permitting the spring 582 to rock the lever 573 counter-clockwise and to shift the bar 577 forwardly until the projection 580 or 581 thereon comes into contact with the corresponding stud 83 or 129 in the depressed key 75 or 76, to position said bar and said lever 573 in accordance with the depressed key 75 or 76. The positioning of the lever 573 takes place before any appreciable movement is imparted to the rack 567 and the latch 568, under influence of the drive plate 526, whereupon forward movement of said parts causes the stud 571 to contact the step 572 corresponding to the depressed key, to disengage the latch 568 from the shoulder on the drive plate 526, to position the rack 567 in accordance with the depressed key 75 or 76. This positioning of the rack 567, through the gear 565, positions the segment 563 also in accordance with the depressed key, causing the camming slot 562, in cooperation with the roller 561 and through the linkage shown in Fig. 49, to shift the engaging arm 553 upwardly to engage the stud 552 with the notch 549 or 550, depending upon which of the keys 75 or 76 is depressed.

For example, depression of the Non-Add key 75 (Figs. 38 and 42) moves the stud 83 therein into the path of the corresponding projection 580 to position the bar 577 and the lever 573 so that the first or non-add step 572 is opposite the stud 571. Upon operation of the machine, the step 572, in cooperation with the stud 571, disengages the latch 568 from the plate 526 and simultaneously engages a tooth on the pawl 559 with the corresponding one of a series of alining notches 587 in the lower edge of the plate 575, to aline and secure the rack 567 in non-add position. The rack 567 in turn positions the segment 563 in its first or non-add position, in which the slot 562, in cooperation with the roller 561, does not impart any upward movement to the engaging arm 560, and, as a result, said arm remains in ineffective position, as shown here, in which a shoulder 589 thereon is in the path of the bar 70, to retain said arm and connected parts in non-add position. It is, therefore, evident that in non-adding operations no movement will be imparted to the arm 553, and consequently the balance totalizer will receive no engaging and disengaging movement in such operations. The Non-Add key 75 is used principally as a machine-starting key when it is desired to make computations in the group totalizers only, without involving the balance totalizer.

Depression of the Balance key 75 to initiate

a balance operation moves the stud 83 therein into the path of the corresponding projection 580 to position the bar 577 and the lever 573 so that the third or balance step 572 on said lever is opposite the stud 571. This in turn positions the rack 567 and the segment 563 (Figs. 38, 42, and 49) in third position, causing the camming slot 562 in said segment 563 to lift the arm 553 upwardly a sufficient distance to engage the stud 552 with the notch 549 in the subtract and total engaging bar 388. During operation of the machine, the cams 402 and 403 (Fig. 49) operate according to the time given in space 6 of the chart (Fig. 52) to rock the crank 555 and the shaft 395 back and forth in total timing. The shaft 395 for the balance totalizer is similar in every respect to the shaft 379 (Figs. 21 and 22) for the group totalizer line and is connected to similar engaging mechanism for shifting the balance totalizer shaft 181 up and down to engage and disengage the wheels of the balance totalizer with and from the amount actuators 135. Therefore it is evident that, when the Balance key 75 is depressed, the plus wheels 178 (Figs. 31 and 32) of the balance totalizer will be alined with the amount actuators 135, and said wheels will be alined with and disengaged from said actuators in total or reset timing to cause said wheels to be zeroized and the amount thereon simultaneously recorded upon the statement sheet 212.

Depression of the Overdraft key 76 (Figs. 38 and 42) moves the stud 129 therein into the path of the corresponding projection 581 on the bar 577 to position said bar and the lever 573 in exactly the same position (third) as the Balance key 75, to cause the balance totalizer to be engaged and disengaged in total timing. In overdraft operations, the slide 514 (Figs. 31 and 38) moves full distance rearwardly, causing the cam 538 to shift the minus wheels 180 of the balance totalizer into alinement with the amount actuators 135. Consequently, in overdraft operations the minus side of the balance totalizer will be zeroized and the amount of the overdraft thereon will be simultaneously recorded upon the statement sheet 212.

Depression of the Sub-Balance key 75 (Figs. 38 and 42) to initiate a sub-balance operation moves its stud 83 into the path of the corresponding projection 580 to position the bar 577 and the lever 573 so that the fourth or sub-balance step 572 is opposite the stud 571. During machine operation, this positions the rack 567 and the segment 563 in fourth position, causing the camming slot 562 to lift the arm 553 (Figs. 38 and 49) upwardly to engage the stud 552 with the notch 550 (Fig. 48) in the sub-total engaging bar 390 to cause the balance totalizer to be engaged and disengaged in sub-total timing. As explained previously, the Sub-Balance key 75 selects the plus side of the balance totalizer for engagement with the amount actuators; therefore, in sub-balance operations, the plus wheels 178 (Fig. 31) will be read or sub-totalized and the amount thereon will be simultaneously recorded upon the statement sheet 212.

The Sub-Overdraft key 76 positions the segment 563 in exactly the same position (fourth) as the Balance key 75, and, in addition, said Sub-Overdraft key selects the minus side of the balance totalizer for alinement with the amount actuators. Therefore, in sub-overdraft operations, the minus side of the balance totalizer will be sub-totalized and the amount thereon will be

simultaneously recorded upon the statement sheet 212.

By referring to Fig. 42, it will be noted that the control bar 577 has no projections 580 for the Add and Deposit keys 75 or projections 581 for the Subtract and check keys 76; therefore the depression of any one of these keys permits said bar and the lever 573 to move full distance forwardly and counter-clockwise, respectively, to move all of the steps 572 on said lever above the stud 571, thus permitting the rack 567 to move full distance forwardly under influence of the differential drive plate 526 until a stud 588 in the plate 575 (Figs. 38 and 42) rocks the latch 568 out of engagement with the shoulder on said plate 526 to position said rack 567 and the segment 563 in their fifth or add position. This positioning of the segment 563 causes the camming slot 562, in cooperation with the roller 561, to engage the stud 552 (Figs. 47 and 49) in the arm 553 with the notch 551 in the add engaging bar 392. It is, therefore evident that, when the Add or Deposit key 75 or the Subtract or Check key 76 is depressed, the balance totalizer will be engaged and disengaged in adding time under influence of the cams 414 and 415, according to the time given in space 4 of the chart, Fig. 52.

Teeth on the upper edge of the rack 567 (Fig. 38) mesh with a gear 606 free on the rod 205, said gear in turn meshing with the external teeth of a ring gear 607, which drives a corresponding type wheel 608 to transmit the positioning of said rack 567, under influence of the keys 75 and 76, to said type wheel 608, so that, upon operation of the impression mechanism, an identifying character, corresponding to the type of operation being performed, will be recorded upon the statement sheet 212.

It will be remembered that, in adding or plus operations in the balance totalizer, the plus wheels 178 (Fig. 1 and 31) are engaged with the amount actuators 135 and are driven in an additive direction thereby to enter in said plus wheels the value of the depressed amount keys, and that in subtracting or minus operations the minus wheels 180, which are geared to their corresponding plus wheels, are engaged with the amount actuators 135 in adding time exactly as the plus wheels and reversely rotate their corresponding plus wheels to subtract therefrom the value set up on the depressed amount keys. The Add and Deposit keys 75 select the plus wheels 178 of the balance totalizer for engagement with the amount actuators, and the Subtract and Check keys 76 select the minus wheels 180 for engagement with the amount actuators.

Inter-control mechanism for balance and group totalizers

A good example of use of the machine embodying the present invention is that of a banking establishment in the balancing of individual checking accounts, and the keyboard of said machine has been arranged for such use. Inasmuch as it is desirable to accumulate a group total of all the deposits, all the checks, and all the balances, the selecting and control keys 75 and 76 for the balance totalizer, in addition to controlling the functions of the balance totalizer, are also arranged to simultaneously select certain of the sets of totalizers on the group totalizer line for engagement with the amount actuators to cause certain group totals to be accumulated.

For example, the Deposit key 75 (Figs. 1 and

38) selects the total deposit totalizer on the group totalizer line for engagement with and disengagement from the amount actuators in adding time to accumulate therein a total of the deposits. Likewise the Check key 76 simultaneously selects the total check totalizer on the group totalizer line for engagement with and disengagement from the amount actuators in adding time, to accumulate therein a total of all of the check items. The Balance key 75 selects the total balance totalizer on the group totalizer line for engagement with and disengagement from the amount actuators 135 in adding time to accumulate a total of all the balance items, and the Overdraft key 76 also selects the total balance totalizer on the group totalizer line for engagement with and disengagement from the amount actuators 135 in subtract timing to subtract therefrom the amounts of all overdrafts, so that the group total of the total balances will be correct.

