Nov. 10, 1953 E. J. RABENDA 2,658,683

ACCOUNTING MACHINE FOR HANDLING NONDECIMAL ENTRIES

Filed June 12, 1951 12 Sheets-Sheet 1

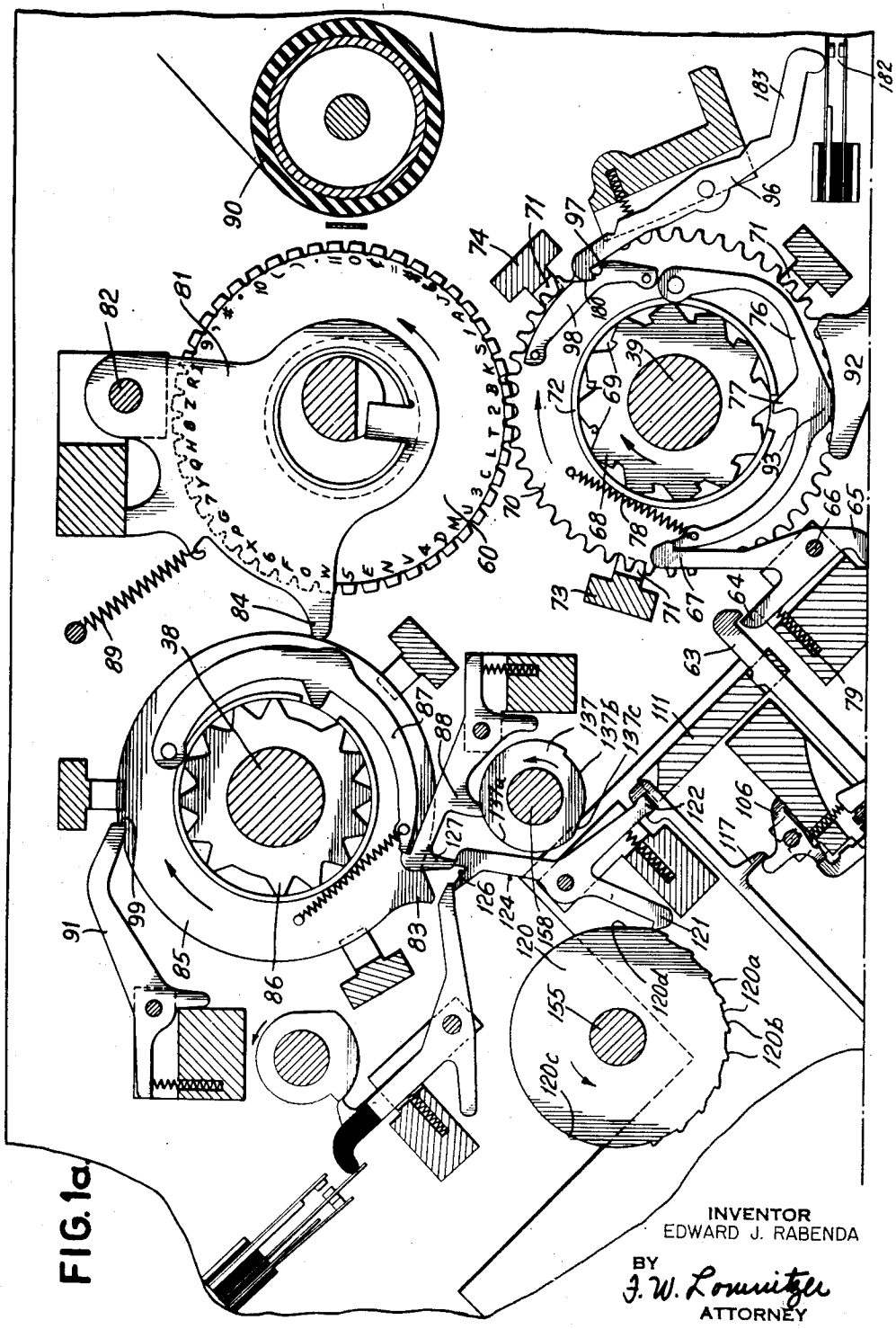


FIG. 1a

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ACCOUNTING MACHINE FOR HANDLING NONDECIMAL ENTRIES

