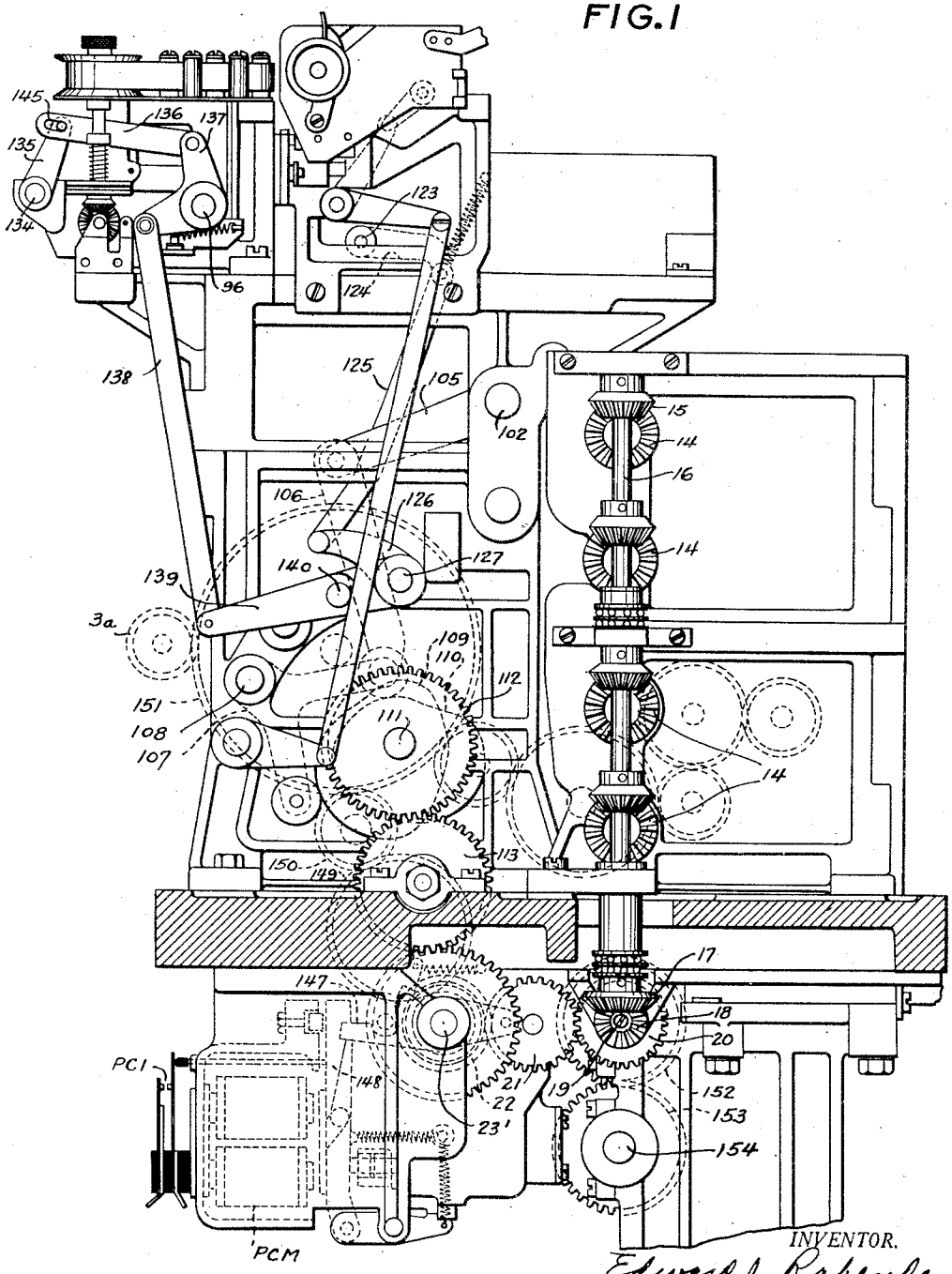
April 13, 1937. E. J. RABENDA 2,076,743

ACCUMULATING AND PRINTING DEVICE

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FIG. 1



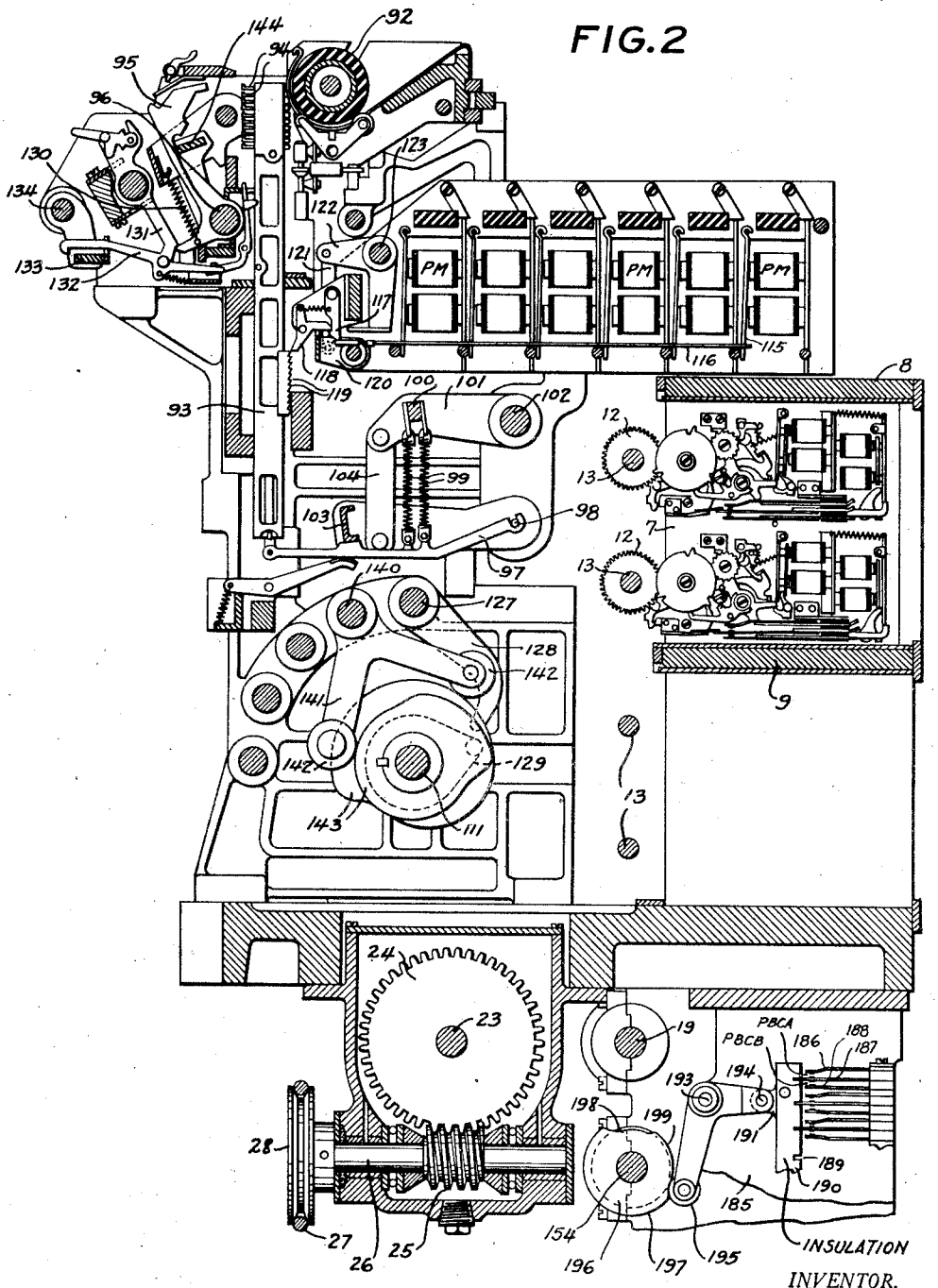
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ACCUMULATING AND PRINTING DEVICE

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FIG. 2



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ACCUMULATING AND PRINTING DEVICE

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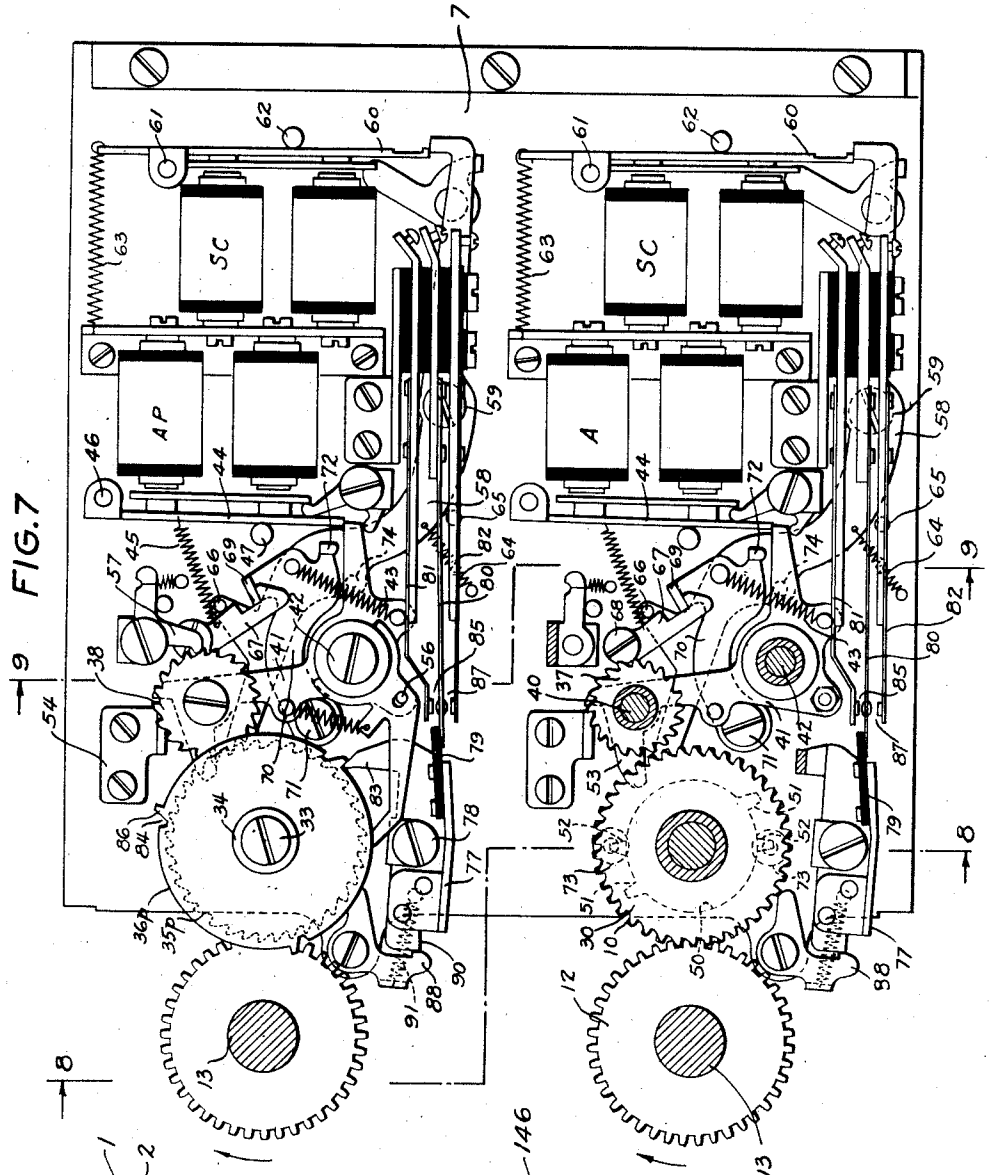