The studs 83 in the Deposit key 75 and the Balance key 75 (Figs. 1, 38, and 42) cooperate, respectively, with corresponding camming projections 609 and 610, and the studs 129 in the Check key 76 and the Overdraft key 76 cooperate with corresponding camming projections 611 and 612 on a control bar 613 shiftably mounted by means of parallel slots therein, in cooperation with the studs 85 and 86 respectively in the key frame 79. A downward projection of the bar 613 has a slot which engages a stud 614 in the upper end of a crank 615 secured on a short shaft 616 supported by the plates 350 and 575 (Figs. 40 and 41). Also secured on the shaft 616 is a control pawl 617, said pawl, the shaft 616, and the crank 615 being urged counter-clockwise by a spring 618 tensioned between said pawl 617 and the bar 267, to urge the bar 613 forwardly to normally maintain the camming projections 609 to 612 in contact with the corresponding studs 83 and 129.

Depression of the Deposit key 75, the Balance key 75, or the Check key 76 causes the corresponding stud 83 or 129 therein, in cooperation with the corresponding camming projection 609 to 612, to shift the bar 613 rearwardly to rock the crank 615, the shaft 616, and the pawl 617 clockwise, against the action of the spring 618, a sufficient distance to move a surface 619 (Fig. 40) on a forward extension of said pawl into the path of a square stud 620 secured in the bar 267. The surface 619, in cooperation with the stud 620, obstructs rearward movement of the bar 267, when the stud 270 is rocked out of the path of the arm 268, upon releasing movement of the key lock shaft 97. As a result, the bar 267 remains in its forward position, as shown here, to retain the arm 264 and the zero latch 262 in their ineffective positions, as shown here, in which the shoulder 272 on said zero latch is out of the path of the ear 273 on the key stop slide 274 for the selecting keys 73, so that said slide will be free to move rearwardly in operations involving the use of the above-named keys 75 and 76, but not involving the keys 73.

Depression of the Overdraft key 75 (Figs. 41 and 42) causes the stud 129 therein, in cooperation with the camming projection 612, to shift the bar 613 a greater distance rearwardly than said bar is shifted by the Deposit, Balance, or Check keys. This rocks the pawl 617 clockwise a greater distance to move the surface 619 into the path of the stud 620 to retain the arm 264 and the zero latch 262 in ineffective positions and also to move a depending finger 622 on said pawl

into the path of a stud 623, which extends through an arcuate slot in the plate 350 and is secured in the control lever 348 for the keys 74. The finger 622, in cooperation with the stud 623, locates the lever 348 in its second or subtract position, for a purpose to be explained presently. The Deposit, Balance, and Check keys do not rock the pawl 617 clockwise sufficiently to move the finger 622 into the path of the stud 623.

Means under control of the Deposit key 75 and the Check key 76 (Figs. 1 and 9) is provided for positioning the key stop slide 274 to select the total deposit totalizer or the total check totalizer on the group totalizer line, depending upon which of these keys is depressed.

Depression of either the Deposit key 75 or the Check key 76 moves the corresponding stud 83 or 129 therein into the path of a corresponding projection 591 or 592 on a control bar 593 shiftably mounted by means of parallel slots therein in cooperation with the studs 578 and 579. A downward extension of the bar 593 has a slot which engages a stud 594 in the upper end of a crank 595 secured on a short shaft 596 journaled in the plates 350 and 575 (Figs. 34, 35, and 41). Also secured on the shaft 596 is a control arm 597 having, in a rearward extension thereof, a slot which engages a stud 598 in a bell crank 599 free on a stud 600 in the plate 350. A spring 601 (Figs. 9 and 45) urges the bell crank 599 clockwise to normally maintain a downward finger thereof in contact with a stud 602 in the extension 316 of the latch slide 288 for the group totalizer mechanism.

Initial forward movement of the slide 288, when the zero latch for the group totalizer differential mechanism is retained ineffective, as explained above, withdraws the stud 602 from the finger of the bell crank 599 to release said bell crank, the arm 597, the shaft 596, the crank 595, and the bar 593 to the action of the spring 601, which urges said bell crank clockwise, the arm 597, the crank 595, and the shaft 596 counterclockwise, and the bar 593 forwardly until the projection 591 or 592 contacts the stud 83 or 129 in the depressed Deposit key 75 or Check key 76. This prevents further movement of the parts and positions the bar 593 and the arm 597 in accordance with the depressed Deposit or Check key.

Depression of Check key 76 (Figs. 1 and 9) moves the stud 129 therein into the path of the upward projection 592 on the bar 593, whereupon initial movement of the key stop slide 274 and the latch slide 288, when the zero latch for said key stop slide is retained ineffective, as explained above, withdraws the stud 602 from the finger of the bell crank 599 to release said bell crank for clockwise movement under influence of the spring 601. The bell crank 599 in turn moves the arm 597, the shaft 596, and the crank 595 counterclockwise to shift the bar 593 forwardly until the projection 592 contacts the stud 129. This obstructs further movement of said parts and positions the arm 597 so that a forwardly projecting finger 603 thereon is in the path of a surface 604 on the rearward end of the key stop slide 274, said positioning taking place before said slide 274 has moved sufficiently in a rearward direction to interfere therewith. The finger 603, in cooperation with the surface 604, positions the slides 274 and 288 (Figs. 45 and 46) exactly the same as the Total Check key 73, which, through the mechanism shown in Figs. 21 and 22 and explained earlier herein, aligns the set of group totalizer wheels 182 corresponding to the Total Check key

73 with the amount actuators 135 for actuation thereby.

In check operations, the pawl 617 (Figs. 40 and 41) and the bar 267 hold the arm 264 beneath the surface 364 on the arm 358; consequently the control lever 348 is free to move full distance counter-clockwise to ineffective position. In this case, the stud 418 disengages the latch 353 to locate the rack 355 and the segment 374 (Figs. 35 and 38) in their fifth or add positions to cause the total check totalizer to be engaged with and disengaged from the amount actuators in adding time to accumulate a group total of the check items.

From the foregoing description it is obvious that, when the Check key 76 (Fig. 1) is depressed, the minus side of the balance totalizer is selected for engagement with the amount actuators 135 to subtract from said totalizer the amount of the check item, and simultaneously the total check set of totalizer wheels 182 on the group totalizer line is selected for engagement with the amount actuators to add therein the amount of the check item.

Depression of the Deposit key 75 (Figs. 1 and 9) moves the stud 83 therein into the path of the projection 591 to position the bar 593 and the arm 597 so that a shoulder 605 on said arm is in the path of the surface 604 of the slide 274. This terminates rearward movement of the slide 274 in exactly the same position as the Total Deposit key 73 (Fig. 1) to select the set of wheels on the group totalizer line corresponding to said Total Deposit key for engaging and disengaging movement with the amount actuators 135. As explained previously, depression of the Deposit key 75 causes the stud 83 therein, in cooperation with the projection 609 (Fig. 42), to shift the bar 613 rearwardly in the same manner and to exactly the same extent as the Check key 76 to render the arm 264 and the zero latch 262 (Fig. 40) ineffective by moving the surface 619 of the pawl 617 into the path of the stud 620, but, as was true in check operations, the finger 622 is not moved into the path of the stud 623; consequently the control lever 348 is free to move full distance counter-clockwise to cause the total deposit wheels 182 of the group totalizer line to be engaged with and disengaged from the amount actuators 135 in add timing to accumulate therein a group total of the deposit items.

As explained previously, depression of the Balance key 75 causes its stud 83, in cooperation with the projection 610 (Figs. 1, 40, 41, and 42), to shift the bar 613 rearwardly a sufficient distance to move the surface 619 of the pawl 617 into the path of the stud 620 to render the arm 264 and the zero latch 262 ineffective, but does not rock said pawl 617 a sufficient distance to move the finger 622 into the path of the stud 623. The above-described disabling of the zero latch 262 releases the key stop slide 274 for rearward positioning movement, and, as there is no projection on the bar 593 (Fig. 9) corresponding to the stud 83 in the Balance key, said bar is free to move full distance forwardly to rock the arm 597 full distance counter-clockwise to move the finger 603 and the shoulder 605 on said arm beneath and out of the path of the rearward end of the slide 274 so as not to interfere with rearward positioning movement of said slide. Therefore, in this case, as when the Total Balance key 73 (Fig. 1) is depressed, the slide 274 is free to move full distance rearwardly, which is determined by the surface 624 (Fig. 46) on the rearward end thereof

contacting the square stud 625 in the plate 81. This causes the total balance set of wheels 182 on the group totalizer line to be alined with the amount actuators 135 (Figs. 21 and 22.)

The above-explained disabling of the arm 264 in balance operations frees the control lever 348 (Fig. 41) for full counter-clockwise movement, as explained in connection with check and deposit operations, to cause the total balance totalizer wheels 182 to be engaged with and disengaged from the amount actuators 135 in adding time to accumulate in said wheels a group total of the balances.