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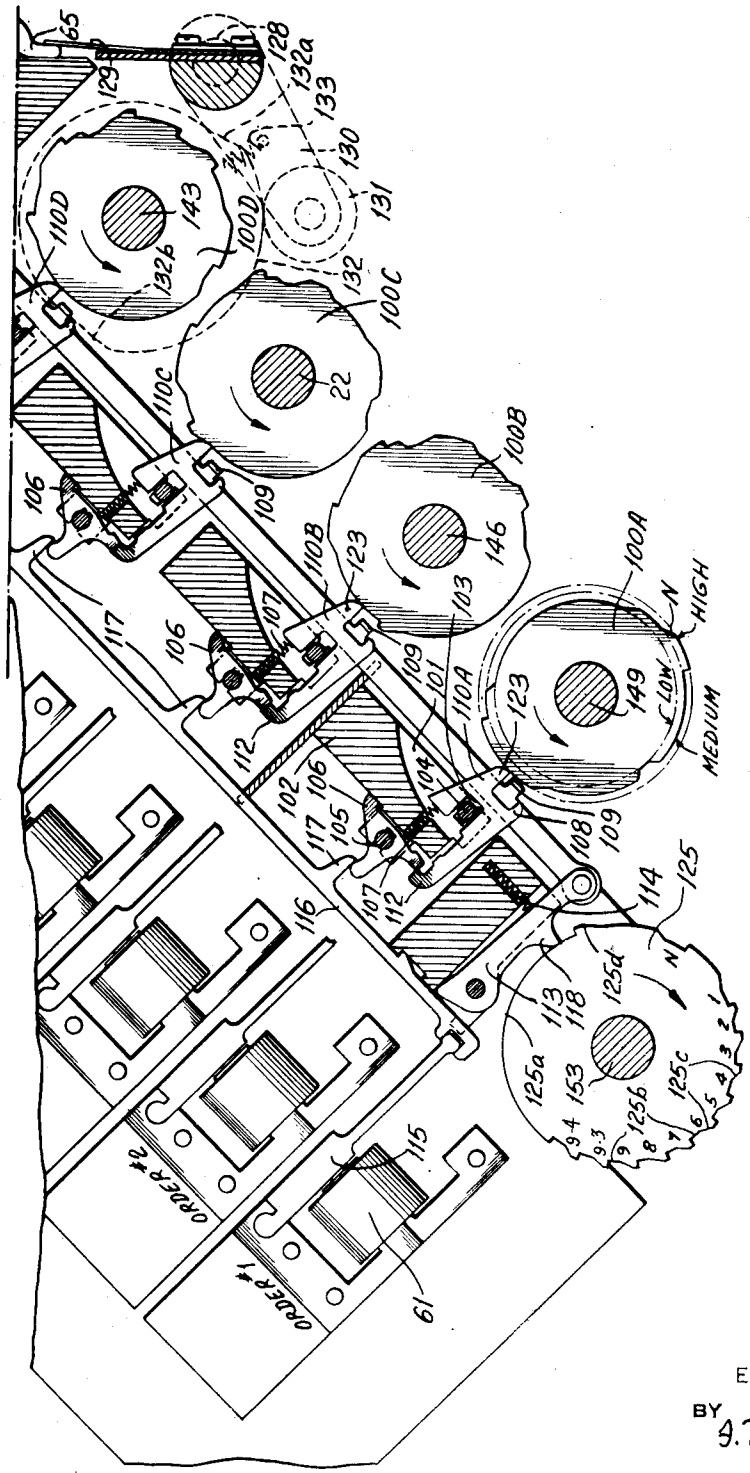


FIG. 1b.

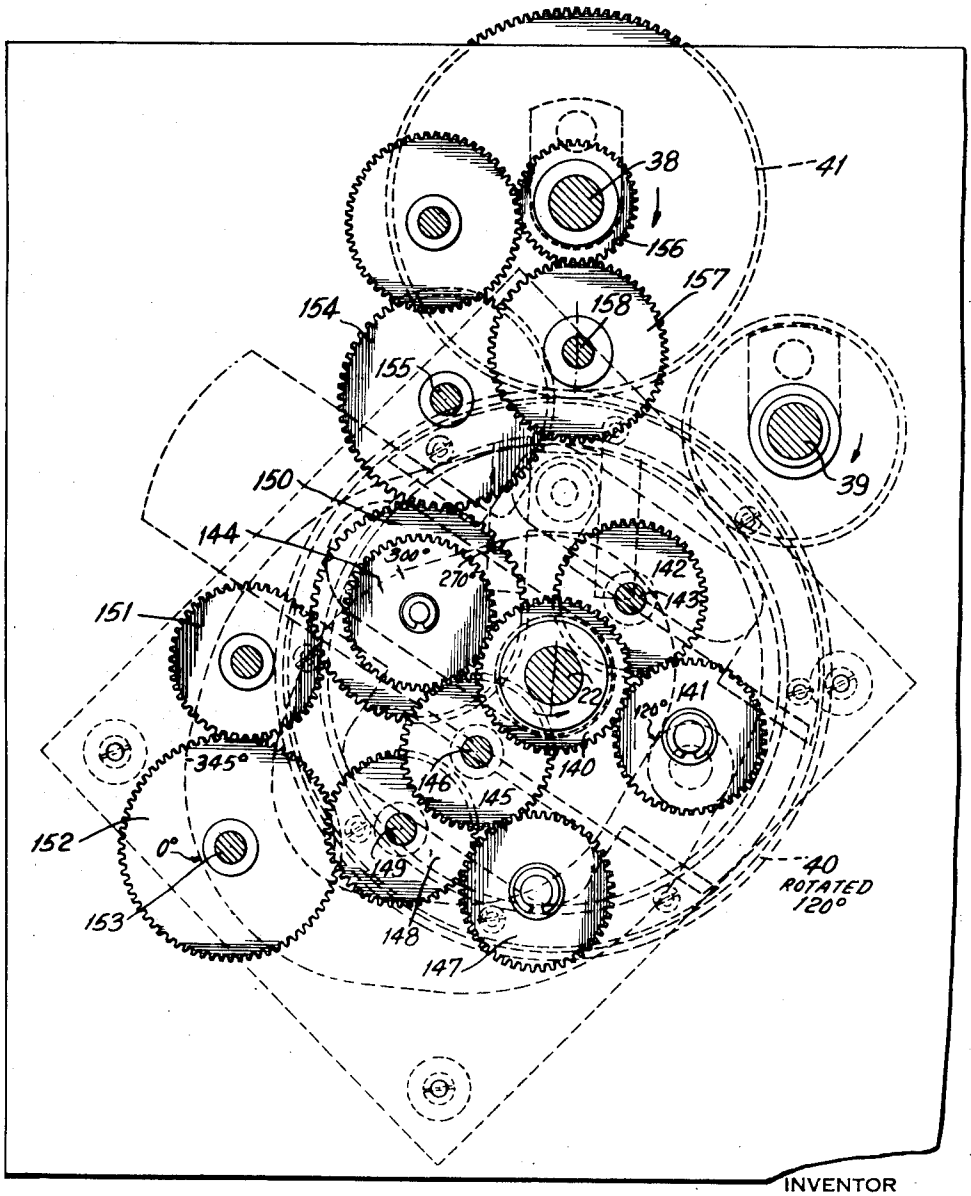
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ACCOUNTING MACHINE FOR HANDLING NONDECIMAL ENTRIES