FIG. 7

FIG. 3

1	2
R	R
R	R
R	R
R	R
O	X
X	X
X	X
X	X
X	X
O	X
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
1	1
1	1
1	1
O	1
1	1
1	1
1	1
1	1
2	2
2	2
2	2
2	2
2	2
2	2
2	2
2	2
3	3
3	3
3	3
3	O
3	3
3	3
3	3
3	3
4	4
4	4
4	4
4	4
4	4
4	4
4	4
4	4
5	5
5	5
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5	5
O	5
5	5
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8	8
8	8
8	8
8	8
8	8
8	8
9	9
9	9
9	9
9	9
9	9
9	9
9	9
9	9

FIG. 4

146

2 3–
6 10
15 00
3 11
1 8–

1 1 1 0 *

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FIG. 8

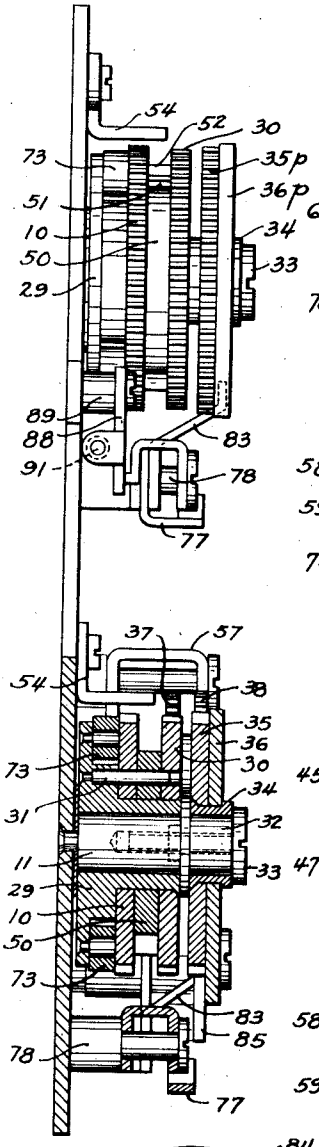


FIG. 9

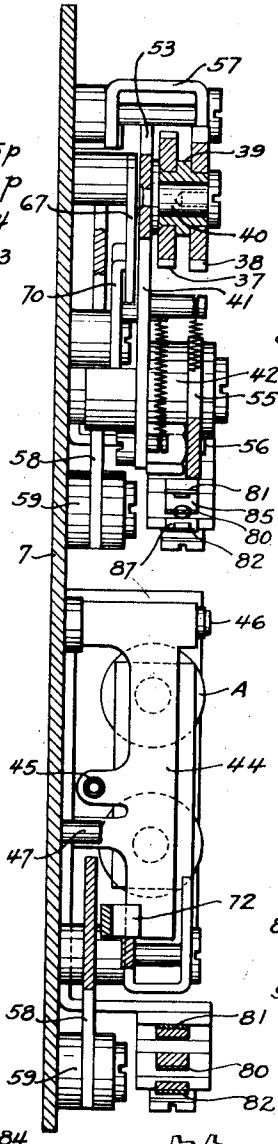


FIG. 10

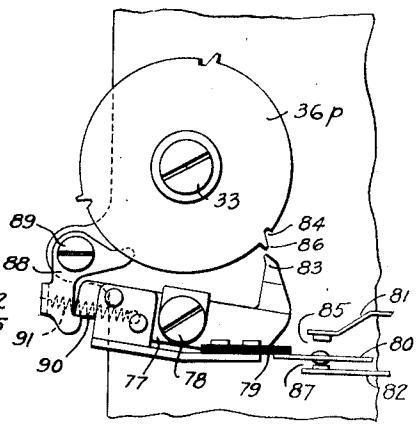


FIG. 11

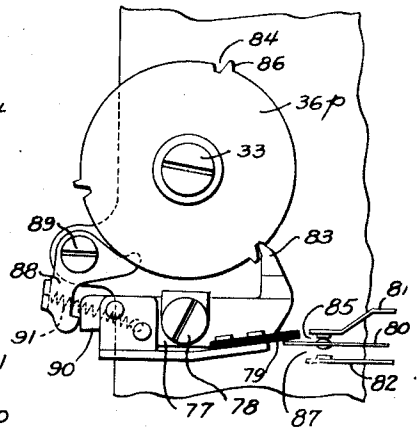


FIG. 5

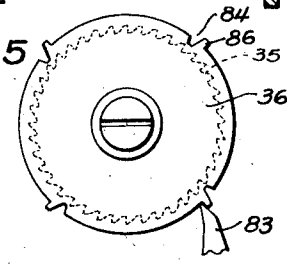
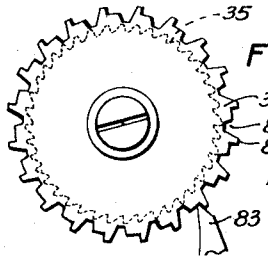


FIG. 6



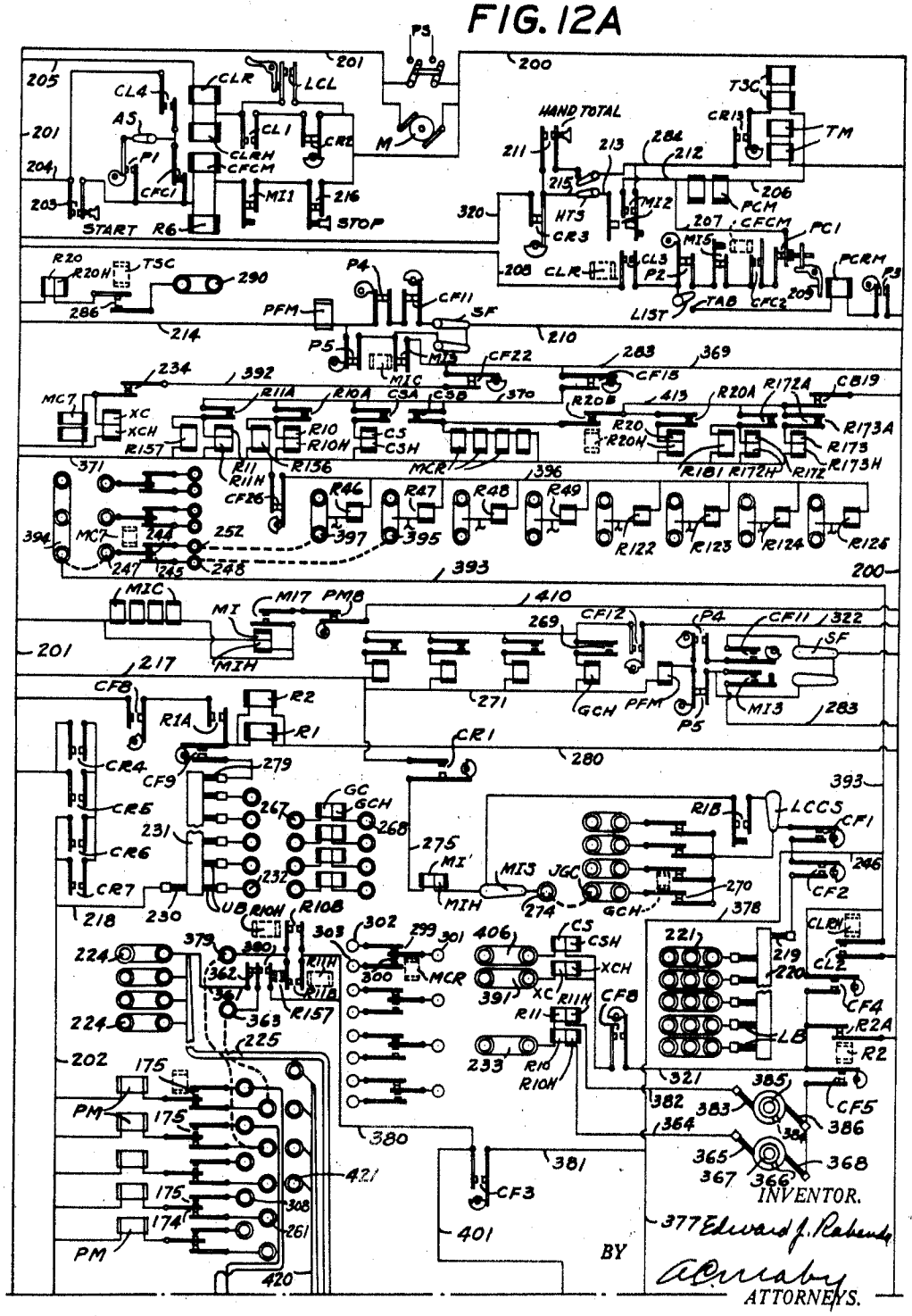
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April 13, 1937. E. J. RABENDA 2,076,743