Depression of the Overdraft key 76 (Figs. 1 and 42) to initiate an overdraft operation causes the stud 129 therein, in cooperation with the camming projection 612, to shift the bar 613 a greater distance rearwardly than said bar is shifted by the Check, Deposit, and Balance keys, to cause the surface 619 on the pawl 617, in cooperation with the stud 620, to obstruct the rearward movement of the bar 267 to render the arm 264 and the zero latch 262 ineffective and to move the finger 622 on said pawl 617 into the path of the stud 623 (Fig. 41). As was the case with the Balance key 75 (Fig. 9), there is no projection on the bar 593 for cooperation with the stud 129 in the Overdraft key 76; consequently the key stop slide 274 for the group totalizer line is again free to move full distance rearwardly until the surface 624 contacts the stud 625 to aline the total balance set of wheels 182 on the group totalizer line with the amount actuators 135. As the arm 264 (Figs. 40, 41, and 42) is retained ineffective, the control lever 348 is free to move counter-clockwise until the stud 623 contacts the finger 622, to position said lever 348 so that the second or subtract step 351 thereon is opposite the stud 352 to cause the totalizer control rack 355 to be moved to its second or subtract position. The rack 355 in turn positions the segment 374 (Fig. 35) in subtract position, thereby causing the slot in said segment, in cooperation with the roller 377 (Figs. 22 and 36) to engage the stud 386 with the notch 387 in the subtract engaging bar 388 to cause the total balance set of wheels 182 on the group totalizer line to be engaged with and disengaged from the amount actuators 135 in subtract timing, to subtract therefrom the amount of the overdraft in order to maintain a correct group total of the balances.

Tens transfer mechanism for the balance totalizer

Inasmuch as the selected set of wheels, plus or minus, of the balance totalizer is always driven in an additive direction, the transfer mechanism need function only in an additive direction.

When the plus side of the balance totalizer is selected for actuation by the amount actuators 135, and if during this actuation a lower order plus wheel 178 passes through zero, the transfer mechanism functions to advance the next higher order plus wheel one tooth space to effect the transferring of a tens digit thereto. When the minus side of the balance totalizer is selected for engagement with the amount actuators 135, and if during this actuation a lower order minus wheel 180 passes through zero, the transfer mechanism for the next higher order wheel is tripped and, upon functioning, advances the minus wheel for the next higher order one step, said wheel in turn through its reverse gear connection to its corresponding adding wheel moving said adding

wheel one step in a reverse or subtractive direction to effect the transfer of a tens digit.

It is necessary to provide this type of totalizer with a "fugitive 1" mechanism for adding "1" in the lowest order minus wheel when the highest order minus wheel passes through zero and for adding "1" to the lowest order plus wheel when the highest order plus wheel passes through zero, in order to correct the amount standing on said totalizer wheels under these conditions. The transfer mechanism for the balance totalizer is similar in many respects to the transfer mechanism for the group totalizers, explained earlier herein, with the exception that no provision is made for shifting the tripping pawls of said balance totalizer transfer mechanism from adding position to subtracting position and vice versa, as the balance totalizer mechanism always functions in an additive direction. Inasmuch as the transfer mechanism is substantially duplicated in each denominational order, it is believed that a description of the mechanism of the one denominational order shown in side elevation in Figs. 19 and 32 will be sufficient.

Referring to Figs. 19, 31, 32, and 33, each denominational order of the balance totalizer has a transfer segment 627 having in its upper edge three teeth which cooperate with the teeth of the corresponding plus and minus wheels 178 and 180. The transfer segment 627 for the denominational order being described is pivoted on a stud in a corresponding order plate 628, there being such a plate for each denominational order. Each of the plates 628 has in its upper end a slot which engages the rod 547 and another slot which engages the shaft 548 to mount said plates for vertical shifting movement. A notch in the lower edge of the transfer segment 627 is normally engaged by a tooth 629 on a detent 630 free on a stud 631 in the order plate 628. A spring 632 urges the detent 630 clockwise to normally maintain the tooth 629 in the notch in the segment 627 to restrain said segment 627 against the action of a spring 633 tensioned between a stud 634 in said segment and a stationary stud, which spring urges said segment counter-clockwise. The detent 630 (Figs. 19, 31, and 32) carries a stud 635, which underlies a surface 636 on the downward edge of a detent release arm 637 pivoted on a stud 638 in the plate 546 for this particular denomination. A spring 639 urges the arm 637 counter-clockwise to normally maintain a shoulder 640 thereon in engagement with a bent-over ear 641 on a transfer latch 642 pivoted on a stud 643 secured in the plate 546 for the next lower denomination.

The latch 642 has a bent-over ear 645, which cooperates with the long tooth on the plus wheel 178 for the next lower denomination when the plus side of the balance totalizer is alined with the amount actuators 135, and which cooperates with the long tooth on the minus wheel 180 for the next lower denomination when the subtract side of the balance totalizer is aligned with the amount actuators 135.

By referring to Figs. 38 and 49, it will be recalled that the balance totalizer is provided with an engaging mechanism which is similar to and functions in exactly the same manner as the engaging mechanism for the group totalizer line, explained in detail earlier herein. It will also be recalled that the stud 552 in the engaging arm 553 is engageable with corresponding notches in the three engaging bars 388, 390, and 392, whereupon said bars operate the shaft 395, which is

similar in every respect to the corresponding shaft 379 (Figs. 21 and 22) for the group totalizer line. The shaft 395, through a lever (not shown) similar to the lever 420 and an arm (not shown) similar to the arm 423, operates the shaft 548 (Fig. 32) rotatively back and forth, causing rollers carried by cranks (not shown) secured on said shaft, in cooperation with camming slots similar to the slots 426 for the group totalizer, to shift the balance totalizer framework, including the plates 544, 545, and 546 (Figs. 19, 31, and 32), the shaft 181, which supports the balance totalizer wheels, and the shaft 548, up and down to engage and disengage the wheels of the balance totalizer with and from the amount actuators 135 in proper timing. Secured on the shaft 548 is a bell crank 646 (Fig. 32) for each denominational order, similar in every respect to the bell crank 456 for the group totalizer line (Fig. 20), said bell crank 646 carrying a roller 647, which cooperates with a camming slot 648 in the lower edge of the corresponding plate 628, to shift said plate, the transfer segment 627, and the detent 630 up and down in relation to the balance totalizer framework.

The contour of the slot 648 (Fig. 32) is such that the plate 628, the segment 627, and the detent 630 move upwardly in unison with the balance totalizer framework, to retain the teeth of said segment in engagement with the teeth of the selected totalizer wheel until the teeth of said wheel are engaged with the teeth in the corresponding amount actuator 135. After this, the plate 628 is returned downwardly to disengage the segment 627 from the totalizer wheel and to retain said segment disengaged until after the selected totalizer wheel has been actuated, whereupon the procedure outlined above is reversed. The reason for retaining the segment 627 in engagement with the selected balance totalizer wheel while said wheel is being engaged and disengaged is that this is the only means of holding said wheel in position at these times. A stationary aliner 649 (Figs. 19 and 31) is provided for each denominational order and has an alining bar which engages the teeth of the corresponding plus or minus totalizer wheel, which is not in alinement with the amount actuators 135, to retain said wheels in alinement.

It will be recalled that in either adding or subtracting operations in the balance totalizer, the selected plus or minus wheels are engaged with the amount actuators 135 in adding time. This is effected by the stud 552 in the arm 553 (Figs. 47 and 49) being engaged with the notch 551 in the add bar 392, which bar is actuated by the cams 414 and 415 in adding time, as graphically outlined in space 4 of the chart, Fig. 52. Initial movement of the shaft 548 (Figs. 19 and 32) causes the balance totalizer framework and the plate 628 for the denomination being described to move upwardly in unison until the corresponding totalizer wheels 178 or 180 are engaged with the corresponding amount actuator 135, after which continued rotative movement of the shaft 548 causes the roller 647, in cooperation with the slot 648, to move the plate 628 downwardly to disengage the segment 627 from said corresponding totalizer wheel.

Full counter-clockwise movement of the bell crank 646 causes a stud 650 in an upward extension thereof to engage a surface 651 on an extension of the detent release arm 637 to restore said arm clockwise, against the action of the spring 639, until a spring 644, tensioned between

said lever and the latch 642, causes the shoulder 640 to by-pass the ear 641 on said latch, whereupon said latch retains said arm in untripped position. Full downward movement of the plate 628 (Figs. 19, 31, and 32), after the selected wheel of the balance totalizer has been engaged with the amount actuator, disengages the teeth of the segment 627 from said wheel and causes the stud 634 in said segment, in cooperation with a camming surface 652 (Fig. 19) formed by a notch in the plate 546, to restore the segment 627 to its control or untripped position, in which the tooth 629 of the detent 630 engages the notch in the lower end of said segment to latch said segment in untripped position, as shown here.

If the selected totalizer wheel, plus or minus, in the adjacent lower order passes through zero while being turned in a clockwise or additive direction by the corresponding amount actuator 135, the long tooth thereon engages the ear 645 on the latch 642 (Fig. 32) to rock said latch counter-clockwise against the action of the spring 644 to disengage the ear 641 from the shoulder 640. This releases the arm 637 to the action of the spring 639, which rocks said arm counter-clockwise until a shoulder 653 thereon engages the ear 641.