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FIG. 2

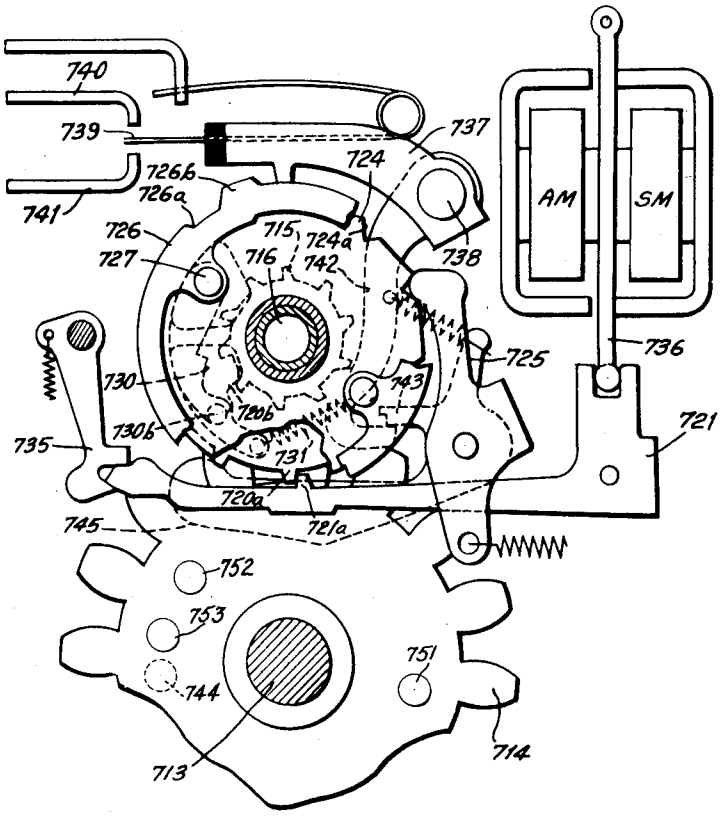


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ACCOUNTING MACHINE FOR HANDLING NONDECIMAL ENTRIES

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FIG. 3



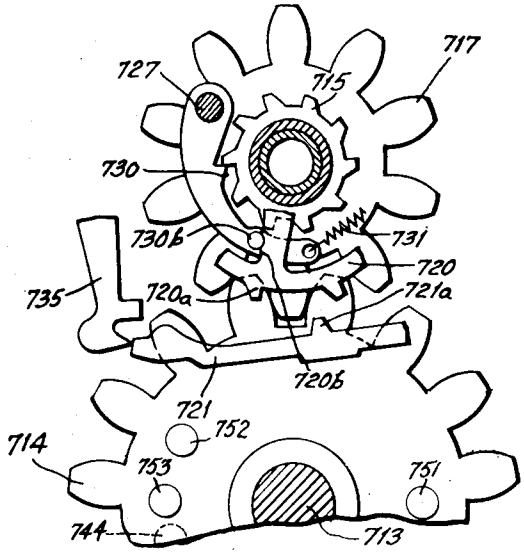


FIG. 4

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ACCOUNTING MACHINE FOR HANDLING NONDECIMAL ENTRIES