ACCUMULATING AND PRINTING DEVICE

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FIG. 12A

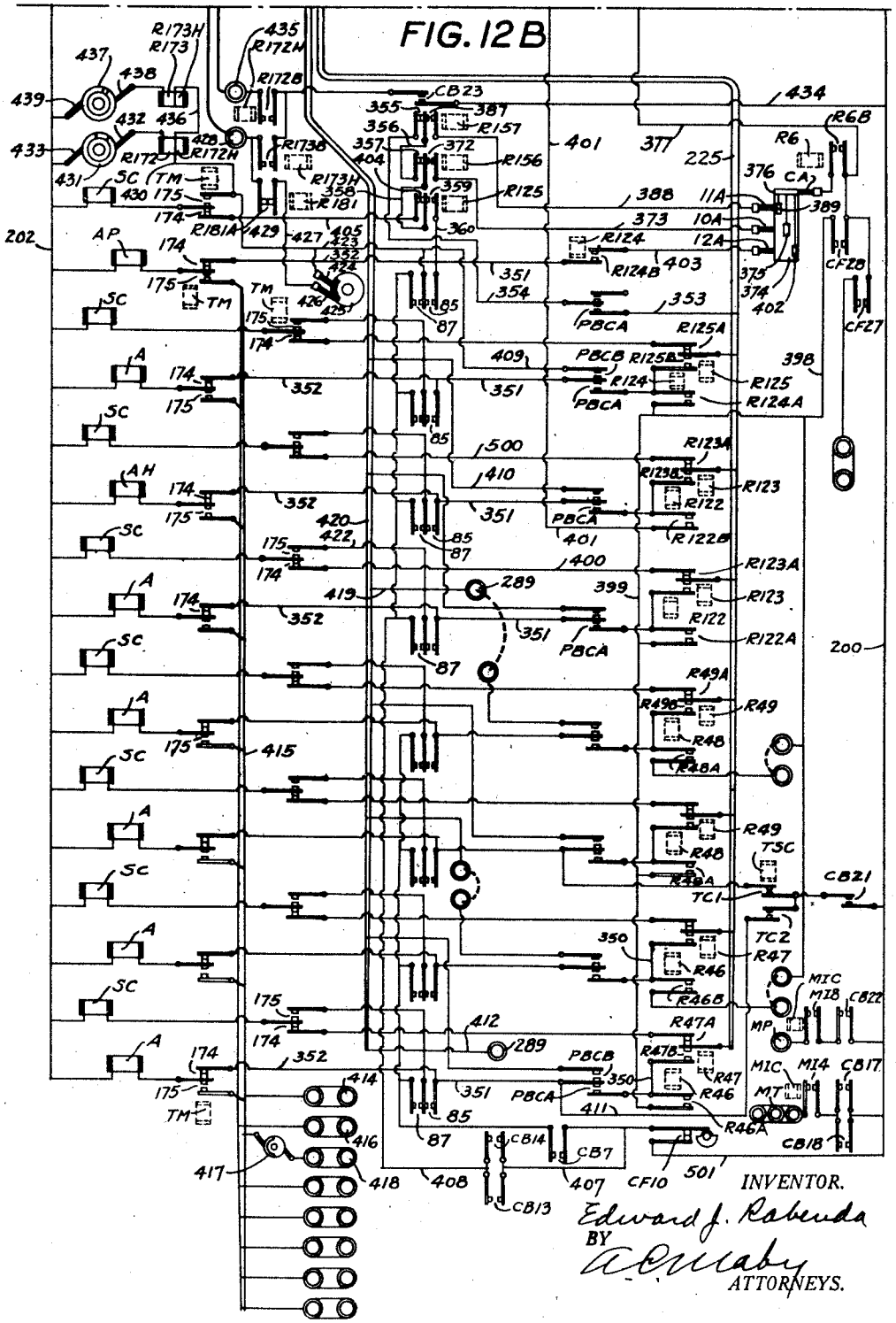


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ACCUMULATING AND PRINTING DEVICE

Filed May 16, 1934 6 Sheets-Sheet 6

FIG. 12B



Patented Apr. 13, 1937 2,076,743

UNITED STATES PATENT OFFICE

2,076,743

ACCUMULATING AND PRINTING DEVICE

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Application May 16, 1934, Serial No. 725,837

9 Claims. (Cl. 235—61.9)

The present invention relates to improvements in fraction accumulating, subtracting and total printing devices and more particularly is concerned with perforated record card controlled apparatus which is adapted to receive entries of debit and credit amounts in English currency and furnish a true net balance as a result.

An object of the invention is to provide an improved means for accumulating and total printing debit and credit amounts in the duo-decimal system, such as pence, twelfths, inches, dozens, etc. The apparatus also contains means for handling fractions such as halves used in the English currency system in changing from shillings to pounds.

Another object of the invention is to provide an improved and simplified subtracting device for handling English currency.

A feature of the invention is the improved means for using a standard Hollerith card for controlling the accumulation of positive or negative fractions and English currency amounts.

Another object of the invention is to provide means for controlling the accumulation of a multi-denominational ordered number by means of a special perforation on a record card.

Another object of the invention is to provide means for sensing the value of a number during one cycle of operation and only entering the number into an accumulator on the following cycle of operation of the machine.

An object of the invention is to provide means for sensing a special perforation representing a multi-denominational ordered number on one cycle of the machine and then causing printing of such a number on the following cycle of the machine.

Another object of the invention is to provide devices for controlling a plurality of type bars by a single accumulator order. The machine disclosed contains devices for reading a value such as ten or eleven registered on a single accumulator wheel and thereby controlling two separate type bars for the printing of 10 or 11.

An object of the invention is the provision of devices for entering and printing complements of a multi-denominational number represented by a single perforation on a record.

Another object of the invention is the provision of printing control devices adapted for universal use in the decimal system, for fractional representation and English currency tabulation.

A feature of the invention is the selective control of two typebars by a single column of perforation positions on a card or a single position on an accumulator wheel. The printing of a single decimal digit by one bar or the printing of duodecimal figures by two bars represents either an entered item or a total.

The accumulating and total taking devices disclosed herein are an improvement on the devices set forth in the application of Albert W. Mills, Serial No. 634,454, filed September 23, 1932.

Further objects, uses, and advantages of the present invention are pointed out hereinafter in the specification and claims and shown in the drawings which illustrate what is considered to be the preferred embodiment of the invention.

In the drawings:

Fig. 1 is a side elevation view of the machine showing the driving and operating connections.

Fig. 2 is a vertical section taken through the center of the machine. The printer, accumulator, control cams, and other devices in the machine are illustrated in this view.

Fig. 3 is a detail view of a portion of a perforated record card used to control the machine.

Fig. 4 is a portion of a record strip showing the recording of a few amounts and a total.

Fig. 5 is a detail view of an ordinary transfer cam associated with the usual decimal wheel which is active when passing from 9 to 0.

Fig. 6 shows a detail view of a transfer cam associated with a "halves" wheel. In an English currency accumulator this wheel is in the third order representing tens of shillings or half pounds.

Fig. 7 is a side elevation of an accumulator assembly showing two accumulating orders. The upper order shown is a units order adapted to accumulate pence. Some of the parts in the lower order are sectioned and other parts are removed to reveal the totalizing mechanism.

Fig. 8 is a composite front and sectional elevation view of the accumulators taken along the line 8—8 of Fig. 7.

Fig. 9 is a sectional elevation view of the accumulators taken along the line 9—9 in Fig. 7.

Fig. 10 is a detail view of the transfer control contacts as positioned when a related pence accumulator wheel is located in the zero position after having passed from the 11 to zero.

Fig. 11 is a detail view of the transfer control contacts as positioned when the associated accumulator wheel is located in the 11 position.

Figs. 12A and 12B, when taken together, form a wiring diagram of the machine.

Referring to the portion of the card I disclosed in Fig. 3, a plurality of columns of index point positions ranging from R to 9 are shown. An amount

which is to be added or subtracted in a machine is entered by perforations in the successive columns. The card shown is perforated to represent two amounts in English money. The one amount is 6 pounds and 10 pence; the other amount is 13 shillings and 11 pence. The index points designated X are used to signify ten pence in a units order and the index points marked R are used to position a perforation for the representation of 11. The X index point positions in certain orders have another controlling value when perforated. Thus, on the card shown the perforation "2" shows that the amounts on the record are credit items. The amounts are punched in the same manner to indicate either a credit item or a debit item. If the card contains a credit item, the control perforation "2" is punched in the upper portion of the card and used to control the machine to effect reverse operation of adding and subtracting in the accumulators of the machine. In the absence of such a perforation, the machine will effect addition of a true number in a debit accumulator and add the complement of the true number in the credit accumulator.

In Fig. 3, the perforation "2" is shown in the twelfth column of index points on the card. The perforation may be placed in any of the columns and the machine may be plugged accordingly.

The cards are fed through the machine by feed rollers and analyzed successively by upper sensing brushes UB and lower sensing brushes LB in the usual way. The card is fed past the brushes with the 9 index point position passing under the brushes first, followed by the 8 position, and then the 7, and so on in a manner which is well known in the art.

The upper brushes are used for control sensing while the lower brushes effect the adding and subtracting of the amounts represented on the card. When an item on the card is to be added in one of the accumulators and a perforation appears in the first column in the 6 index position (as in Fig. 3) then when the perforation passes under the lower brush the related accumulator wheel is clutched to the driving means to commence adding one unit as each of the succeeding points on the card passes under the brush. At the time the zero position passes under the brush, the machine automatically declutches the accumulator wheel so that it stops turning. It will thus have turned six steps to accumulate the value 6. In the fourth column on the card, the related upper brush will contact with the perforation in the X position to clutch the related accumulator wheel to commence adding one step before the nine position on the following cycle of the reading in the card. Then, when the zero position is reached and the wheel is declutched, the value 10 will have been added.

During the entry of a credit item, the described adding operation takes place in the credit accumulator. The machine may be arranged so that as this is occurring, a debit accumulator may be controlled so as to enter the complement of the number added in the credit accumulator. In order that an accumulator may receive the complemental amount, its accumulator wheels are clutched early in the cycle so as to commence adding in all orders except the units order when the 9 index point position on the card passes under the lower brushes. The units order or pence wheel is clutched three steps before the other wheels. When a perforation is sensed by the lower brush in any particular column, the accumulator wheel in the credit accumulator is declutched. Another form of mechanism is provided to take care of the entry of complements in the pence orders. This mechanism is operated to enter the value 1 or 2 according to whether 11 to 10 pence perforations are presented in the pence order columns of index points.

In the order representing tens of shillings or half pounds the clutching of the accumulator wheel takes place in the index point 1 and is adapted to cause the entry of either one or zero according to whether the index points zero or one are punched in the card. In this way the complement of any possible number of shillings ranging up to 19 may be entered in the tens and hundreds wheel representing units and tens of shillings.

When a perforation is sensed by the lower brushes in any of the columns other than the pence or shillings columns, the related accumulator wheel in the debit accumulator is declutched. Thus, with the card of Fig. 3, the debit accumulator wheel associated with the first column will commence adding as the nine position passes the related lower brush and then as the 6 position passes the brush the perforation in this position will be sensed and the energization of an electromagnet will cause the accumulator wheel to be disengaged after entering the amount "3" which is the complement of the figure 6 represented on the card. Since no perforations appear in the next two columns on the card, the complement 19 will be entered into these two accumulator wheels. The fourth column is perforated to represent the value 10 and therefore the amount 2 is entered into this order since the values 2 and 10 are complementary in the duodecimal system.

Accumulator driving mechanism

In Figs. 2 and 7 is shown the manner of mounting two accumulator orders on a plate 7. This plate may be held in the machine by sliding it between supporting frame members 8 and 9 (Fig. 2). A number of these units may be mounted in the machine side by side. Other of such units may be mounted in the space provided below the frame member 9.

As shown in Fig. 7, each accumulator has a gear 10 rotatably mounted on a stud 11 fixed in the plate 7. This gear is in constant mesh with a gear 12 mounted on a shaft 13 upon which there is also mounted a bevel gear 14 (Fig. 1) meshing with a bevel gear 15 on a vertical shaft 16. The shaft is provided with four bevel gears, one for each drive shaft 13. On the lower end of the shaft is mounted a bevel pinion 17 meshing with a bevel pinion 18 on a shaft 19 which has a gear 20 meshing with an idler gear 21 which in turn meshes with a gear 22 on shaft 23 (Fig. 2) in axial alignment with a shaft 23' (Fig. 1). The shaft 23 is provided with a worm wheel 24 (Fig. 2) meshing with a worm 25 on a shaft 26 which is driven by a belt 27 on grooved pulley 28 fixed to the shaft 26. The belt 27 is driven by an electric motor or some other source of power. The motor is constantly running while the machine is in operation, so that shaft 16 is turning constantly. Through the described driving connections, the gear 10 in each accumulator order is adapted to rotate constantly.