After the actuators 135 have completed their return movement and the selected totalizer wheel has been actuated, the shaft 548 and the bell crank 646 (Fig. 32), operating according to the time given in space 4 of the chart, Fig. 52, are returned clockwise, causing the roller 647, cooperating with the slot 648, to shift the plate 628 upwardly to engage the segment 627 with the selected totalizer wheel. After the segment 627 (Figs. 19 and 32) has engaged the selected totalizer wheel, and before said segment and the plate 628 have completed their upward movements, and also before the balance totalizer framework has begun to shift downwardly, the surface 636 on the tripping arm 637 engages the stud 635 and rocks the detent 630 counter-clockwise, against the action of the spring 632, to disengage the tooth 629 from the notch in the segment 627 to release said segment to the action of the spring 633. Continued return movement of the shaft 548 and the bell crank 646 shifts the balance totalizer framework downwardly to disengage the selected totalizer wheel from the corresponding amount actuator 135. Immediately after the selected totalizer wheel is disengaged from the corresponding actuator, the spring 633 urges the segment 627 counter-clockwise, causing the teeth therein, in cooperation with the teeth of said selected totalizer wheel, to advance said wheel in an additive direction the equivalent of one tooth space to transfer a tens digit from a lower denomination to a higher denomination. The counter-clockwise or transferring movement of the segment 627 is limited by the stud 634 therein engaging a projection 654 formed by a notch in the upper edge of the plate 628. In the succeeding operation, the segment 627 and the arm 637 are restored, after the selected set of totalizer wheels have been engaged with the amount actuators 135, in the manner explained earlier.

"Fugitive 1" mechanism

In the type of balance totalizer with which the present machine is equipped, it is necessary to enter a "fugitive 1" in the lowest order wheel when the highest order wheel passes through zero, in order to correct the amount standing on

the selected totalizer wheels. This entering of the "fugitive 1" is effected automatically by mechanism comprising a latch 656 for the highest order (Figs. 31 and 32), which is similar in every respect to the latch 542, said latch 656 being pivotally connected to the plate 546 for the highest order and having a bent-over ear which is arranged to be engaged by the long teeth on the plus and minus wheels 178 and 180 of the highest order for tripping said latch when said wheels pass through zero. A bent-over ear of the latch 656 cooperates with a shoulder on an arm 657, similar in every respect to the arm 637, said arm being pivoted to the left end plate 545 for the balance totalizer framework. The arm 657 carries a stud 658, which engages a slot in the upper end of a crank 659 secured on the left-hand end of a shaft 660 journaled in downward extensions of the plate 546 for the highest order and the right end plate 544. Secured on the right-hand end of the shaft 660 is a crank 661, similar to the crank 659, having in its upper end a slot engaging a stud 662 in an arm 663 for the lowest order, said arm being similar in every respect to the arm 637.

Whenever the highest order plus or minus wheel 178 or 180 (whichever is selected) passes through zero, the long tooth thereon rocks the latch 656 out of engagement with the shoulder on the arm 657 to release said arm, the shaft 660, and the arm 663 (for the lowest order) to the action of their respective springs 664 and 665, which immediately urge said arms counter-clockwise, as viewed in Fig. 32. Counter-clockwise movement of the arm 663 causes the surface on the lower edge thereof, in cooperation with the stud 635 for the detent 630 for said lowest denominational order, to rock said detent out of engagement with the transfer segment 627 for the lowest order, so that "1" will be entered in the plus or minus wheel 178 or 180, whichever is selected, for the lowest order of the balance totalizer, in order to correct the amount therein. The bell crank 646 (Fig. 32) for the highest order restores the arm 657, the shaft 660, and the arm 663 at the beginning of the succeeding operation, and the transfer segment 627 for the lowest order is restored by a camming surface in the plate 546 for said lowest order, in exactly the same manner as explained above in connection with Fig. 19.

In balance and sub-balance operations, which are initiated, respectively, by the depression of the Balance key 75 and the Sub-Balance key 75 (Figs. 1, 32, and 38), the plus wheels 178 of the balance totalizer are engaged with the actuators 135 in total and sub-total timing, respectively, and are reversely rotated by said actuators until the long teeth thereon contact the upper edge of the ears 645 on the corresponding latches 642. This zeroizes the plus wheels 178 and positions their corresponding actuators in accordance with the amount standing thereon to record the balance or the sub-balance, as the case may be, upon the statement sheet 212.

As explained before, in balance operations the plus wheels 178 are disengaged from the amount actuators 135 (Figs. 31 and 32) prior to return movement of said actuators, and consequently said wheels remain in a zeroized position. In sub-balance operations, the plus wheels 178 remain in engagement with the amount actuators

135 during their return movements and are consequently returned to their original positions.

Zero latch throwout mechanism

5 In balance and sub-balance recording operations, it is necessary to provide means to release the zero latches 120 (Figs. 1, 2, and 3) for the key stop slides 124 for the amount banks, so that said key stop slides and their corresponding differential mechanisms are free to move rearwardly to be positioned under influence of the wheels of the selected totalizer. This same thing, of course, is true in total and sub-total recording operations in the totalizers on the group totalizer line.

15 Depression of either the Sub-Balance or the Balance keys 75 (Figs. 1, 35, 38, 50, and 51) causes a left-hand extension of the stud 83 therein, in cooperation with a corresponding projection 667 or 668 on a bar 669 shiftably mounted by means of parallel slots therein, in cooperation with the studs 346, to shift said bar forwardly. Likewise, depression of either the Overdraft key 76 or the Sub-Overdraft key 76 causes the stud 129 therein, in cooperation with a corresponding projection 670 or 671 on the bar 669 to shift said bar forwardly. Forward movement of the bar 669 (Figs. 50 and 51) causes a forward extension thereof, in cooperation with an upward extension of a three-armed lever 672 free on the shaft 117, to rock said lever counter-clockwise against the action of a spring 673.

A forward extension 674 of the lever 672 extends within a cut-away portion of a sleeve 675 removably retained in axially aligned holes in the plates 81 and 82 by a clip 666 having a notch which engages an annular groove in said sleeve, said clip being secured to the plate 82 (Fig. 38). Assembled in the central bore of the sleeve 675 are a floating piston 676 and a plunger 677, said piston and plunger being retained against the action of a compressible spring 678, which is tensioned to urge said parts toward the right by a plug 679 secured in the central bore of said sleeve 675. Counter-clockwise movement of the lever 672 (Figs. 50 and 51) when one of the above-mentioned keys is depressed causes a wedge-shaped surface on the forward extension 674 to force its way between the floating piston 676 and the plug 679 to shift said piston and the plunger 677 toward the left against the action of the spring 678. Left-hand shifting movement of the plunger 677 causes a tenon 680 thereon, which extends through a reduced portion of the central bore in the sleeve 675, to be moved into the path of an upward extension 681 of a lever 682 free on a stud 683 in the lower end of a crank 684 secured on the right-hand end of a square shaft 685 journaled in the plates 160 and 80. A spring 686 (Fig. 50) urges the lever 682 counter-clockwise to normally maintain a curved portion of the forward edge of said lever in contact with a stud 687 in the crank 684. Forward movement of the group totalizer differential drive rack 298 (Figs. 14 and 50) according to the time given in space 2 of the chart (Fig. 52) causes a stud 688 secured in the forward end of said rack, in cooperation with a downward extension 689 of the lever 682, to rock said lever, the crank 684, and the shaft 685 clockwise from the position shown in full lines in Fig. 50 to the position shown in dot-and-dash lines.

70 Secured on the shaft 685 (Figs. 2, 3, and 51) is a zero latch release arm 690 for each amount bank, each arm having a bent-over ear 691, which overlies the zero latch 120 in the corresponding amount bank. Clockwise movement of the arm

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690 for the amount bank shown in Figs. 2 and 3 causes the bent-over ear 691 to rock the zero latch 120 clockwise to disengage the tooth on said latch from the ear 123 of the key stop slide 124 to release said slide for rearward movement in sub-balance, balance, overdraft, and sub-overdraft operations, so that said slide 124 and its corresponding differential mechanism may be positioned under influence of the long tooth on the selected wheel 178 or 180 of the balance totalizer.

Mechanism similar to that described above is provided for actuating the zero latch throwout mechanism by the Total and Sub-Total keys 74.

Depression of either the Sub-Total key 74 or the Total key 74 causes the corresponding stud 253 therein (Figs. 1, 35, 50, and 51), in cooperation with a corresponding camming projection 705 or 706 on a control bar 692, shiftably mounted by means of parallel slots therein, in cooperation with the studs 346, to shift said bar forwardly. Forward movement of the bar 692 causes a forward extension thereof, in cooperation with one arm of a three-armed lever 693 free on the shaft 117, to rock said lever counter-clockwise against the action of a spring 694. Counter-clockwise movement of the lever 693 (Figs. 35 and 51) causes a wedge-shaped surface on a forward extension 695 thereof, which extends within the opening in the sleeve 675, to wedge itself between the floating piston 676 and the right-hand end of the plunger 677 to shift said plunger toward the left against the action of the spring 678. Left-hand shifting movement of the plunger 677 (Figs. 50 and 51) moves the tenon 680 thereof into the path of the upward extension 681 of the lever 682 to render said lever effective in exactly the same manner as explained above, to rock the shaft 685 and the arms 690 clockwise, upon forward movement of the drive rack 298, to in turn rock the zero latches 120 (Fig. 2) for the amount banks to ineffective position to free the corresponding key stop slides 124 for positioning movement under control of the wheels of the selected totalizer.