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FIG. 5

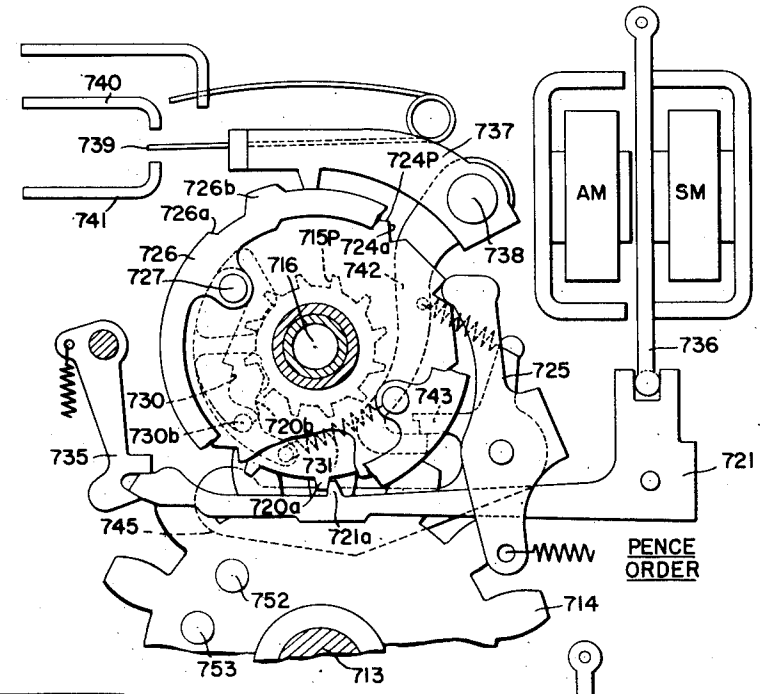
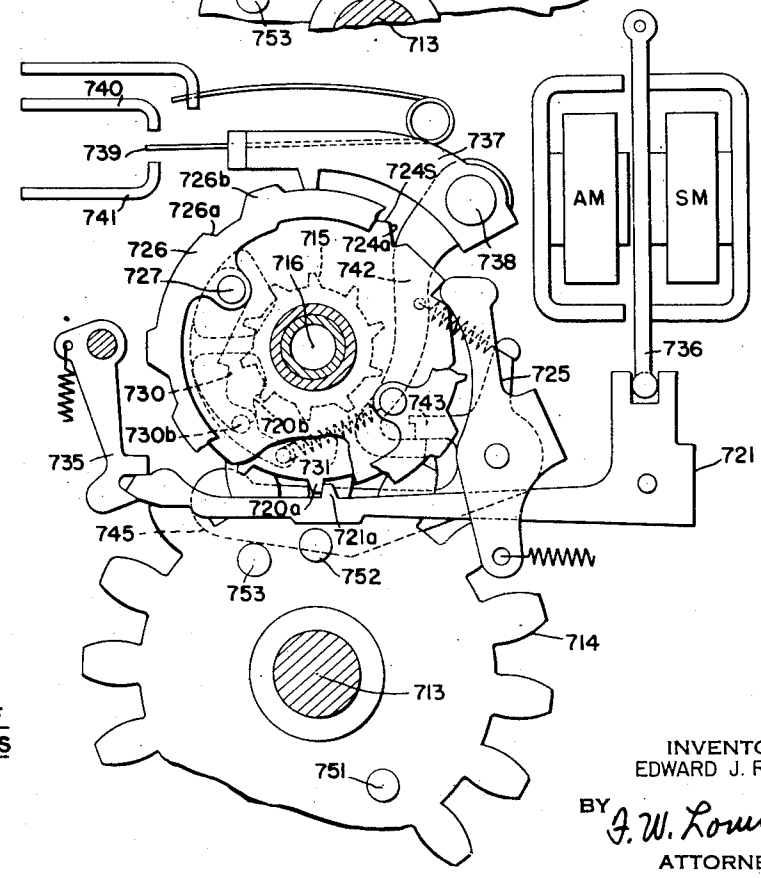


FIG. 6



TENS OF SHILLINGS ORDER

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ACCOUNTING MACHINE FOR HANDLING NONDECIMAL ENTRIES

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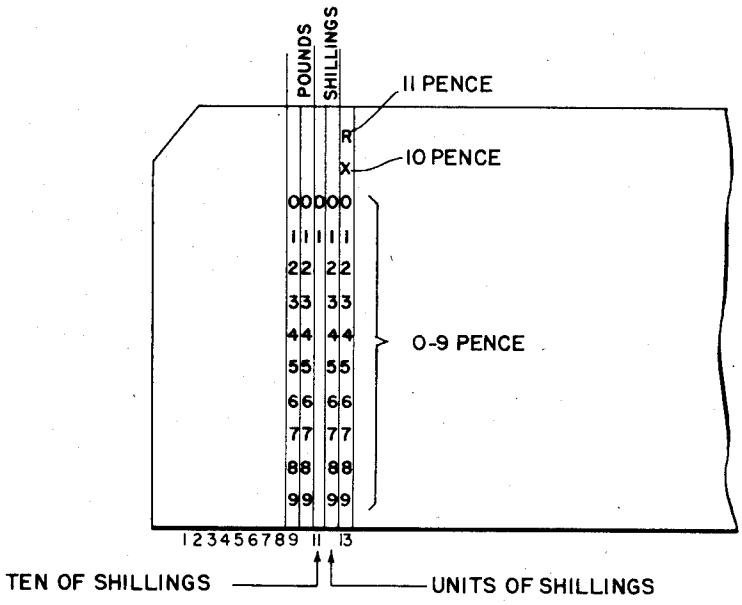