At the extremities of the shaft 23 (Fig. 2) are magnetically controlled clutch devices adapted upon actuation to form a driving connection at

one end to a card feeding device and at the other end to a shaft 23' for driving a printing mechanism.

The shaft 23 carries, adjacent to gear 22 (Fig. 1) a notched disk adapted to be engaged by a dog 147 pivotally mounted upon an arm integral with a gear 114. An armature latch 148 normally holds dog 147 out of engagement with the driving disk. When the printing clutch magnet PCM is energized, it draws latch 148 to the left, releasing dog 147 so that the printing mechanism drive gear 114 is clutched to the driving shaft. Upon deenergization of magnet PCM, armature 148 is moved by a spring into the path of a projecting toe on dog 147 to throw the dog out of engagement with the clutch disk. The arm on gear 114 is also engaged by armature 148 to prevent further movement of the gear.

Shaft 23 carries at its other end another clutch disk with which cooperates a dog operated under control of a card feed clutch magnet. The engagement of these clutch elements is controlled in a manner similar to that described above with reference to magnet PCM. However, the card feed clutch is engaged before the print clutch to allow more time early in a subtraction operation. The card feed driving connections are shown in Fig. 1 and include a gear meshing with a train of gears 149, 150, 151 driving the card feed gears 3a. Other idler gears drive through gear 152 to gear 153 mounted on the shaft 154. This shaft is thereby adapted to be rotated in a counterclockwise direction for each operation of the card feeding mechanism thereby operating all the CF cam contacts mentioned hereinafter.

The credit and debit accumulators

The gear 10 in each accumulator order is mounted on a bushing 29 (Fig. 8) and keyed to another gear 30 by means of a dowel pin 31 fastened to the bushing. The unit comprising the gears and the bushing is free to rotate constantly on the stud 11. The stud is extended by attaching a shouldered sleeve 32 thereon by a screw 33. Between the head of the screw and the shoulder on the sleeve is located a hub 34 carrying an accumulator gear wheel 35p and a transfer cam disk 36p. Thus, the two separate gear units may rotate independently on the stud 11. The unit containing driving gear 30 is rotated one-half revolution for each cycle of operation of the machine. The units order or pence accumulator gear 35p shown in Fig. 7 is provided with thirty-six teeth, therefore one third of a revolution of this gear represents a complete adding operation of twelve steps.

The two gears 30 and 35p are adapted to be clutched together so that the accumulator gear 35p may be driven a differential distance by the drive gear 30. The clutching device includes two pinions 37 and 38 (Figs. 7 and 9) which are held together by a bushing 39 on a stud 40 mounted on a clutching lever 41 pivoted at 42 (Fig. 7). The pinion 37 is adapted to engage with the gear 30 but the teeth thereon are normally out of engagement with the gear teeth. The other pinion 38 maintains engagement with the teeth on accumulator gear 35p. A spring 43 attached to lever 41 urges the lever counterclockwise to clutch pinion 37 with gear 30 for driving, but the lever is prevented from moving by the contact of the end of a horizontal arm thereon with the end of an armature 44 pivoted at 46 and associated with the accumulator magnet AP or A, the armature being held in such a position against a stop stud 47 by a spring 45. When the magnet is energized, attracting the armature, the lever 41 is released and then the spring 43 rocks the pinion 37 into mesh with the gear 30.

In Fig. 5 there is shown the ordinary form of gear 35 and cam disk 36 associated with all of the regular decimal orders; i. e., all the orders except the units or pence order and the third or half pounds order. The gear 35 is provided with forty teeth, so that one-quarter revolution of this gear represents a complete adding cycle of ten steps. The disk 36 is provided with four projections (one for each ten steps) as distinguished from the three projections (one for each twelve steps) on the disk 36p.

Fig. 6 shows the gear 35 and cam disk 36h associated with the half pounds or tens of shillings order of the accumulator. One-twentieth of a revolution or two steps of movement of gear 35 represents a complete adding cycle in this order. The disk 36h is formed with twenty projections, one for each pair of teeth on gear 35.

Aside from the differences shown in Figs. 5 and 6, the accumulating mechanism in all orders is the same as that in the pence order shown in Figs. 7–11, and the mode of operation in accumulating and transferring is the same. The energization of an accumulator magnet A or AP during adding or debit item entering operation is effected at a differential instant under control of an amount perforation in one of the data columns of the record card 1 (Fig. 3). The pinion 37 is then thrown into mesh with the gear 30 while the latter is rotating. Through the connections between pinions 37 and 38 and gear 35, the accumulator gear is caused to rotate until the zero position on the card reaches the reading brushes at which time the pinion 37 is thrown out of mesh by a cam 50 (Figs. 7 and 8) which cooperates with the clutching lever 41. This cam is fixed with respect to gears 10 and 30 and thus is constantly rotating with them. As shown in Fig. 7, two cam projections 51 and two projections 52 are provided on the cam 50 because the cam is timed to turn a half revolution for each accumulating cycle. After the pinion 37 is thrown into mesh with gear 30 and commences to rotate gear 35, as soon as the cam projection 51 reaches an arm 53 extending from lever 41, the cam rocks the lever clockwise about the pivot 42 to move the pinion 37 out of mesh with gear 30 so that the accumulating gear 35 is declutched from the driving means and ceases to rotate. The lever 41 is latched in the declutched position by the armature 44.

When the clutching lever 41 is moved counterclockwise to clutching position, an extension on the top of the lever engages a shoulder on a plate 54 which is properly located to stop the lever. An impositive latch or pawl 55 is pivoted at 42 and connected to lever 41 by a pin and slot connection 56. When the lever holds the clutching pinions out of engagement, pawl 55 engages the teeth on gear 35. The pawl also prevents overthrow of the gear as it is declutched. The pinion 38 is provided with an impositive latch 57 pivoted on plate 7.

The foregoing description deals mainly with the addition of an amount in an accumulator. If it is desired to subtract an amount from an accumulator, the complement of the amount is added to the accumulator. This may be done at the same time that the true amount is being added in another accumulator.

In adding the complement, the ordinary ac-

cumulator magnets A are energized automatically at the nine index position to mesh pinions **37** with gears **30** and start the wheels rotating. Each wheel continues to rotate until a perforation is sensed or the zero position is reached, then the gears in the accumulator receiving the complement are declutched. The hundreds order differs by automatically energizing the related accumulator magnet AH at the one index position so that the complement representing 10 shillings or a half pound may be added. The pence order magnet AP may be energized in one of three ways to enter a complement of pence. Ordinarily it is energized at the twelve index position to start adding the complement of 0–9 pence. However should the position X or R, Fig. 3, be perforated representing 10 or eleven pence, then the magnet AP is automatically energized at the two or one index point, respectively, to add the complements 2 or 1 in a manner more fully explained hereinafter.

A subtraction and cancellation control magnet SC (Fig. 7) is energized at the time when the wheel adding the complement is to be declutched. The time of energization is controlled by the differential position of the perforation in a related column of index points on the record card **1**. A magnet SC is provided for each accumulator order and is associated with devices for operating clutching lever **41** to declutch gear **35***p*. A long lever **58** is pivoted at **59** on plate **7** and has one end cooperating with the bottom of an armature **60** associated with magnet SC. The armature is pivoted at **61** and held normally against a stop stud **62** by a spring **63**.

When the magnet is energized, releasing the end of the lever **58**, a spring **64** urges the lever in a counterclockwise direction against stop **65**, and a pin **66** on the lever is pushed against a latch **67** pivoted at **68**. The latch **67** normally engages a shoulder **69** on an arm **70** pivoted at **71**.

Another shoulder **72** on the arm **70** is held near the horizontal arm on lever **41** by means of the spring **43** attached to a stud on the arm. The sudden release of the arm **70** after the pin **66** pushes the latch **67** away from shoulder **69**, causes the two parts **70** and **41** to rock clockwise under the urging of the spring **43** connecting the two, thereby swinging the lever **41** in a clockwise direction to declutch the gears. The lever **41** is latched in normal position by the armature **44**.

At the end of each machine cycle the lever **58** is restored by one of a pair of rollers **73** mounted on a flange of the bushing **29** (Fig. 8). The roller strikes the lower side of the left end of the lever (Fig. 7) rocking it clockwise and latching the right end under armature **60**. While restoring, a pin **74** on lever **58** strikes the lower edge of arm **70** and restores the arm, placing shoulder **69** above the latching face on latch **67** and tensioning spring **43** to urge lever **41** in the proper direction for clutching the gears. The parts **67** and **70** provide means for controlling the declutching time so that a uniform disengagement of the gears is secured during the operation of the machine at listing or tabulating speed.

From the foregoing section of the description it is clear that for subtraction the accumulator wheels are clutched to the driving gears by the accumulator magnets A, AP and AH and they are declutched by the magnets SC at differential times during a cycle or by cam **51** at the end of a cycle. During ordinary adding operations, the magnets SC are not used, the accumulator wheels being clutched at the differential times by the magnets A, AP and AH and declutched at the zero position by cams **51**.

Accumulator transferring devices

For effecting carrying or transferring from one order to the next order in an accumulator, a frame **77** pivoted at **78** is adapted to cooperate with the cam faces on the transfer cam disk **36***p* which is attached to the accumulator gear wheel **35***p* as described hereinbefore. An insulation block **79** secured to frame **77** cooperates with the center blade **80** of a set of contact blades **80**, **81** and **82**. A finger **83** extending from the frame **77** cooperates with the periphery of the transfer disk **36**.

When the accumulator wheel is located in the eleven position (Fig. 11) a notch **84** in the disk is in line with finger **83** and allows frame **77** to rock in a counterclockwise direction, permitting the center spring contact blade **80** to rise, closing the contacts **85** between the two upper blades.

If the accumulator wheel passes from the eleven to the zero position during an adding operation (Fig. 10) a projection **86** on disk **36** strikes the finger **83** and rocks the frame **77** in a clockwise direction. The block **79** then depresses the center blade **80** below the normal position and closes contacts **87** between the two lower blades. A latch **88** pivoted at **89** cooperates with a shoulder **90** to hold the frame in shifted position after the wheel passes the camming position. A spring **91** holds the latch in position until the end of the adding cycle when one of the rollers **73** strikes the latch and releases frame **77** for movement counterclockwise into normal position as urged by blade **80**.

The transferring devices for the ordinary decimal orders using cam disks **36** (Fig. 5) are constructed and operated in a similar way, the only differences being that the finger **83** drops into notch **84** when a disk **36** is in the nine position, and the frame **77** is rocked in a clockwise direction by projection **86** when a decimal wheel goes from nine to zero.

In the half pounds or tens of shillings order the transfer cam disk **36***h* cooperates with a similar form of electric transfer mechanism. However, here the finger **83** drops into notch **84** when the accumulator wheel is in any "one" registering position. And when the tens of shillings accumulator wheel goes from one to zero the frame **77** is rocked in a clockwise direction by projection **86**. In this way a unit is transferred to the pounds order every time the shillings orders accumulate more than nineteen shillings.