By referring to Figs. 50 and 51, it will be noted that the stud 683, which forms a pivot for the lever 682, extends through an arcuate slot 696 in the plate 160 and, in cooperation with the rearward end of said slot, determines the home position of said lever, the crank 684, the shaft 685, and the arms 690.

Obviously only one of the levers 672 or 693 will be effective in one machine operation, as it is impossible to perform total or sub-total operations in more than one totalizer line at a time.

It may be well to repeat here that, in total and sub-total operations in the totalizers on the group totalizer line, under control of the Sub-Total and Total keys 74 (Fig. 1), the machine is released for operation by depression of the Non-Add key 75, as this key has no effect other than to initiate operation of the machine.

Interlock between amount and total control keys

An interlocking mechanism between the zero latch throwout mechanism and the key lock shaft 97 is provided for preventing release of the machine for operation when an attempt is made to initiate a sub-total operation or a total recording operation with one of the amount keys 72 depressed.

Using the amount banks shown in Figs. 2 and 3 as illustrative of all the amount banks, depression of any one of the amount keys 72 shifts the control plate 115 forwardly to rock the lever 116 counter-clockwise to move a shoulder on said

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lever beneath the ear 691 on the zero latch release arm 690. This locks the arm 690, the shaft 685, and the crank 684 (Figs. 3 and 50) against clockwise movement. The lever 682 (Figs. 50 and 51) has a rearward extension 697, which engages a stud 698 in one arm of a bell crank 699 free on a stud 700 in the plate 160. The bell crank 699 is connected by a link 701 to a crank 702 secured on the key lock shaft 97.

In operations other than sub-total, total, sub-overdraft, and overdraft operations, the lever 682 is free to move independently of the crank 684 and the shaft 685. Consequently, under these conditions, releasing movement counter-clockwise of the key lock shaft 97, through the link 701, rocks the bell crank 699 also counter-clockwise, and said bell crank in turn rocks the lever 682 clockwise independently of the crank 684 and the shaft 685.

When the shaft 625 is locked by the depression of an amount key 72, as explained above, and either the Sub-Total key or the Total key 74 (Figs. 38, 50, and 51) is also depressed, the tenon 680 is moved into the path of the upward extension 681 of the lever 682, and in this case it is impossible for said lever to move independently of the crank 684 and the shaft 685. Consequently, the extension 697, through the bell crank 699, the link 701, and the crank 702, obstructs releasing counter-clockwise movement of the key lock shaft 97, thereby preventing operation of the machine when an amount key is depressed and an attempt is made to depress either the Sub-Total key 74 or the Total key 74 simultaneously.

With an amount key depressed, as explained above, depression of any one of the Sub-Balance or Balance keys 75 or the Overdraft or Sub-Overdraft keys 76 shifts the tenon 680 of the plunger 677 into the path of the extension 681 (Figs. 38, 51, and 52) to lock the key lock shaft 97 against counter-clockwise releasing movement prior to the time that said keys, which, it will be recalled, are also machine releasing keys, release said key lock shaft, through the mechanism shown in Fig. 38 and explained earlier herein, to prevent operation of the machine when an amount key is depressed and an attempt is simultaneously made to depress any one of the keys 75 or 76, shown in Fig. 51, which cause the balance totalizer to be engaged and disengaged in either reading or resetting time.

When either of the levers 672 or 693 (Figs. 50 and 51) has been rocked counter-clockwise by depression of a corresponding total control key to displace the plunger 677, as explained above, the piston 676, in cooperation with the forward extension 674 or 695 of the other lever, obstructs counter-clockwise movement of said other lever, thus locking the corresponding total control keys against depression. This forms an interlock between the Sub-Total and Total keys and the Sub-Balance and Balance keys 75 and the Overdraft and Sub-Overdraft keys 76, to prevent the depression of more than one of these keys at one time.

MODE OF OPERATION

While it is believed that a thorough understanding of the operation of the machine embodying the present invention will have been obtained from a perusal of the preceding specification, still a brief statement of operation, using the fragment of a statement sheet 212, shown in Fig. 37, as a basis, may prove helpful and will now be given.

For convenience and purposes of illustration only, the keyboard arrangement and certain of the mechanisms of the machine embodying the present invention have been shown arranged for use by banking establishments in the balancing or posting of individual checking accounts. However, this is but one of the many uses to which the present machine may be applied, as the many features and the novel construction thereof make said machine easily adaptable to almost any type of present-day business system where accounting machines and/or cash registers are used.

In the handling of individual checking accounts, most banking establishments provide a statement sheet, such as that shown in Fig. 37, for each individual checking account, upon which the balancing or posting of said checking account takes place. It is the general practice to post or balance each individual checking account daily, if said account has been active, and this includes the listing of the check and deposit items, the recording of a new balance upon the main portion of the statement sheet, and the duplication of the balance upon the stub or small portion of said sheet. At the end of a certain predetermined period, such as a month, the main portion of the statement sheet, having the separate listings of the check and deposit items and the balances thereon, is separated from the stub portion and forwarded to the customer, and the stub portion is retained by the bank as a matter of record.

The statement sheets 212 corresponding to the active checking accounts are generally withdrawn from the files daily and placed in alphabetical order in a stack, conveniently located in relation to the machine and the operator, and, with the cancelled checks and the deposit slips in other convenient stacks, the operator begins the posting of the checking accounts.

In beginning a new statement sheet 212 for John Q. Public, the operator inserts the sheet all the way in the chute 211 (Figs. 2 and 37), ascertains the previous balance by observing the last balance recording on the previous statement sheet for John Q. Public, sets up the amount of this previous balance, \$1,500.00, on the amount keys 72 (Fig. 1), and initiates machine operation by depressing the Add key 75. During operation of the machine, the plus side of the balance totalizer is selected for addition and the amount of the previous balance, \$1,500.00, is entered therein and is simultaneously printed at the head of the Balance column on the main portion of the statement sheet 212. Next, in a sub-balance operation, initiated by depression of the Sub-Balance key 75 (Fig. 1), the plus side of the balance totalizer is sub-totalized or read, and the amount of the previous balance, \$1,500.00, is recorded at the head of the Balance column on the stub portion of the statement sheet.

In the posting of John Q. Public's checking account for May 1, 1944, there are two check items of \$100.00 and \$25.00, respectively. These amounts are set up, one at a time, on the amount keys 72, and the machine is released for operation by depression of the Check key 76. Operation of the machine causes the minus side of the balance totalizer to be selected for engagement with the amount actuators 135 and simultaneously causes the total check totalizer on the group totalizer line to be selected for engagement with the said actuators. During ma-

chine operations, the amounts of the checks, \$100.00 and \$25.00, are subtracted from the plus side of the balance totalizer and simultaneously added into the total check totalizer, which, as previously explained, stores a group total of the check items.

Next, the amount of the deposit item, \$100.00, is set up on the amount keys 72, and machine operation is initiated by depression of the Deposit key 75. During machine operation, the plus side of the balance totalizer is selected for engagement with the amount actuators, and the total deposit totalizer on the group totalizer line is simultaneously selected for engagement with the amount actuators in adding time to cause the amount of the deposit, \$100.00, to be added in the plus side of the balance totalizer and simultaneously added in the total deposit totalizer, where a group total of all deposits is accumulated.

As this completes the entries for May 1, the operator initiates a sub-balance operation by depressing the Sub-Balance key 75 (Fig. 1), during which operation the plus side of the balance totalizer is sub-totalized or read and the amount therein, \$1,457.00, is simultaneously printed in the Balance column of the main portion of the statement sheet 212, and the sub-balance symbol (s) is simultaneously recorded directly to the right of the sub-balance to identify the operation.

Next, the float analysis is set up on the amount keys 72, and operation is initiated by depression of the Non-Add key 75, during which the float analysis is recorded in the Float column of the stub portion of the statement sheet. In this operation, the machine is merely a printing machine, and numbers set up on the keys 72 are not entered in any of the totalizers.

Next, the operator initiates a balance operation by depressing the Balance key 75 (Fig. 1), and during this operation the plus side of the balance totalizer is totalized or cleared and the amount therein, \$1,475.00, is recorded in the Balance column of the stub portion of the statement sheet 212. Simultaneously with the recording of the balance, a balance symbol (*) is printed directly to the right of the amount of the balance to identify the operation.

It will be noted that, simultaneously with the recording of the sub-balance and the balance in the Balance column of the main and stub portions of the statement sheet 212 (Fig. 37), the date, May 1, 1944, is recorded in the Date columns immediately to the left of said Balance columns.

As John Q. Public's checking account was active between the posting on May 1 and May 2, his account again comes up for posting on May 2, 1944. As before, the operator ascertains the previous balance of \$1,475.00 from the last entry in the Balance column and sets this amount up on the amount keys 72 (Figs. 1 and 37) and enters it in the plus side of the balance totalizer by depressing the Add key 75. In this case, the previous balance of \$1,475.00 is not recorded again upon the statement slip 212 but is printed upon an exposed right-hand portion of a journal sheet (not shown), which underlies the statement sheet and upon which a duplicate of every entry made upon said statement sheet is recorded.