FIG. 8

HOLES-TYPE	
9	9
8	8
7	7
6	6
5	5
4	4
3	3
2	2
1	1
0	0
9-4	11
9-3	10

FIG. 7

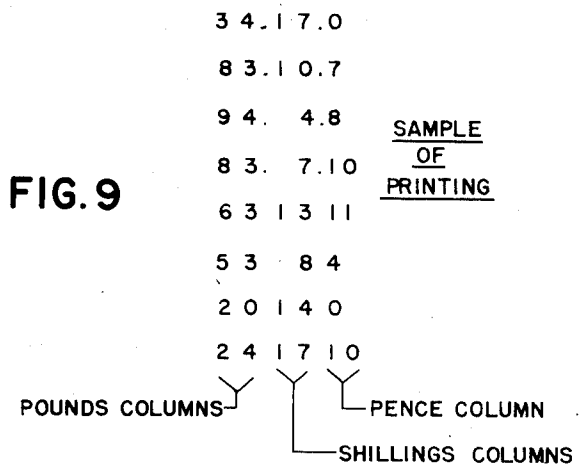


FIG. 9

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ACCOUNTING MACHINE FOR HANDLING NONDECIMAL ENTRIES

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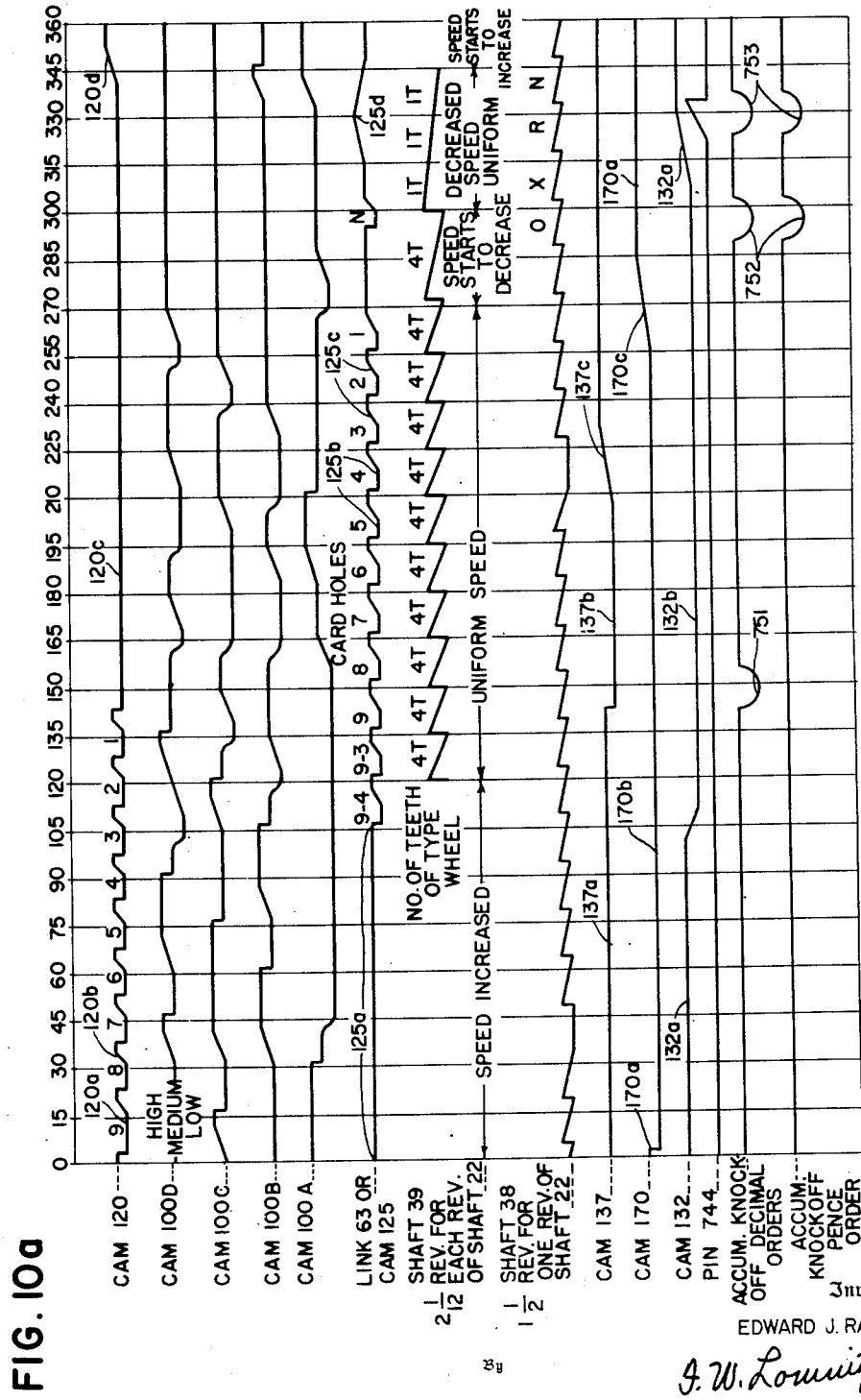