After accumulating, the wheels are restored to the normal zero position, finger **83** rests on the concentric edge of the disk, and frame **77** holds the center blade **80** with both contacts **85** and **87** opened.

Each lower contact **87** is wired in series with the next higher order accumulator magnet A or AH in a manner to be explained more fully hereinafter with reference to the wiring diagram.

The upper contacts **85** are also wired to connect to higher order magnets so that if a transfer impulse is directed to the magnet associated with closed contacts **85**, the impulse is carried through them to the next higher magnet. The transfer impulses through the contacts **85** and **87** are timed to occur after the cam projection **51** (Fig. 7), passes the extension **53**, so that if a transfer is desired the magnet A or AH is energized, releasing lever **41** and clutching the accumulator gear

for one step of movement after which the clutch lever is again thrown out by the engagement of cam projection 52 with extension 53.

The highest order upper contacts 85 are used in minus balance testing, and the contacts 87 are used to declutch the accumulator wheels at zero in total taking and for printing the total in a manner more fully explained hereinafter.

The energization of the units order magnet at the twelve rather than the eleven position during complement addition is mentioned before in this specification. The extra unit thus gained fills out the complement to the true full complement of the number being subtracted. If the number represented on a record card contains a zero in the units column, the rotation of the units order wheel through twelve steps of movement will actuate the transferring mechanism to induce a carry into the next higher order wheel, thus automatically carrying the extra unit to the higher orders to fill out the complement.

Printing mechanism

The printing mechanism includes a platen 92 (Fig. 2) and a series of type carriers 93 each having a plurality of type elements 94 adapted to be struck by a hammer 95 loosely pivoted on a shaft 96. The type carrier is connected at its lower end to an arm 97 fulcrumed at 98. Springs 99 connected to the arms 97 and to a cross beam 100 connected between arms 101 pivoted at 102, tend to raise the arms 97 to raise the type carriers. A restoring bail 103 connected by links 104 to arms 101 is adapted to restore the arms 97 to their lowest or normal position.

An arm 105 (Fig. 1) fixed to the shaft 102 on which the arms 101 are also fixed, is connected by a link 106 to a complementary cam follower arm 107 pivoted at 108 and cooperating with cams 109 and 110 on cam shaft 111.

Shaft 111 is driven through a chain of gears 112, 113, and 114 the latter of which is mounted on shaft 23'. The shaft 23' turns in synchronism with the feeding of the cards through the machine, and thus the bail 103 (Fig. 2) is raised so as to permit the type carriers to rise in synchronism with the feeding of the card.

Thus when the type element 94 carrying the numeral nine is approaching the printing line with respect to platen 92 and the actuating hammer 95, the nine position on the card will be passing the card reading brushes LB. If there is a perforation in the card at the nine position, a circuit will be closed through the brush LB to a printing magnet PM (Fig. 2) of that particular column. This will attract the associated armature 115 which is connected to one of the rods 116 which at the other end is connected to a latching member 117 of that particular column. This will release a latching pawl 118 permitting it to cooperate with the top one of the ratchet teeth 119 carried by the type carrier to stop the type carrier with the nine type 94 in line for printing.

When the arms 101 raise the bail 103 to permit the type carriers to rise, the springs 99 will be stretched when the type carriers are latched and the arms 97 are stopped in differential positions. After printing has been effected, the arms 101 are then lowered with the bail 103 to restore the type carriers to normal position.

The latching pawls 118 must then be restored before the type bars can begin the next upward movement. For this purpose a bail 120 is adapted, when rocked clockwise, to rock the latching pawls 118 counterclockwise against the action of their spring and permit them to be latched by the latches 117. The bail 120 is connected by link 121 to arm 122 fixed on shaft 123 on which is also fixed an arm 124 (Fig. 1) connected by link 125 to an arm 126 pivoted at 127 and connected to a cam follower arm 128 (Fig. 2) adapted to be actuated by a cam 129 on shaft 111.

The several type actuating hammers 95 are actuated by individual springs 130 tending to rock them against the type 94 to effect printing. The hammers are normally locked in their retracted position by individual latches 131. These latches are connected to levers 132 adapted to be moved to the left by a bar 133.

The bar or bail 133 is pivoted at 134 and is connected to an arm 135 (Fig. 1) connected by a link 136 to a bell crank 137 in turn connected by a link 138 to an arm 139 fastened to a shaft 140 which carries (see Fig. 2) a cam follower arm 141 having rollers 142 cooperating with complementary cams 143 mounted on shaft 111.

A bail 144 which restores the hammers to normal position is supported on a pair of arms fixed on the shaft 96 to the end of which is fixed the crank 137 (Fig. 1). The pin and slot connection 145 between link 136 and arm 135 permits the shaft 96 to turn clockwise a slight amount without link 136 moving arm 135. This is arranged in order that bail 144 (Fig. 2) may be moved out of the path of the hammers 95 before the arm 135 and bail 133 are actuated by link 136 to release the hammers.

Where listing is to be effected on a record sheet 146 (Fig. 4), while an item is also being accumulated, the printing magnet PM will be connected to receive an impulse through the perforation in the card simultaneously with the transmission of such impulse to the related accumulator magnet AP, A or AH. The amount may be listed whether the item is a debit or a credit.

The total taking control

When a total is to be taken of a group of items which have been accumulated, and the total or balance is to be printed, it is necessary to open the listing circuits to the sensing brushes and close the total printing circuits to contacts in the accumulator. The mechanism for effecting these circuit changes is controlled by a total control magnet TM, the operation of which is explained with reference to the wiring diagram. This magnet is adapted to be energized either by depression of the total key or automatic operation of group control devices whenever a total is to be taken.

The plugboard circuit breaker switch

During accumulating, total taking and transferring operations it is necessary to break connections between the sensing brushes, the accumulator magnets and the total printing contacts in order to prevent back circuits.

The devices for opening and closing the contacts PBCA and PBCB (Fig. 12B) are shown in Fig. 2. A plate 185 is fastened to the machine frame near the card feed control shaft 154. The plate carries a series of contacts arranged in groups of three, an upper blade 186, a center blade 187, and a lower blade 188. Each center blade 187 projects into a slot 189 cut in the side of a vertical insulation bar 190 riveted on a link 191. A bell crank 192 pivoted at 193 is pivotally connected to the link 191 at 194, and on the end of a vertical arm carries a roller 195 cooperating

with a cam 196 on shaft 154. Another horizontal arm (not shown) guides the lower end of link 191. The cam 196 has three different concentric levels 197, 198 and 199 for adjusting crank 192 and controlling the contacts.

Early in the counterclockwise movement of cam 196, the roller is raised to level 197 and the crank is rocked counterclockwise to close the upper contacts PBCA and condition the machine for adding so that the impulses from the lower brushes are directed to the accumulator magnets. At transferring time, the crank roller 195 falls to level 198 and closes the lower contacts PBCB enabling the transmission of transferring impulses through the transfer contacts to the accumulator magnets. Then finally the crank is brought to rest on level 199 whereupon both contacts PBCA and PBCB are opened and the machine is adapted to take a total.

The machine operating connections

The wiring diagram in Figs. 12A and 12B shows the control connections in the machine for effecting adding, subtracting, transferring, printing and total taking.

The source of energy is at PS (Fig. 12A) and includes the lines 200 and 201. When the switch is closed at PS, the operating motor M is energized and turns the shafting to which may be clutched the various mechanisms in the machine. Another main line 202 is connected to line 201 through contacts CR4, CR5, CR6, and CR7 which are closed instantaneously as the index point positions on the card appear under the upper and lower brushes UB and LB.

When the start key is depressed, contacts 203 are closed and a circuit is established from line 200, through the stop key contacts 216, contacts MI1, card feed clutch magnet CFCM, magnet R6 in parallel therewith, contacts 203 and wire 204 to line 201.

The energization of magnet CFCM will cause operation of the card feeding mechanism to feed cards through the machine. This magnet also controls contacts CFC1 and CFC2, closing them when the magnet is energized. As the cards feed through the machine they depress the lower card lever and operate the lower card lever contacts LCL. The magnet R6 closes contacts R6B as long as cards are feeding, but opens these contacts to prevent the passage of pence accumulating and printing impulses during the taking of a total.

When contacts LCL are closed a circuit is established through magnets CLR and CLRH, from line 200, through contacts LCL, magnets CLR, CLRH, in parallel, and wire 205 to line 201. The magnet CLRH when energized forms a holding circuit by closing contacts CL1 which are in series with contacts CR2 which close when contacts LCL open. The other magnet CLR closes contacts CL4 in parallel with start key contacts 203, so that by means of contacts CFC1 and CL4 the energization of magnet CFCM is maintained after the start key is released. If the auto start switch AS is closed as shown, the closing of the contacts P1 at the end of a total cycle serves to energize the magnet CFCM and resume card feeding. If cards fail to feed because of an empty magazine or jammed cards, the contacts LCL remain open and the circuit is opened at CL4, deenergizing the card feed clutch magnet and stopping the card feeding mechanism.

If printing is to be effected under the control of the cards being fed through the machine, the list switch is closed as shown so that when contacts CFC2 are closed by magnet CFCM and contacts CL3 are closed by magnet CLR, the printing clutch magnet PCM is energized. The circuit is as follows: line 200, wire 206, magnet PCM, wire 207, contacts PC1, contacts CFC2, contacts MI5, the switch arm, contacts CL3, and wire 208 to line 201.

The energization of magnet PCM causes the printing operation devices to be clutched to the main operating mechanism so that the type bars and associated mechanism are operated. If tabulating control of printing is desired, the switch may be shifted to TAB, then during the printing of the first card after a total, contacts P2 open to deenergize magnet PCM. The magnet remains deenergized during the accumulation of a group of cards because contacts PC1 are opened by the unlatching of armature 209 by energization of magnet PCRM. The circuit includes line 200, contacts P3 closed during the printing of the first card after the total, magnet PCRM, the switch arm at TAB, contacts CL3 and wire 208 to line 201.

The magnet PCM may be energized for the printing of a total by the automatic closing of contacts MI2, or the closing of contacts 211 by the hand total key. The circuit is from line 200, wire 206, magnet PCM, wire 212, contacts MI2, wire 213, the switch HTS in the position shown for automatic totals or moved to the left for hand totals, thence through wire 215 or contacts 211, contacts CR3 normally closed, and wire 320 to line 201.

While the machine is in operation and cards are being fed the machine may be stopped at any time by depression of the stop key to open the contacts 216. This will break the circuit through the card feed clutch magnet CFCM which then allows contacts CFC2 to open to deenergize the printing clutch magnet PCM. The operating motor will continue to operate until the switch at PS is opened.

A platen feed mechanism is provided to feed the record paper before printing in both listing and total taking operations. A platen feed magnet PFM, when energized acts to clutch the platen spacer to the driving mechanism. The circuit through the platen feed magnet is as follows: line 200, wire 210, switch SF, contacts CF11, contacts P4 closed during printing, paper feed magnet PFM, and wire 214 to the other line 201. The magnet may be energized in automatic total taking by the closing of contacts MI3 and contacts P5.