In four check-entering operations, the four check items of \$500.00, \$100.00, \$800.00, and \$200.00 are subtracted from the plus side of the

balance totalizer and simultaneously added into the total check totalizer on the group totalizer line and recorded in the Check column of the statement sheet. Next, the deposit item of \$25.00 is set up on the amount keyboard, and in a deposit operation, initiated by depression of the Deposit key 75, the amount of the deposit, \$25.00, is added in the plus side of the balance totalizer and simultaneously added in the total deposit totalizer on the group totalizer line.

The posting of May 2 results in an overdraft in the balance totalizer, and this is brought to the attention of the operator either by the locking of the Balance key 75 or by a visual indicating mechanism, or by both, and in this case the operator depresses the Sub-Overdraft key 76 to initiate a sub-overdraft operation, in which the minus side of the balance totalizer is sub-totalized or read, and the positive amount of the overdraft, \$100.00, is recorded, usually in a distinctive color, such as red, in the Balance column of the main portion of the statement sheet 212 and simultaneously a symbol (s) is recorded directly to the right of said overdraft to identify this item as a sub-overdraft. As before, an analysis of the float is entered in the Float column of the stub portion of the statement sheet, and finally, in an overdraft operation initiated by depression of the Overdraft key 76 (Figs. 1 and 37), the minus side of the balance totalizer is cleared or reset and the amount of the overdraft, \$100.00, is recorded, usually in red, in the Balance column of the stub portion of the statement sheet and simultaneously a symbol (OD) is recorded immediately to the right of said overdraft to identify it as such.

Simultaneously with the recording of the overdraft of \$100.00 in the Balance column of the stub portion of the statement slip, as explained above, the amount of the overdraft is subtracted from the total balance totalizer on the group totalizer line to insure that a correct total of the balances is stored in said total balance totalizer.

It will be noted that the lines on the statement sheet 212 are numbered at the extreme right of the stub portion to facilitate the alining of the proper line thereof with the printing mechanism when said statement sheet is inserted into the chute 211 (Figs. 2 and 37). It will also be noted that, as before, the date is recorded in the Date column, on both the main portion and the stub portion of the statement sheet 212, simultaneously with the recording of the sub-balance and the balance.

Generally, at the end of a day's posting, the total check, total deposit, and total balance totalizers are cleared by the use of the corresponding selecting keys 73 (Fig. 1) in conjunction with the Total key 74 and the Non-Add key 75, and the totals of the corresponding items are simultaneously recorded upon the exposed portion of the journal sheet immediately to the right of the statement sheet 212.

It is to be understood that the above explanation of use of the machine embodying the present invention is but one of the many ways in which this machine may be used, as its many features and unique construction well adapt said machine for use in connection with practically any business system where an accounting machine and/or a cash register is needed.

While the form of mechanism herein shown and described is admirably adapted to fulfill the objects primarily stated, it is to be understood

that it is not intended to confine the invention to the one form or embodiment disclosed herein, for it is susceptible of embodiment in various forms all coming within the scope of the claims which follow.

What is claimed is:

1. In a machine of the character described, having means to set up numerical items and means to record said items, the combination of a part connected to the recording means; a member differentially positionable by the setting up means; a constant displacement means to drive the member, said constant displacement means arranged to return said member to a neutral position each machine operation; a rack and a floating gear connecting the part and the member in such a manner as to permit said member to be returned to neutral position independently of said part; and means to move the floating gear to a certain position each machine operation to transmit the positioning of the member through said rack to the part and thence to the recording means to position the latter to record items as determined by said member and said rack.

2. In a machine of the character described, having means to set up items and means to record said items, the combination of a member differentially positionable by the setting up means; means to drive the member in an initial direction to position same, and to drive said member in a return direction to a neutral position; a part connected to the recording means; a device movable with said member and including a gear connecting the part to the member, the axis of said gear being freely movable in relation to said member and said part; and means to move the gear to a certain position during positioning movement of the member to transmit the positioning of said member, through said device, to the part and thence to the recording means to record the items under control of said member and rack, said moving means ineffective during return movement of said member so that the positioning of the part and the recording means will not be disturbed.

3. In a machine of the class described, having means to set up digital values and means to record said values, the combination of an actuator positionable by the setting up means and having an angular slot; a plate having an angular slot oppositely disposed in relation to the angular slot in the actuator; a member; a driver for the member; a latch on the member to connect said member to the driver; a pin in the latch coacting with the angular slots; yieldable means to urge the actuator and the plate in opposite directions to cause the angular slots in cooperation with the pin to normally retain the latch connected with the driver, the angular slot in the actuator acting to disconnect the latch when positioning movement of said actuator is interrupted by the setting up means; a part connected to the recording means; a rack and a gear connecting the part to the member, said gear having a movable axis; and means to move the gear to a certain position, while the actuator and the member and the rack are being positioned to transmit the positioning of said actuator and said member to the recording means to set the latter to record digital values under control of said member and rack.

4. In a machine of the class described, having means to set up digital values and means to

record said values, the combination of a reciprocable actuator positionable by the setting up means and having an inclined slot; a reciprocable plate having a slot inclined oppositely to the slot in the actuator; a reciprocable member; a reciprocable driver for the member, said driver effective to return said member to a neutral position near the end of each machine operation; a latch on the member to connect it to the driver; a pin in the latch coacting with the inclined slots; yieldable means urging the actuator and the plate in opposite directions to cause the inclined slots, in cooperation with the pin, to normally retain the latch connected to the driver, said inclined slot in the actuator acting to disconnect the latch from the driver when positioning movement of said actuator is terminated by the setting up means; a reciprocable part connected to the recording means; a rack, movable with such member, and a gear connecting the part to the member, said gear having a non-fixed axis; and means to move the gear an extent commensurate with the positioning of the member and the rack after the actuator and said member and said rack have been positioned, to transmit such positioning to the recording means, said moving means ineffective during return movement of the member, whereupon the gear is free to roll idly between said rack and the part so as not to disturb the positioning of said part and the recording means to control the latter to record digital values determined by the positioning of said member and rack.

5. In a machine of the class described, the combination of a horizontally shiftable actuator having an angular slot; a horizontally shiftable driver therefor; means to arrest the actuator in different positions; a latch normally engaged with the driver; a horizontally shiftable member carrying the latch; a horizontally shiftable element adjacent the actuator and having an angular slot inclined substantially at right angles to the slot in said actuator; a pin carried by the latch and coacting with the two angular slots to connect the actuator and the element to the member; and a spring urging the actuator and the element in opposite directions, causing the angular slots, in cooperation with the pin, to normally retain the latch in yielding engagement with the driver, said angular slot in said actuator coacting with said pin to disconnect said latch from said driver when said actuator is arrested during its positioning movement.

6. In a machine of the class described, the combination of a horizontally shiftable actuator having an inclined slot; means to arrest the actuator in different positions; a horizontally shiftable plate adjacent the actuator and having a slot inclined oppositely to the slot in the actuator; a horizontally shiftable member; a driver for the member; a latch on the member to connect it to the driver; a pin in the latch extending through and coacting with the two inclined slots to connect the actuators and the plate to the driver; and a spring urging the actuator and the plate in opposite directions, causing the inclined slots, in cooperation with the pin, to normally retain the latch connected to the driver, said inclined slot in said actuator coacting with the pin to disconnect the latch from the driver when positioning movement of said actuator is arrested.

7. A linear type of differential mechanism for an accounting machine, comprising a horizontally shiftable actuator; a driver for the actu-

ator; means to arrest the actuator in various positions corresponding to digital values; a horizontally shiftable plate adjacent the actuator; angular slots in the actuator and the plate, said slots inclined in opposition to each other; a horizontally shiftable member positioned by the actuator; a latch carried by the member; a pin carried by the latch and extending through and coacting with the angular slots, to connect the parts for unitary movement; and a spring tensioned to urge the actuator and the plate in opposite directions, causing the opposed slots, in cooperation with the pin, to normally retain the latch in yielding engagement with the driver until said actuator is positioned by the arresting means, whereupon the slot in said actuator, coacting with the pin, disengages the latch from the driver.

8. In a machine of the class described, having means to set up digital values and means to record said values, the combination of a part connected to the recording means; a member differentially positionable under influence of the setting up means; a shiftable rack mounted on the member and differentially positionable therewith; a gear having a non-fixed axis connecting the rack to the part; means effective while the member and the rack are being positioned under influence of the setting up means to move the rack relatively to said member to adjust said rack in proper relationship to said member and the part to control the setting of said recording means; and means to move the gear an extent commensurate with the combined movements of the member and the rack to transmit the positioning of said member and said rack to the part and the recording means to set the latter to a position determined by said member and rack.