FIG. 10a

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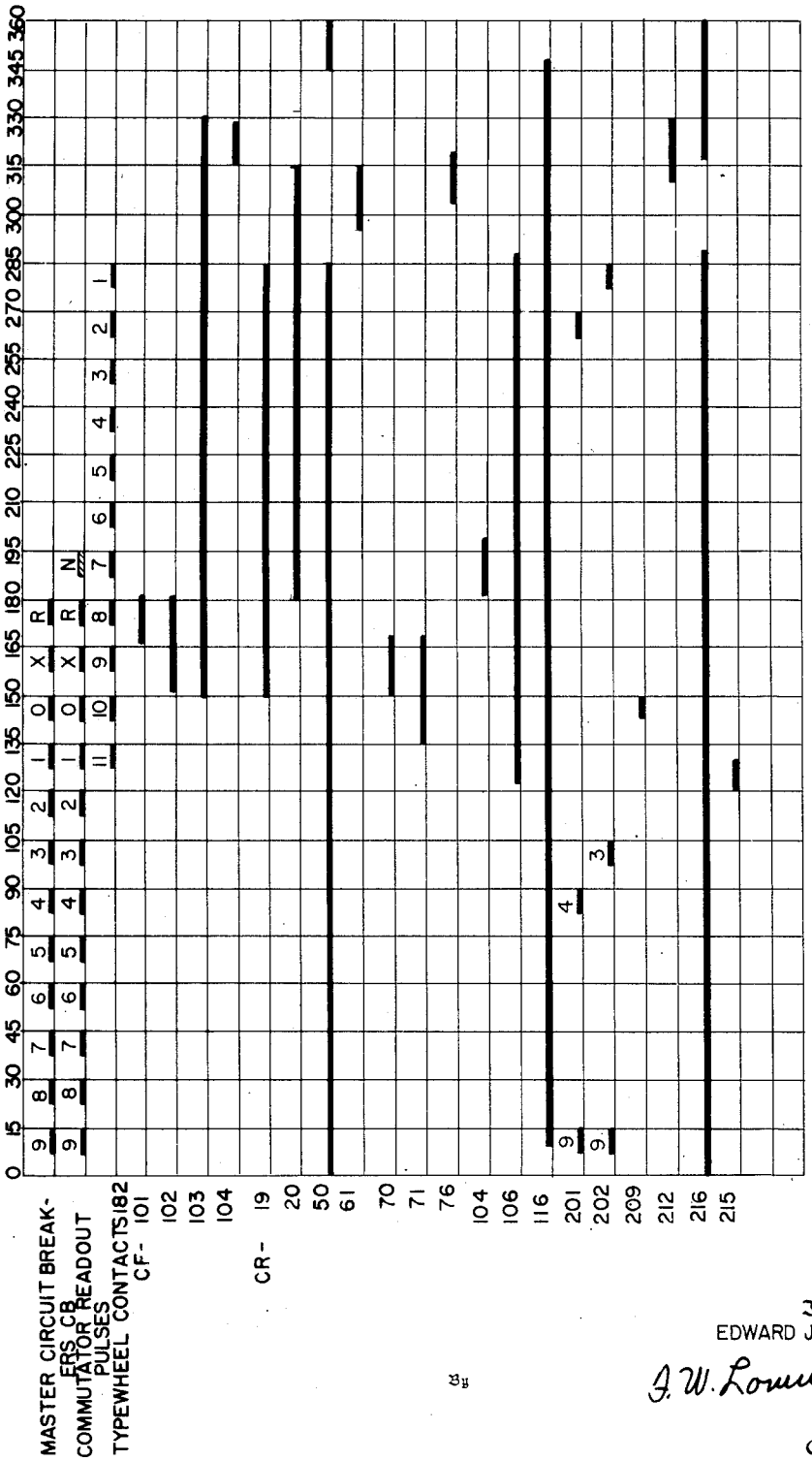