The passage of cards under the upper brushes UB serves to deenergize magnets R1 and R2 which in turn control the operation of many contacts throughout the machine. These contacts are associated with magnet R2 and are operated thereby to indicate the presence of cards under brushes UB. When cards fail to appear under the brushes UB a circuit is closed through line 202, wire 218, common brush 230, contact roller 231, brush 279, contacts CF9, magnets R1 and R2 in parallel and wire 280 to line 200. Magnet R1 closes associated contacts R1A and a holding circuit is established through contacts CF8 and R1A.

In an ordinary adding operation, as the card passes the lower brushes LB the amount perforated therein is added and printed. The circuit is from line 200 (Fig. 12A), contacts CL2, and CF2, common brush 219, contact roller 220, brush LB touching roller 220 at a differential time controlled by the location of the perforation, jack 221, plug wires to jacks 224 and 261

if both adding and listing control is desired; then the circuit branches out in two parallel circuits, the printing or listing branch includes contact 174, printing magnet PM and line 202; the adding branch continues through jack 224, cable 225, (Fig. 12B), contacts R47B closed for adding, wire 350, contacts PBCA closed during accumulating, wires 351 and 352, contacts 174 closed for item entry, accumulator magnet A and line 202.

The energization of the accumulator magnet acts to clutch the accumulator wheel to the driving gear and rotation continues until cam 51 (Fig. 7) declutches the gears.

The addition of the amounts 1 to 9 are carried out in a similar way in the pence order. The circuit for the addition of such numbers in this lower order bank may be traced at the top of Fig. 12B. The impulses from the lower brushes travel along the cable 225, through wire 353, contacts PBCA, wire 354, contacts 355, wire 356, contacts 357, wire 358, contacts 359 closed during adding, wire 360, wire 352, contacts 174, magnet AP and line 202.

The listing of the ordinary decimal figures in the pence order follow a path somewhat different from the printing circuit in the higher orders. The circuit may be followed in Fig. 12A from line 200, contacts CL2 and CF2, common brush 219, contact roller 220, brush LB in the lower order, jack 221, a plug wire to socket 224, wire 361, contacts 362, plug socket 363, a plug wire to socket 261, in the pence order of printing bank, contacts 174, magnet PM and line 202.

In the adding of ten or eleven pence in the lowest order of the accumulator a different mode of entry is employed. The perforations representing these two amounts are placed at the top of the column of index points on the record card 1. Referring to Fig. 3, it is noted for the perforation in the fourth column from the left that the X position represents 10 pence. A perforation in the 9th column at the R index position represents 11 pence. These two perforations are sensed as the card passes through the upper brushes, one card cycle before the regular adding operation takes place as the card passes through the lower brushes. The sensing of such perforations causes contacts to be adjusted for the early meshing of the accumulator wheels to add the amount of 10 or 11.

Considering first the mode of operation for the entry of 10 pence, the sensing of an X perforation in the pence column sets up a control circuit which may be traced starting with line 202 (Fig. 12A) through wire 218, common brush 230, contact roller 231, brush UB in the lowest order, socket 232, a plug wire to socket 233, magnet R10, wire 364, brushes 365 which make contact with a segment 366 on a commutator 367 which is rotated in synchronism with the feeding of the card and adjusted to make contact as the X position passes the upper brushes. The circuit continues through brush 368 contacting a continuous ring on commutator, contacts CF5, contacts R2A and line 200. The energized magnet R10 closes contacts R10A and sets up a holding circuit including magnet R156. The circuit may be followed from line 200, wire 369, contacts CF15, wire 370, contacts R10A, holding magnet R10H and magnet R156 and wire 371 to line 201. The energized magnet R156 holds contacts 357 opened and contacts 372 closed during the following cycle to add 10 pence into the accumulator.

The circuit through accumulator magnet AP for the addition of 10 pence may be followed from line 202 (Fig. 12B) magnet AP, contacts 174, wire 352, wire 360, contacts 359, wire 358, contacts 372 operated by magnet R156, wire 373, brush 10A cooperating with a commutator 374 provided with a spot 375, contacting brush 10A, early in the adding operation at the time calculated to mesh the accumulator wheel to add the value 10. The circuit continues through spot 375 to a contact ring 376, common brush CA, contacts R6B, wire 377 (Fig. 12A), wire 378, wire 246, and contacts CL2 to line 200.

During the adding of the 10 pence in the lowest order of the accumulator, the number ten is printed on the record sheet 146 (Fig. 4) as shown by the second item on the sample sheet. For this purpose, two orders of the printing device and two type bars are associated with a pence order of the accumulator. When the magnet R10 is energized by the appearance of the X perforation, the contacts R10B (Fig. 12A) are closed to effect the entry of an impulse at the one time in the operation of the machine to cause the tens of pence order of the type bars to print the figure 1. The listing circuit may be followed from line 202 (Fig. 12A) through the pence order of the printing magnet PM, contacts 174, plug socket 261, plug wire to socket 379, contacts R10B, wire 380, contacts CF3 closed at the one index point, wire 381, wires 378 and 246, and contacts CL2 to line 200. In the lowest order of the printing bank, the figure 0 will be printed since no perforation is sensed through contacts 362 during the rising movement of the lowest order type bar. Therefore, this type bar will rise to the highest position with the 0 type in-line with the printing hammer.

The entry of 11 pence into the accumulator involves an operation somewhat different from the entry of 10 pence. The existence of a perforation in the R position on the card is sensed as the card passes the upper brushes. The circuit through the lowest order of upper brushes UB is similar up to the socket 233. There, the impulse is directed through magnet R11 through wire 382 and brush 383 because the spot 384 on commutator 385 is timed to make contact as the R position is passing the upper brushes. The circuit continues through brush 386, contacts CF5, and contacts R2A to line 200.

The energized magnet R11 closes contacts R11A and sets up a holding circuit through holding magnet R11H and R157. The holding circuit includes line 200, wire 369, contacts CF15, wire 370, contacts R11A, magnets R11H and R157, wire 371 and line 201. Magnet R157 then closes contacts 387 (Fig. 12B) to connect the pence order magnet AP to a circuit timed to operate the accumulator gear for a movement of 11 steps. The circuit runs from line 202 (Fig. 12B) through magnet AP, contacts 174, wire 352, wire 360, contacts 359, wire 358, contacts 357, wire 356, contacts 387, wire 388, brush 11A, commutator segment 389, contact ring 376, brush CA, contacts R6B, wire 377 (Fig. 12A), wire 378, wire 246 and contacts CL2 to line 200.

At the same time that the value 11 is added in the pence bank, the two lowest order printing banks are operated to print the number 11. To do this, the magnet R157 opens contacts 362 (Fig. 12A), and closes contacts 390 at the same time magnet R11H closes contacts R11B. After these connections are made, the closing of contacts CF3 at the one index point directs a pair of impulses through plug sockets 363 and 379

energizing the two lowest order printing magnets PM in time to print two figures one as shown in the fourth item on the same record in Fig. 4.

The appearance of a perforation at the X position on the card may not only indicate the value of 11 pence, but its presence in certain columns, when the machine is plugged for control in subtraction, may indicate that the card carries a credit item which is to be subtracted from other amounts such as debit items carried on cards free from such special perforations as perforation 2 in Fig. 3.

When the cards are fed through the machine they pass first under the upper brushes and then one cycle later under the lower brushes. As the card passes under the upper brushes it is sensed to determine whether it carries a credit item accompanied with a special perforation such as the X hole 2. If such a perforation is sensed, certain relays are energized to shift contacts so that the complement of the number on the card is added in the accumulator. If desired, true numbers of such credit amounts may be added at the same time that the complements are entered into another accumulator then it is necessary that the accumulator orders be divided into two sections, one to receive the true numbers of credit items and complements of debit items and the other to receive two numbers of debit items and complements of credit items. Such construction is shown in the copending application of A. W. Mills, referred to hereinbefore.

In the present case, the accumulator is shown as having only one accumulator designed to add and subtract English currency. It is understood that a pair of such accumulators may be provided to handle simultaneously debit and credit amounts.

The subtraction control circuit is as follows: from line **202**, wire **218**, common brush **230**, contact roller **231**, an upper brush UB in a column plugged for sensing special perforations, plug socket **232**, a plug wire to socket **391**, magnet XC, contacts CF8, wire **321**, contacts R2A and line **200**.

The energized magnet XC closes contacts **234** and sets up a holding circuit through magnets MC7 and to magnet XCH. This circuit is from line **200**, wire **369**, contacts CF22, wire **392**, contacts **234**, magnets XC and MC7 and line **201**.

The energized magnets MC7 operate a series of contacts **244**, **245** to deenergize certain relays and energize other relays for the shifting of subtraction control contacts throughout the machine. Normally, the contacts **245** are closed to energize relays R47, R49, R123 and R125 to control the direction of an adding impulse for the addition of a debit item. An example of a circuit through one of such relays may be followed from line **200**, through contacts CL2, wire **393**, jack **394**, plug wire to socket **247**, contacts **245** normally closed, socket **248**, plug wire to socket **395**, magnet R47, bus bar **396**, contacts CF26, and wire **371** to line **201**. On the operation of magnet MC7, contacts **244** are closed and then the circuit is directed through plug socket **252** and a plug wire to socket **397**, magnet R46, bus bar **396**, contacts CF26, and wire **371** to line **201**. By reversing the plugging in certain orders, such as the highest order, in running a plug wire from **252** to **395** and from **248** to **397**, a complement may be entered as other orders enter true numbers. For ordinary adding operation the magnet R47 is energized by plugging directly from socket **394** to **395**.

Considering first the entry of a complement in the ordinary accumulator banks other than the pence bank and half pounds bank. In these orders, the accumulator magnet A is energized at the 9 index position to start the accumulator wheel revolving. The operation of accumulation continues until the associated magnet SC is energized by the appearance of the perforation at a certain index point in a related column on the card. The differential position of the perforation determines the complemental value of the figure entered.

A circuit for the clutching of the accumulator wheels at the 9 index position may be traced from line **200** (Fig. 12A), contacts CL2, wire **246**, wire **378**, wire **377** (Fig. 12B), contacts CF28 closed at the 9 index position, wire **398**, wire **399**, contacts R122A closed by magnet R122 during subtraction, contacts PBCA, wire **351**, wire **352**, contacts **174**, through magnet A to line **202**. This serves to start the accumulator wheel revolving and the operation of the wheel continues until a perforation is sensed, then a circuit is directed through the related magnet SC (in the present instance the pounds order magnet) for the termination of the complement entry. A circuit may be followed from line **200**, contacts CL2, wire **246**, contacts CF2, common brush **219**, contact roller **220**, lower brush LB, socket **221**, a plug wire to socket **224**, through cable **225** (Fig. 12B), contacts R123A closed for subtraction, wire **400**, contacts **174**, magnet SC and line **202**.