9. In a machine of the class described, having means to record numerical values, the combination of a part connected to the recording means; a differentially positionable member; a rack shiftable mounted on the member and differentially positionable therewith; an idler gear connecting the rack to the part; means effective during positioning movement of the member and the rack to move the rack relatively to said member to adjust said rack and the gear in proper relationship to said member and the part; and means to move the gear an extent corresponding to the combined positioning movements of the member and the rack to cause said gear to transmit such combined movement to the part and the recording means to position the latter under control of said member and rack.

10. In a machine of the character described, having means to set up numerical values and means to record said values, the combination of a part connected to the recording means; a member differentially positionable under influence of the setting up means, said member returnable to a neutral position after having been positioned; a rack movably mounted on said member but differentially positionable therewith; an idler gear connecting said rack to the part; means, effective when the member is returned to neutral position, to move the rack relatively thereto to move said rack and the gear out of proper recording relationship with said member and the part; means effective during positioning of the member and said rack to move the rack relatively thereto to adjust said rack and the gear in proper recording relationship with said member and the part; and means to move the

gear to a certain position during positioning of the member and the rack to transmit said positioning of the member and rack to the part and thence to the recording means to position the latter under control of said member and rack, said moving means ineffective during return movement of the member and the rack to permit the gear to float idly between the rack and the part so as not to disturb the positioning of said part and the recording means.

11. In a machine of the character described, having means to set up numerical values and means to record said values, the combination of a part connected to the recording means; a member differentially positionable under influence of the setting up means, said member returnable to a neutral position after having been positioned; a rack mounted on the member for movement therewith; a gear connecting the rack to the part, said gear having a non-fixed axle; and means to move the axle and the gear to a certain position during positioning of the member to cause said gear to transmit the positioning of said member and the rack to the part and to the recording means to set the latter under control of said member and rack, said moving means ineffective during return movement of the member to permit the axle and the gear to float between said rack and said part so as not to disturb the positioning of said part and the recording means.

12. In an accounting machine having means to set up digital values and means to record said values, the combination of a part connected to the recording means; a member differentially positionable under the influence of the setting up means, said member returnable to a neutral position after having been positioned; a rack, movable with said member, and a gear connecting the member to the part, said gear having a floating axis; and means to move the axis of the gear to a certain position during positioning of the member and the rack to cause said gear to transmit the positioning of said member and said rack to the part and thence to the recording means to set the latter according to the digital value position of said member and rack, said moving means ineffective during return movement of said member and the rack to permit said gear to float idly between said rack and said part so as not to disturb the positioning of said part and the recording means.

13. In an accounting machine having a type carrier for each denominational order to print digital values, the combination of a part for each denominational order connected to the corresponding type carrier; a differentially positionable member for each denominational order, said members returnable to a neutral position after having been positioned; a rack shiftably mounted on each of the members; a gear connecting each rack to the corresponding part to transmit the positioning of the members to the parts and thence to the corresponding type carriers; means normally effective when the members are in neutral position to retain the racks in a non-printing position to eliminate the printing of zeros; means effective when one of the members is being differentially positioned to move the corresponding rack from non-printing position to printing position; and means to transmit the movement of said corresponding rack to the rack of the adjacent lower order to move said lower order rack and connected parts to printing position to effectuate the printing of zeros in the lower order.

14. In a machine of the character described,

having a type carrier for each denominational order, the combination of a member for each denominational order, said members having a neutral position but differentially movable to various positions; means, including a shiftable element on each member, to connect them to the corresponding type carriers to position said type carriers in accordance with the differential positions of the members; means operable when the members are in neutral position to retain the corresponding elements in a certain position in relation to said members to adjust the corresponding type carriers in non-printing position; means effective when a member is being differentially positioned to move the corresponding element from said certain position, to adjust the corresponding type carrier in printing position; and means to transmit the movement of said corresponding element to the element of the adjacent lower order to cause the corresponding type carrier to be moved into printing position.

15. In a machine of the class described, having a type carrier for each denominational order, the combination of a member for each denominational order, said members having a neutral position but differentially movable to various positions; means including a shiftable element on each member to connect the member to the corresponding type carriers to position said type carriers in accordance with the positioning of said members; means operable when the members are in neutral position to retain the corresponding elements in a certain position in relation to the corresponding members to adjust the corresponding type carriers in non-printing position; means effective when a member of a higher order is being differentially positioned to shift the corresponding element from said certain position to another position, to adjust the corresponding type carrier in proper printing relationship with said member; and means to transmit the positioning of said corresponding element of the higher order to the elements of the lower orders to adjust the corresponding type carriers for the lower order elements in proper printing relationship with the corresponding members.

16. In a machine of the class described, having a type carrier for each denominational order, the combination of a member for each denominational order, said members being differentially adjustable to positions corresponding to various digital values, but normally retained in a neutral position; an element shiftably mounted on each member; means to connect the elements to the corresponding type carriers to transmit the positioning of said members thereto; means effective when the members are in neutral position to retain the corresponding elements in a certain position in relation thereto to locate the corresponding type carriers out of proper printing relationship with said members; means effective when a member of a higher order is being positioned to shift the corresponding element from said certain position to another position to locate the corresponding type carrier in proper printing relationship with said member; and means to transmit the positioning of said corresponding element of the higher order to the elements of the lower orders to position the corresponding type carriers in proper printing relationship with their corresponding members, regardless of whether or not said members are differentially adjusted or are retained in neutral position.

17. In a machine of the character described, having means to record various digital values,

the combination of a member for each denominational order, said members adapted to be returned to a neutral position at the end of each machine operation; means to differentially position the members in accordance with digital values; an element shiftably mounted on each member; means to connect each element to the corresponding recording means to transmit positioning of the corresponding members to said recording means; means effective when the members are in neutral position to retain the corresponding elements in a certain position in relation thereto to move the corresponding recording means out of normal recording relationship with said members; means effective when a member of a higher order is differentially positioned to move the corresponding element from said certain position to another position to move the corresponding recording means into normal recording relationship with said member; and means to transmit the positioning of said corresponding element of the higher order to the elements of the lower orders to move the corresponding recording means into normal recording relationship with their corresponding members, when said members are not positioned under influence of the positioning means.

18. In a machine of the class described, having a type carrier for each denominational order, the combination of a member for each denominational order, said members returnable to a neutral position near the end of each machine operation; means to differentially position the members in accordance with various digital values; an element shiftably mounted on each member; means, including a minimum-movement device, to connect each element to the corresponding type carrier to transmit the positioning of the corresponding members thereto; means effective when the members are returned to neutral position to move the corresponding elements to a certain position in relation thereto to in turn move the corresponding type carriers out of normal printing relationship with the corresponding members; means effective when a member of a higher order is positioned by the positioning means to move the corresponding element in relation thereto from said certain position to another position to move the corresponding type carrier into normal printing relationship therewith; and means to transmit the movement of said corresponding element of the higher order to the elements of the lower orders to position the corresponding type carriers in normal printing relationship with the corresponding members, when said members are not positioned under influence of the positioning means.

19. In a machine of the class described, having means to record digital values, the combination of a member differentially positionable in accordance with digital values from zero to nine, but normally retained in a neutral position; a movable element on the member; means connecting the element to the recording means to transmit the positioning of the member thereto; means effective when the member is in neutral or zero position to move the element relatively thereto to in turn move the corresponding recording means out of normal recording relationship with said member to a non-recording position; and means effective when the member is positioned in other than zero or neutral position to again move the element relatively thereto to in turn move the recording means into normal recording relationship with the member, to transmit the

positioning of said member to said recording means.

20. In a machine of the class described, having means to record digital values, the combination of a differentially positionable member; means to differentially position the member in accordance with various digital values, said means effective to return said member to a neutral position near the end of each machine operation; an element movably mounted on the member; means to connect the element to the recording means, to transmit the positioning of the member thereto; means effective when the member is returned to neutral position to move the element relatively thereto to in turn move the recording means out of normal recording relationship with the member to a non-recording position; and means effective when the member is positioned by the positioning means to again move the element relatively thereto, to move the recording means into normal recording relationship with the member to transmit the positioning of said member to said recording means.

21. In a machine of the class described, having means to record various digital values, the combination of a member; means to differentially position the member in accordance with various digital values, said positioning means effective to return said member to a neutral position after having formerly moved said member in a positioning direction; an element; means, including a lever, to movably connect the element to the member; means to connect the element to the recording means to transmit positioning of the member thereto; means cooperating with the lever, when the member is returned to neutral position, to move the element relatively thereto to in turn move the recording means out of normal recording relationship with said member; and means cooperating with the lever during positioning of the member by the positioning means to again move the element relatively to said member to in turn move the recording means into normal recording relationship with said member.

22. In a machine of the class described, having means to record various digital values, the combination of a member to control the recording of said digital values; means to differentially position the member in accordance with various digital values; an element; means including a lever to movably connect the element to the member said lever retaining said element in a neutral non-recording position relative to said member; means to connect the element to the recording means to record the various digital values; and means cooperating with the lever during positioning of the member to move the element relatively to said member from said neutral non-recording position into recording relationship with said member to cause the member through said element to record the digital values.