FIG. 10b

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ACCOUNTING MACHINE FOR HANDLING NONDECIMAL ENTRIES

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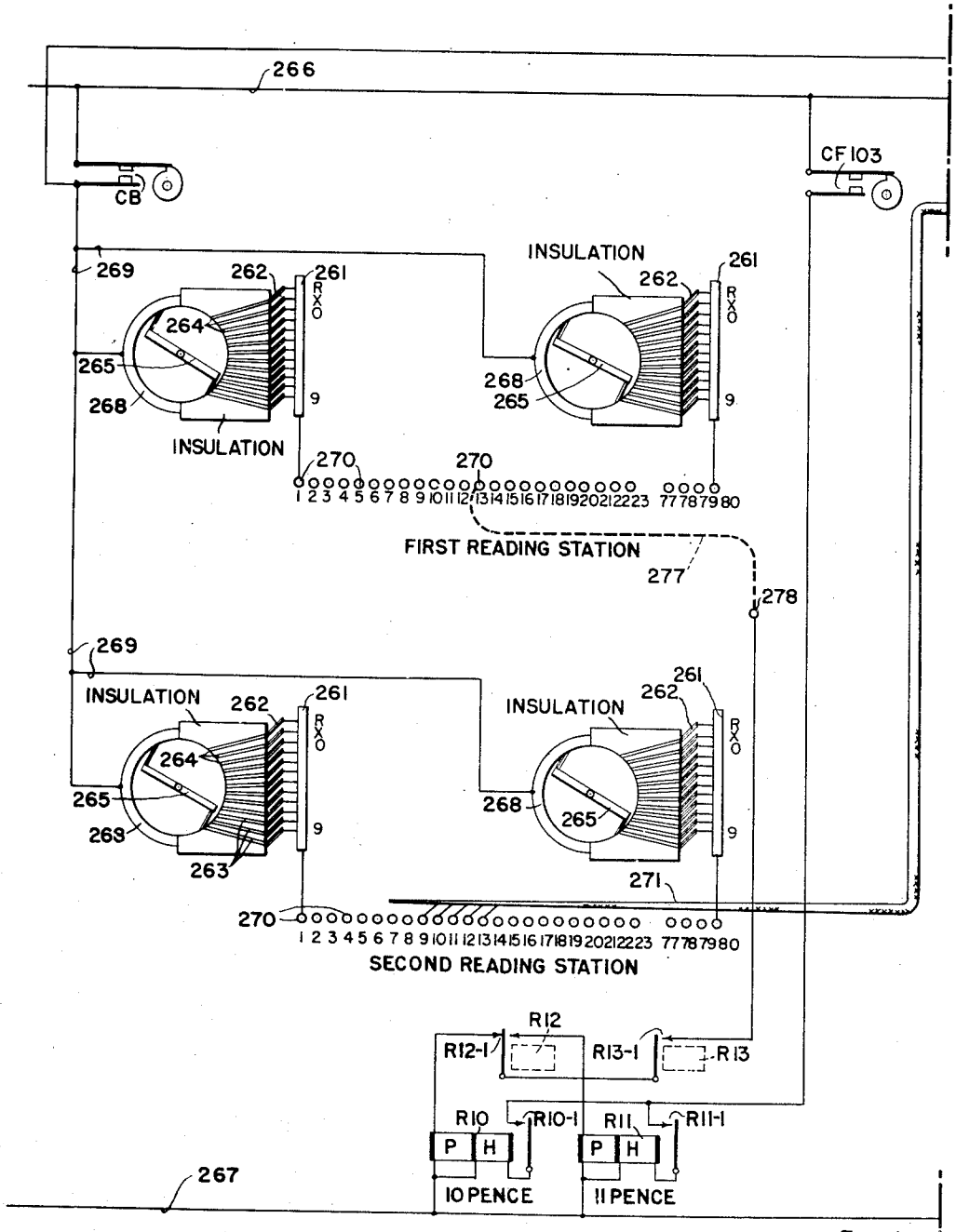


FIG. IIa

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ACCOUNTING MACHINE FOR HANDLING NONDECIMAL ENTRIES

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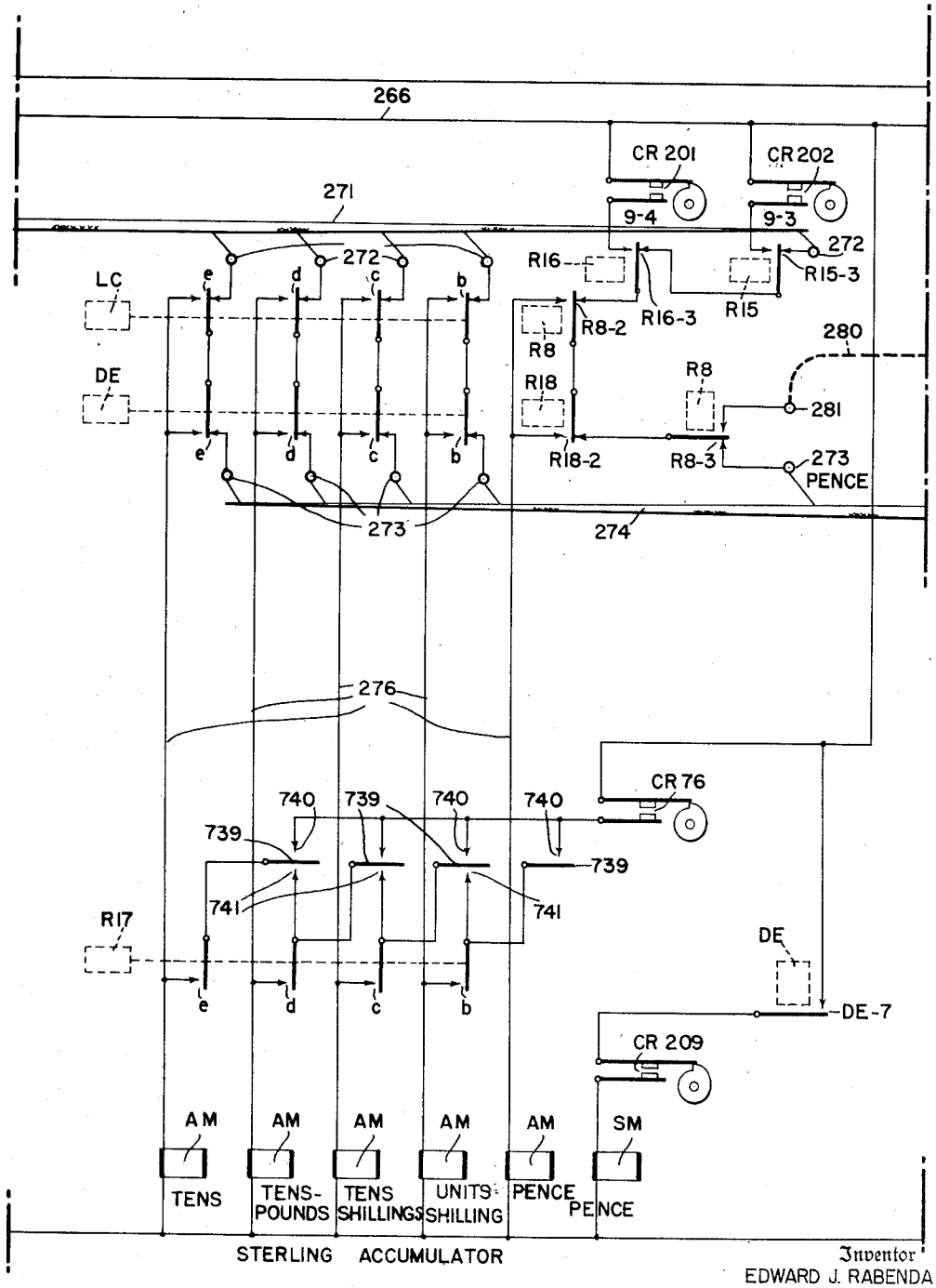