The entry of a complement in the half pounds or tens of shillings order follows a somewhat similar course of operation. However, in this order, it is unnecessary to add more than 1 as a complement at any time. The bank is designed to transfer when amounts larger than one are added in it. Therefore, the related accumulator magnet AH is energized at the one index position for the meshing of the accumulator wheel to start the entry of a unit when a zero is presented in the related column on the card. The circuit through magnet AH may be followed along a circuit from line **200**, contacts CL2, wire **246**, wire **378**, wire **381**, contacts CF3 closed at the one index position, wire **401** (Fig. 12B), contacts R122B, contacts PBCA, wire **351**, wire **352**, contacts **174**, magnet AH to line **202**. The circuit terminating the complement entry operation is directed through a hole in a card to cable **225**, contacts R123A, wire **500** and magnet SC associated with magnet AH in the same manner as described above in connection with the termination of the complement entry in the pounds order.

For the entry of a complement in the pence order, the accumulator magnet is energized at a time corresponding to a twelve index position, in other words, the magnet is energized three index points before the regular nine index point position. This is done so that a complement of any number of pence from zero to eleven may be entered into the lowest order. The pence complement entry initiating circuit may be followed from line **200**, contacts CL2, wire **246**, wire **378**, wire **377** (Fig. 12B), contacts R6B, contacts CA, contact ring **376** on commutator **374**, a contact spot **402** located on the commutator in a position to contact a brush **12A** at the 12 index position. The circuit continues through wire **403**, contacts R124B, wire **351**, wire **352**, contacts **174** and magnet AP to line **202**. The related

accumulator wheel is meshed with the driving gears and rotation is started and continued until magnet SC is energized. If SC is energized by any of the ordinary digit perforations 0 to 9, the complement terminating circuit follows a path which may be traced from the line **200**, contacts CL2, wire **246**, contacts CF2, brush **219**, contact roller **220**, lowest order brush LB, socket **221**, plug wire to socket **224**, cable **225**, wire **353**, contacts PBCA, wire **354**, contacts **355**, contact wire **356**, contacts **357**, wire **358**, contacts **404**, wire **405**, contacts **174**, magnet SC in the pence order, and line **202**.

Should the values 10 or 11 be perforated in the pence column of index points, it is necessary to energize magnet SC early in the complement entering operation. This is done so that the value 2 which is the complement of 10 or the value 1 which is the complement of 11 may be added in the pence order. This early energization of SC is taken care of by the sensing of the X and R perforations under the upper brushes one cycle before the complement operation, just as in the adding operation they were sensed ahead of time and in the same way as in adding, the magnets R10 or R11 are energized according to whether a 10 or 11 perforation is sensed.

The control magnets R156 and R157 are operated selectively to close contacts **372** or **387** to make connection with commutator **374** in the same manner as in adding. The only difference being that in subtraction, the contacts **359** are opened and the contacts **404** are closed so that the special perforations are directed through pence magnet SC instead of magnet AP. In this way, the 10 and 11 impulses are added to pass through magnet SC to follow soon after the starting 12 impulse through magnet AP for the entry of the complements 2 or 1 in the pence order.

The printing of amounts during subtraction of the values in the accumulator is similar in operation to the entry of printing impulses during addition. In the orders other than the pence order, the printing impulses follow the regular course from the lower brushes through socket **221** along a plug wire to socket **261** through contacts **174** and magnet PM. The true credit values perforated in the card are those represented on a record sheet. In the two printing banks associated with the pence order, control is again selectively effected through contacts **362** or contacts **390** or R10B or R11B. The printing impulses for the representation of the digits 0 to 9 are directed through contacts **362**. The printing of 10 and 11 is controlled by the closure of contacts **390** and R10B and the closure of **390** and both R10B and of R11B, respectively.

The special perforation **2** (Fig. 3) has a further use under control of class selection or class elimination. In other words, the appearance of this perforation on the card may be used to control the machine to eliminate the addition or printing of the amounts represented thereon or to cause amounts in a plurality of fields on the card to be directed into a single set of printing banks or accumulator orders. For this purpose, the upper brush sensing the column allotted for the reception of the special perforation **2** is connected with a class selection magnet CS.

The circuit is as follows: from line **202**, through wire **218**, brush **230**, contact roller **231**, upper brush UB, socket **232**, plug wire to socket **406**, through magnet CS, contacts CF8, wire **321**, contacts R2A and line **200**.

The energized magnet CS closes an associated pair of contacts CSA and CSB to set up a holding circuit through magnet CSH and a set of associated magnets MCR. A circuit through magnets MCR includes wire **369**, contacts CF15, wire **370**, contacts CSB, magnets MCR and wire **371**. The operated magnets MCR serve to shift class selection control contacts **299** and **300**. These contacts may be connected between the lower brushes and the adding and printing magnets in many ways to direct the impulses controlled by the card.

The same contacts may also be used during the taking of totals to select the orders in the accumulator to be connected to the printing magnets for the control of the printing of the balance.

Transferring from one order to the next higher order in an accumulator is effected as explained in connection with the mechanism shown in Figs. 5 to 11 inclusive. Wiring connections for these transferring mechanisms are shown in Fig. 12B. If the accumulator wheel of any order passes to 0 during an adding operation, it will cause the contacts **87** to close (see Fig. 10). The closure of these contacts sets up connections as part of a circuit directed through a higher order adding magnet. After the accumulator wheels are disengaged in adding, the contacts CF10 and CB13 (Fig. 12B) are closed momentarily. These contacts are in line with transferring contacts **87**. The closure takes place after cam **51** (Fig. 7) passes the extension **53** on clutch lever **41** so that at this time the lever is free to be operated again to mesh the accumulator wheel with the driving gear.

A transferring control circuit may be traced through the pence order as follows: from line **200**, through wire **501**, contacts CF10, wire **407**, contacts CB13, wire **408**, contacts **87** in the lowest order, wire **409**, contacts PBCB closed during transferring, wire **351**, wire **352**, contacts **174**, and accumulator magnet A in the units of shillings order.

As soon as one step of transferring movement is imparted to the units of shillings wheel, the cam point **52** (Fig. 7) cams the pinion **37** out of mesh so that the accumulator wheel again stops after having received an additional step of movement.

If the shillings accumulator wheel should happen to be standing at 9 when the transfer impulse is directed through the related magnet **A**, the impulse is carried on to the next higher order magnet through the closed contacts **85**. With the wheel at **9**, the contacts **85** are closed as seen in Fig. 11. Therefore, when the transferring impulse passes through wire **409** to wire **351**, it may also pass through contacts **85** and wire **410** to magnet AH in the third order.

The transferring operation is the same in all orders in depending on the condition of transferring contacts **85** and **87**. The operation of these contacts differs in the three different forms of accumulator orders as pointed out hereinbefore. With the ordinary type of decimal wheel shown in Fig. 5, contacts **87** are closed as the wheel passes from nine to zero. In the 12ths or pence orders (Fig. 10), contacts **87** are closed as the wheel passes from 11 to 0. The half pounds order is adapted to operate contacts **87** as a wheel **36*h*** (Fig. 6) passes from 1 to 0. The other transfer contacts **85** are operated by the wheels **36**, **36*p***, **36*h***, when the wheels stand at the 9, 11 or 1 positions respectively.

The machine is provided with group control devices for sensing and comparing the group number perforations on successive cards under the upper and lower brushes. For this purpose each one of a group of magnets GC is connected in series with an upper and a lower brush. A plug wire may connect jack 267 to jack 232, and another plug wire may be placed between jack 268 and jack 221 in a related column. Then, if the perforations in a certain column on successive cards agree in index position, the related magnet GC is energized to prevent the taking of an automatic total. The magnets GC are associated with contacts 269 in series with group control holding circuit magnets GCH, so that when magnet GC is energized, contact 269 is closed and is held closed by the energized magnet GCH which at the same time opens a group control contact 270. The circuit through magnets GCH is from line 201, wire 217, wire 271, magnets GCH, contacts 269, contacts CF12, and wire 322 to line 200.

The opened contacts 270 prevent the energization of the minor group control magnet MI which may be connected in series to one or more of said contacts in parallel by plug wires from jack 274 to jack JGC.

When one or more of the contacts 270 remain closed indicating a change in record card group, the connected group control magnet MI is energized. The circuit is from line 201, wire 217, contacts CR1, wire 275, magnet MI, switch MIS, jack 274, plug wire to the second jack JGC, one or more contacts 270, contacts CF1 closed after comparing cards, wire 246 and contacts CL2 to the line 200. The energized magnet MI acts to operate contacts MI7 and energize the magnets MIC which control the MI contacts throughout the machine, opening some and closing others to stop the regular adding and listing operations of the machine so that an automatic total taking operation may take place. The circuit through magnets MIC may be followed from line 200 to wire 410, contacts PM6, contacts MI7 and through magnets MIC to line 201.

One of the magnets MIC operates to close contacts MI2 to energize the total selection control magnets TSC and TM. The circuit is from line 200 through magnets TM and TSC in parallel through contacts CR13, wire 284, contacts MI2, contacts CR3 and wire 320 to line 201.

The energized magnets TM then act to shift a number of sets of contacts 174, 175 already noted in connection with the wiring in Fig. 12B. The other magnet TSC closes contacts 286 (Fig. 12A), to establish minus balance testing and holding circuits for total selection.

The testing circuit is connected from line 200 through contacts CB21 closed at the testing time, contacts TC2 closed by magnet TSC, wire 411, wire 351, contacts 85 closed when wheel is at 9 registering a complement, wire 412, plug socket 288, and plug wire to socket 290 (Fig. 12A), through contacts 286 and magnet R20 to line 201. If the highest order accumulator wheel does not stand at 9, it is an indication that the accumulator contains a true number or a debit balance and the transfer contacts 85 remain open and the magnet R20 is not energized. However, should the accumulator contain a negative balance, the highest order wheel is at 9 and the contacts 85 are closed with magnet R20 effective because of the circuit traced. With the use of this highest order wheel for minus balance testing, the capacity of the accumulator is understood to be one order less than the number of orders or banks provided. When the magnet R20 is energized, it is adapted to operate contacts R20A and R20B to form a holding circuit for R20H and at the same time energize class or balance selection magnets MCR. The circuit used for the energization of magnets MCR during total taking may be followed from line 200, through contacts CB18, wire 413, contacts R20B, magnets MCR and wire 371 to line 201.

The energized magnets MCR operate class or balance selection contacts 299 and 300 to shift the total taking impulses from connecting one accumulator to another or the elimination of total printing when only the complement of a total is registered. As shown, the accumulator banks are connected to act as one unit, but it is possible to divide the orders shown into two banks of accumulating orders and thus have a positive and negative balance accumulated separately. Then such contacts as 299 and 300 may be used to connect the printing devices to that certain one of the accumulators which holds the balance as a true number.

In the total taking cycle, the magnets A, AP and AH are energized automatically to clutch the accumulator wheels to the driving gears and start the wheels revolving towards the 0 position. The pence order magnet is energized at a point in the cycle three index points before the nine index point. The circuit may be followed from line 200, through contacts CB22, closed early in the operation, contacts MI8, sockets MP, a plug wire to socket 414 through cable 415, to contacts 175 in the pence order, magnet AP and line 202.