23. In a machine of the character described, having a digit-recording means for each denominational order, the combination of a member for each denominational order, said members positionable in accordance with various digital values; a constant displacement device to drive each member; means to connect each member to its driving means; means normally effective to disconnect the connecting means to position the members in zero position; means superseding the above disconnecting means to disconnect the connecting means to position the members in accordance with digital values from 1 to 9; an

element shiftably mounted on each member; means connecting the elements to the corresponding recording means; means effective when the members are positioned at zero to move the corresponding elements relatively to the said members to in turn move the corresponding recording means to a non-recording position, to prevent the recording of zeros; means effective when a member of a higher order is positioned under influence of the second disconnecting means in accordance with a digital value from 1 to 9 to move the corresponding element relatively to said member to in turn move the corresponding recording means into normal recording relationship with the corresponding member; and means connecting the element of the higher order to the element of the adjacent lower order, whereby movement of said higher order element will in turn move the element of the next lower order from non-recording position to recording position, in case the connecting means for the corresponding member is disconnected at zero position, to record the zero.

24. In a machine of the class described, having a printing medium for each denominational order, the combination of a differentially positionable member for each denominational order; means to drive the members, said means effective to return the members to neutral position near the end of each machine operation; means to connect each member to the driving means; means corresponding to digital values from 1 to 9 to disconnect the connecting means to differentially position the corresponding members; means effective when the above disconnecting means is ineffective to disconnect the connecting means to position the corresponding members in zero position; an element for each member; means connecting the elements to the corresponding printing media to transmit the differential positioning of the corresponding members thereto; means including a lever to movably mount each element on its corresponding member; means cooperating with the levers to move the corresponding elements in one direction relatively to the members, when said members are returned to neutral position, to move the corresponding printing media out of normal printing relationship with said members to a non-printing position; means cooperating with the levers when the members are positioned under influence of the first disconnecting means to move the corresponding elements in another direction relatively to said members to move the corresponding printing media into normal printing relationship with said members; and means to transmit the movement of the lever of a higher order to the levers of the lower orders, when the corresponding members are positioned at zero under influence of the second disconnecting means, to cause the corresponding elements to move the corresponding printing media from non-printing position into normal printing relationship with the corresponding members to cause zeros to be printed.

25. In a machine of the class described, having a printing medium for each denominational order, the combination of a differentially positionable member for each denominational order; means to control the positioning of the members in accordance with digital values 1 to 9; means effective when the above positioning control means is ineffective to cause the members to be positioned at zero; an element for each member; means including a lever to movably mount the

elements on the corresponding members; means to connect the elements to the corresponding printing media to transmit the differential positioning of the corresponding members thereto; means to connect each higher order lever to its lower order neighbor, said connecting means effective when the corresponding members are located in zero positions; means cooperating with the lever of the highest order, when the corresponding member is positioned at zero, to retain said lever and the corresponding element in a certain position in relation to said member to in turn cause the recording medium for said highest order to be retained out of normal printing relationship with the corresponding member, to eliminate the printing of a zero; and means effective when the member for the highest order is located in positions other than zero, and cooperating with the corresponding lever to move the corresponding element relatively to said member to in turn move the corresponding printing medium into normal printing relationship with said member, said lever through said lever connecting means moving the levers and the elements for the lower orders in unison therewith to in turn move the corresponding printing media for said lower orders into normal printing relationship with the corresponding members to record the zeros.

26. In a machine of the class described, having a printing medium for each denominational order, the combination of a differentially positionable member for each denominational order; means to control the positioning of the members in accordance with digital values from 1 to 9; means effective when the above positioning control means is ineffective to cause the members to be set in zero position; an element for each member; means including a lever to movably mount the elements on the corresponding members; means to connect the elements to the corresponding printing media to transmit the differential positioning of the corresponding members thereto; means connecting the levers of the various denominational orders for unitary movement, when the corresponding members are positioned at zero; means effective when the highest order member is positioned at zero to retain the corresponding lever and element in a certain position to in turn retain the corresponding printing medium out of normal printing relationship with the member, said retaining action being transmitted through the connecting means for the levers to the lower order elements, to eliminate the printing of zeros in all lower orders in which the corresponding members are located in zero position; and means effective when the member for the highest order denomination is located in positions other than zero, to move the corresponding lever and element relatively thereto to another position, to in turn move the corresponding printing medium into normal printing relationship with said member, said movement being transmitted through the connecting means for the levers to the lower order elements to effectuate the printing of zeros in all lower orders in which the corresponding members are positioned at zero.

27. In a machine of the class described, having means to record digital values, the combination of a differentially positionable member; selective means to control the positioning of the member in accordance with digital values 1 to 9; means effective when the above selective means is ineffective to cause the member to be positioned

at zero; an element; means including a lever to movably mount the element on the member; means to connect the element to the recording means; means cooperating with the lever and effective when the member is positioned at zero, to position the element relatively to said member to in turn position the recording means out of normal recording relationship with said member to prevent the recording of zeros; and means cooperating with the lever and effective when the member is positioned in accordance with digital values 1 to 9, to again position the element relatively to said member to in turn position the recording means in normal recording relationship with said member to cause the digital values 1 to 9 to be recorded.

28. In a machine of the class described, having means to record various numerical items, the combination of constant driving means; a first rack member connected to the recording means; a second rack member; a slotted member supporting the second rack member; latching means for said slotted member intermediate the constant driving means and the slotted member; key controlled means to disengage the latch to permit the differential positioning of the slotted member; means responsive to the positioning of the slotted member to reengage the latch with the driving means upon return of the latter to normal position; a gear meshing with said first and second racks, said gear having a movable axis, and carried by a slidable member; and rockable linkage means connecting the constant driving means and the slidable member to move the gear and its axis to a certain position each machine operation, to transmit the positioning of the slotted member through said second rack to the first rack and thence to the recording means to position the latter to record the items as determined by said slotted member and said second rack.

29. In a machine of the class described, having means to record numerical values, the combination of a differentially positionable member; driving means having a constant forward and backward movement; latch means to connect the member to the drive means during the forward movement; key controlled means to disconnect the latch means from the driving means to cause said member to be set in any of its different positions; means responsive to the differential positioning of said member to again effect the latching engagement between the driving means and the latch during the backward movement of the driving means; a first rack connected to the recording means; means including a second rack operatively connected to the member and movable therewith, and also including a gear meshing with said second rack and said first rack, and carried by a slidable member; and a rockable linkage connecting the drive means to the slidable member to move said gear to a fixed position each machine operation, to transmit the positioning of said differentially positionable member, by means of said second rack to said first rack and thence to the recording means to set the latter under control of said differentially positionable member and said second rack.

30. In a machine of the class described, having means to record numerical values, the combination of driving means having a forward and backward movement; a rack member connected to the recording means; a shiftable member; latching means connecting the shiftable member to the driving means; key controlled means to discon-

nect the latch means from the driving means to differentially position the shiftable member in accordance with various numerical values; a second rack, carried by said shiftable member; a gear meshing with said second rack and with said first rack and having a movable axis to permit said shiftable member to be differentially positioned independently of said first rack, said gear carried by a slidable member; rockable linkage means connecting the driving means and the slidable member to move the gear to a certain position each machine operation, to transmit the positioning of said shiftable member by means of said second rack to the first rack and thence to the recording means to position the latter to record the values under control of said shiftable member and said second rack; and means responsive to the differential positioning of the shiftable member to cause the latch to again engage the driving means upon backward movement of the latter.

31. In a machine of the class described, having means to set up various numerical items, and means to record said items, the combination of a driver having a forward and backward movement; a rack member connected to the recording means; a member differentially positionable by the setting up means; latching means connecting the driver to the differentially positionable member; key controlled means to disconnect the latching means to control the differentially positionable member; a second rack, positionable by said member; a gear having a movable axis and meshing with said second rack and said first rack, said movable axis permitting said member and said second rack to be moved independently of said first rack, said gear carried by a slidable member; and rockable linkage means connecting the driver and the slidable member to move said gear and its axis to a certain position each machine operation, to transmit the positioning of said differentially positionable member and said second rack to said first rack and thence to the recording means to determine the item recording position of said recording means under control of said differentially positionable member and said second rack; and means responsive to the differential positioning of the differential member to cause the latch to again engage the driver upon backward movement of the latter.

RAYMOND A. CHRISTIAN.

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Certificate of Correction

April 11, 1950

Patent No. 2,503,865

RAYMOND A. CHRISTIAN

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

Column 13, line 23, after the word "amount" strike out "of"; column 20, line 33, for "remains" read *remain*; column 29, line 24, for "side" read *slide*; line 30, for "necessiy" read *necessity*; column 40, line 19, for "unstripped" read *untripped*; column 48, line 70, after "stud" insert *586*; column 51, line 42, for "Fig." read *Figs.*; column 53, line 50, after "of" and before "Check" insert *the*; column 64, line 26, for "\$1,457.00" read *\$1,475.00*; column 65, line 23, for "symbol (s)" read *symbol (s)*;

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 18th day of July, A. D. 1950.

[SEAL]

JOE E. DANIELS,
Assistant Commissioner of Patents.