The cancelling circuit through the ordinary adding magnets A may be followed from line 200, through contacts CB17 closed at the ten index point, contacts MI4, plug socket MT, a plug wire to socket 416 and through cable 415 and contacts 175 and magnets A to line 202.

The tens of shillings order wheel is started to revolve in total taking under control of the accumulator magnet AH over a circuit somewhat similar to that used for the magnets A. However, in this order, a commutator 417 is provided in line with the related socket 418 for the purpose of preventing the passage of an impulse at the ten index point. In the same cancelling circuit another contact CB18 is provided and closed at the two index point to start the related tens of shillings wheel 36h (Fig. 6) moving back to the 0 position. The circuit provided for the meshing of this order late in the total taking cycle may be followed from line 200, through contacts CB18, contacts MI4, socket MT, plug wire to socket 418 through commutator 417 which permits passage of an impulse at two index point, cable 415, contacts 175, magnet AH and line 202. The reason the tens of shillings or half pounds wheel is started to turn so late in the total taking cycle is because it never accumulates more than one unit and, therefore, the projection 86 (Fig. 6), is always close to the end 83 for operating the closing of contacts 87 and the printing of the total.

When the magnets A, AP and AH are energized, the related accumulator wheels 35 (Fig. 7) are clutched to the driving gears and continue to turn until they arrive at the 0 position. Then the transfer contacts 87 are closed to direct impulses through magnets SC for declutching accumulator wheels, and similar impulses are directed

through magnets PM to effect the control of total printing.

During total printing, the projection 86 on wheel 36 approaches the end 83 of lever 77 in synchronism with the rising of the type bars. The type bars are stopped in differential positions according to the time of energization of control magnets PM which time, in turn, is controlled by the number of steps that projection 86 is removed from end 83 at the beginning of a total taking operation. As the wheel 36 moves into the 0 position, contacts 87 are closed to energize the related printing magnet PM and also energizes magnet SC to declutch the accumulator wheel from the driving gear and leave it in normal position.

An example of a total printing circuit in one of the ordinary decimal orders may be traced on a diagram in Fig. 12B. The circuit starts at line 200, then through contacts CF10 held closed during total taking because they are opened only when cards feed, wire 407, contacts CB13 or CB14, wire 408, contacts 87, wire 419, cable 420 (Fig. 12A), plug socket 421, a plug wire to socket 308, contacts 175, magnet PM and line 202.

At the same time that this impulse is directed through the printing magnet, the circuit branches at contacts 87 through wire 422 and contacts 175 to direct a similarly timed impulse through the related declutching magnet SC. Thus, the number registered in the accumulator wheel is printed and the wheel is held in the 0 position.

The printing and the declutching operations in the half pounds order is similar to the operation described with relation to the ordinary decimal orders. The only difference being as already pointed out that the energization of magnet AH is delayed until the two index position is reached after which time the operation of the related contacts 87 may result in printing of the figure 1 in the tens of shillings order.

The total printing and zeroizing of the pence order is accomplished by special devices provided between the single accumulator wheel and the pair of type members controlled thereby. In this pence order should the wheel 36P (Fig. 10) stand in the 10 or 11 position, operation of the wheel in total taking will cause an early closing of total control contacts 87. The impulse thus initiated will disconnect the usual connections between the pence accumulator wheel and the lowest order printing control magnet PM and at the same time establish other connections for the printing of 10 or 11 by the two lowest order printing magnets.

Considering first the mode of total printing operation in the pence order when the pence wheel represents a number from 0 to 9. Then the total printing circuit is as follows: from line 200, contacts CF10, wire 407, contacts CB13, CB14, wire 408, contacts 87 in the lowest order, wire 423, brush 424, commutator 425 which establishes contact between 424 and another brush 426 during the last nine index points of movement in total taking, then through wire 427, contacts R181A, plug socket 428 and a plug wire to socket 308 (Fig. 12A) in the lowest order, contacts 175, and printing control magnet PM to line 202.

As printing control is effected, another impulse is directed through the lowest order magnet SC to hold the accumulator wheel in the 0 position. The total control circuit continues through contacts 87, wire 423, through wire 429 and contacts 175 through magnet SC to line 202.

Should the pence wheel be standing at 10 when a total taking operation is initiated, the contacts 87 are closed before a connection is made between brushes 424 and 425. However, the impulse initiated by the early closing of contacts 87 follows another path to energize a magnet R172 for the control of both lower order printing banks for the printing of the numeral 10. This circuit continues through contacts 87, wire 423, wire 429, wire 430, magnet R172, commutator 431 establishing contact between brush 432, and brush 433 early in the total taking operation. The energized magnet R172 closes contacts R172A (Fig. 12A) to set up a holding circuit through magnet R172H and another magnet R181. The circuit through these magnets may be followed from line 200, through contacts CB19, contacts R172A, magnets R172H, R181, and wire 371 to line 201.

The magnet R181 operates the contacts R181A, previously mentioned, to disconnect the lowest order printing control magnet from the usual circuit through plug socket 428. The result being that a 0 is printed in the lowest order. The other magnet R172H closes contacts R172B in line with other contacts CB23 which are closed at the one index point position to control the printing magnet PM for stopping the related type bar in position to print the numeral 1 in the second lowest order. A circuit through R172B can be traced from line 200, through wire 434, contacts CB23, contacts R172B, plug socket 435, and plug wire to socket 308 (Fig. 12A) in the second lowest printing order, through contacts 175, magnet PM to line 202. The above described control of the two lower order printing banks causes the printing of the multi-denominational figure 10 under control of a single accumulator wheel registering the value 10 before the taking of a total.

Should the pence order accumulator wheel stand in a position representing 11 pence when a total taking cycle is initiated, the contacts 87 are closed at a point slightly earlier in the cycle than when the wheel stood at 10. An impulse initiated through contacts 87 by a wheel standing in the 11 position is used to energize magnet R172 and another magnet R173 for the control of both lower order printing banks for the printing of the numeral 11. This impulse occurs at a point in the operation when brush 424 is disconnected from brush 426. The total printing control circuit continues through contacts 87, wire 423, wire 429, wire 430 and wire 436 to magnet R173 and continuing through commutator 437 establishing contact between brush 438 and brush 439 earlier than commutator 431 in the total taking cycle. At the same time that R173 is energized R172 is also energized by a circuit already described. Both circuits set up holding circuits by closing contacts R173A (Fig. 12A) and contacts R172A. A circuit may be followed from line 200, through contacts CB19, contacts R172A and R173A, magnets R172H, R173H and R181, and wire 371 to line 201.

The energized magnet R181 acts in the usual way to open contacts R181A to prevent the passage of impulses from commutator 425. The energized magnet R172H operates in the usual way to connect contacts R172B to the line including contacts CB23. The active magnet R173H closes contacts R173B to connect plug socket 428 to contacts CB23 for the direction of an impulse controlling the printing of 1 in the lowest order. Thus, through the connection of both plug sockets 428 and 435 to the contacts CB23 closed at the one index point position, both lower order print-

ing bars are adapted to be stopped in a position wherein the numeral 1 type is on the printing line.

Since the basic novel features of the invention have been shown and described as applied to a single modification, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and changes in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a machine controlled by a perforated record with digit index points each representing a digit and a plurality of special index points each representing a multidenominational number, an accumulator wheel, a driving means for said wheel, a magnet controlling the engagement of said wheel with said driving means, means for sensing said digit index points and controlling the energization of said magnet at a differential time to operate said wheel to add a digit corresponding to the index point perforated, means for sensing said special index points and controlling an early energization of said magnet to operate said wheel to add a multidenominational number corresponding to the special point perforated, and means for disengaging said wheel from said driving means at the end of an adding cycle.

2. In a machine controlled by records arranged with perforations in columns of index points, each column containing points for the digits 0 to 9 and special points for the numbers 10 and 11, an accumulating wheel, means for sensing the digit points, means under control of said sensing means for operating the accumulator wheel to add a digit, other means for sensing perforations in the special points one cycle before the sensing of said digit points, and means under control of said other means for operating said accumulator operating means to turn said wheel to add 10 and 11.

3. In a machine controlled by a perforated record with a plurality of special index points above the digit index points, means for first sensing said special points on records, other means for sensing said records after said first means, an accumulator wheel, means under control of said first sensing means for operating said accumulator wheel to add a number larger than a digit, and means associated with said operating means and controlled by said other sensing means for operating said accumulator wheel to add a digit.

4. In a machine controlled by records with digit perforations and a special perforation, an accumulator, means under control of the digit perforations for adding digits in said accumulator, a pair of typebars, one for the units order and one for the tens order, means under control of the digit perforations for positioning the units order typebar to print corresponding digits, and means including said adding means under control of said special perforation for operating said accumulator to add multidenominational numbers and for positioning the tens order bar in addition to operating the type bar positioning means to position the units type bar so that both bars together print plural ordered numbers.

5. In a machine controlled by records with digit perforations and a special amount perforation, only one perforation of either kind being present in the same column of the record, an accumulator, means under control of said digit perforations for subtracting corresponding amounts in a certain single order of said accumulator, and additional means cooperating with said subtracting means and under control of said special perforation for subtracting a multi-denominational amount in said single order of said accumulator.

6. In a machine controlled by records with digit perforations, special amount perforations and a subtraction control perforation, an accumulator, means under control of said control perforation and one of said digit perforations for operating said accumulator to add the twelfths complement of any digit corresponding to a digit perforation, and means cooperating with said accumulator operating means under control of said control perforation and one or the other of said special perforations for operating said accumulator to add the twelfths complements of 10 and 11.

7. In a machine controlled by records with digit perforations and perforations representing duo-decimal amounts, said digit and duo-decimal perforations being arranged in one column on the records, an accumulator with a plurality of denominational order wheels, means under control of said perforations for operating the units order accumulator wheel to accumulate digits and duo-decimal amounts, a pair of typebars, and means under control of said units order wheel for adjusting said pair of typebars to print the total duo-decimal amount accumulated thereon.

8. In a machine of the class described, an accumulator comprising a plurality of denominational order wheels, means for adding digits and duo-decimal amounts and twelfths complements thereof on the units order wheel of said accumulator, a pair of units and tens typebars, both under control of said units order wheel, means under control of said wheel for adjusting the units typebar to print a total digit, and means under control of said wheel and selectively operated thereby according to the magnitude of the amount registered thereon for adjusting the tens typebar to print a total duo-decimal digit.

9. In a machine controlled by records with digit perforations, duo-decimal perforations, and a subtraction control perforation, an accumulator comprising a plurality of orders, means under control of said digit and duo-decimal perforations for operating an order of said accumulator to add amounts represented thereby, means under control of said digit and duo-decimal perforations and said control perforation for adding the twelfths complement of the amount representing perforations in said order of said accumulator, a pair of typebars, and means under control of said order of the accumulator to adjust said typebars to print the accumulated balance as a true number.

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