FIG. 11b

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ACCOUNTING MACHINE FOR HANDLING NONDECIMAL ENTRIES

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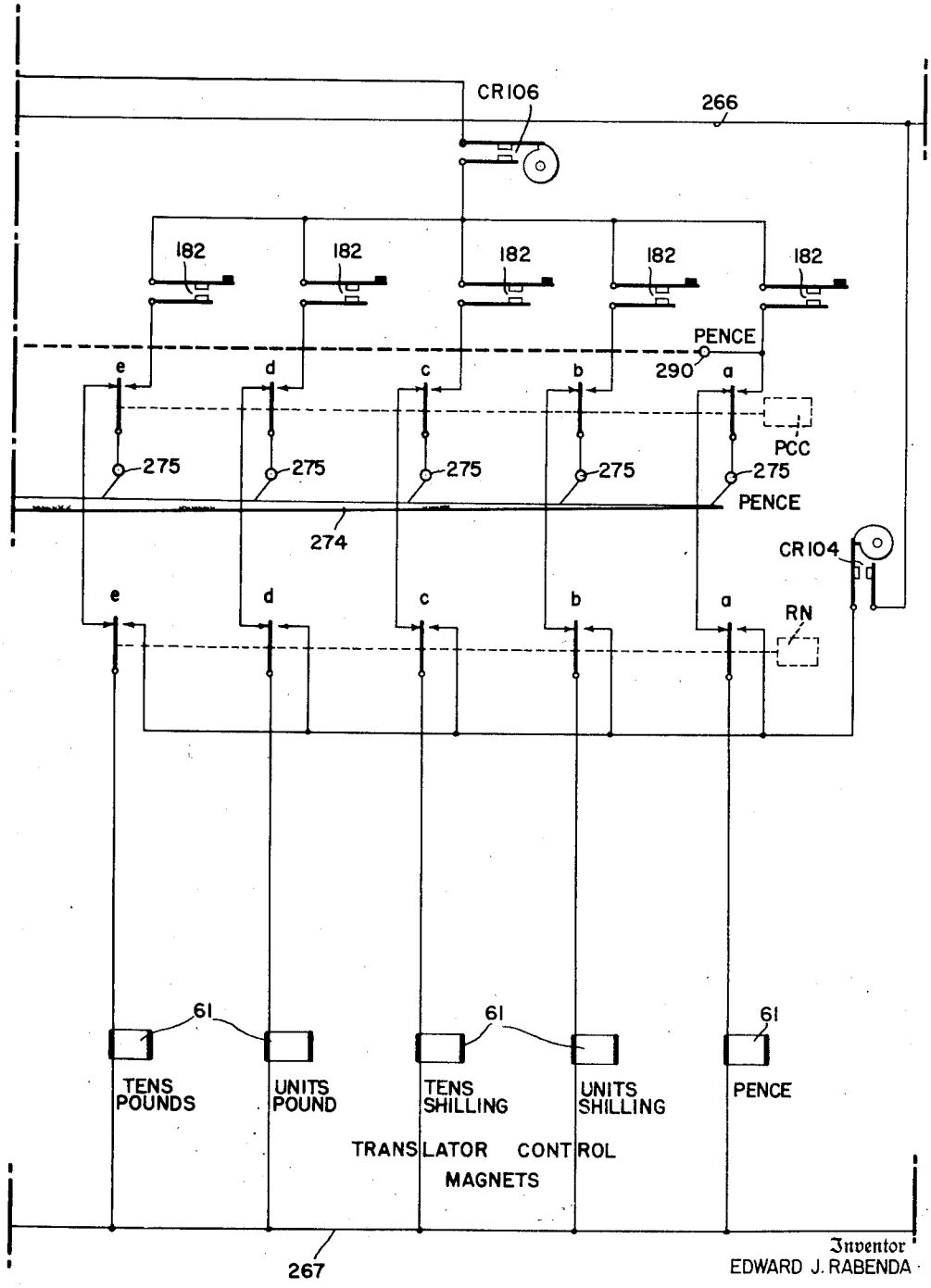


FIG. 11c

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ACCOUNTING MACHINE FOR HANDLING NONDECIMAL ENTRIES

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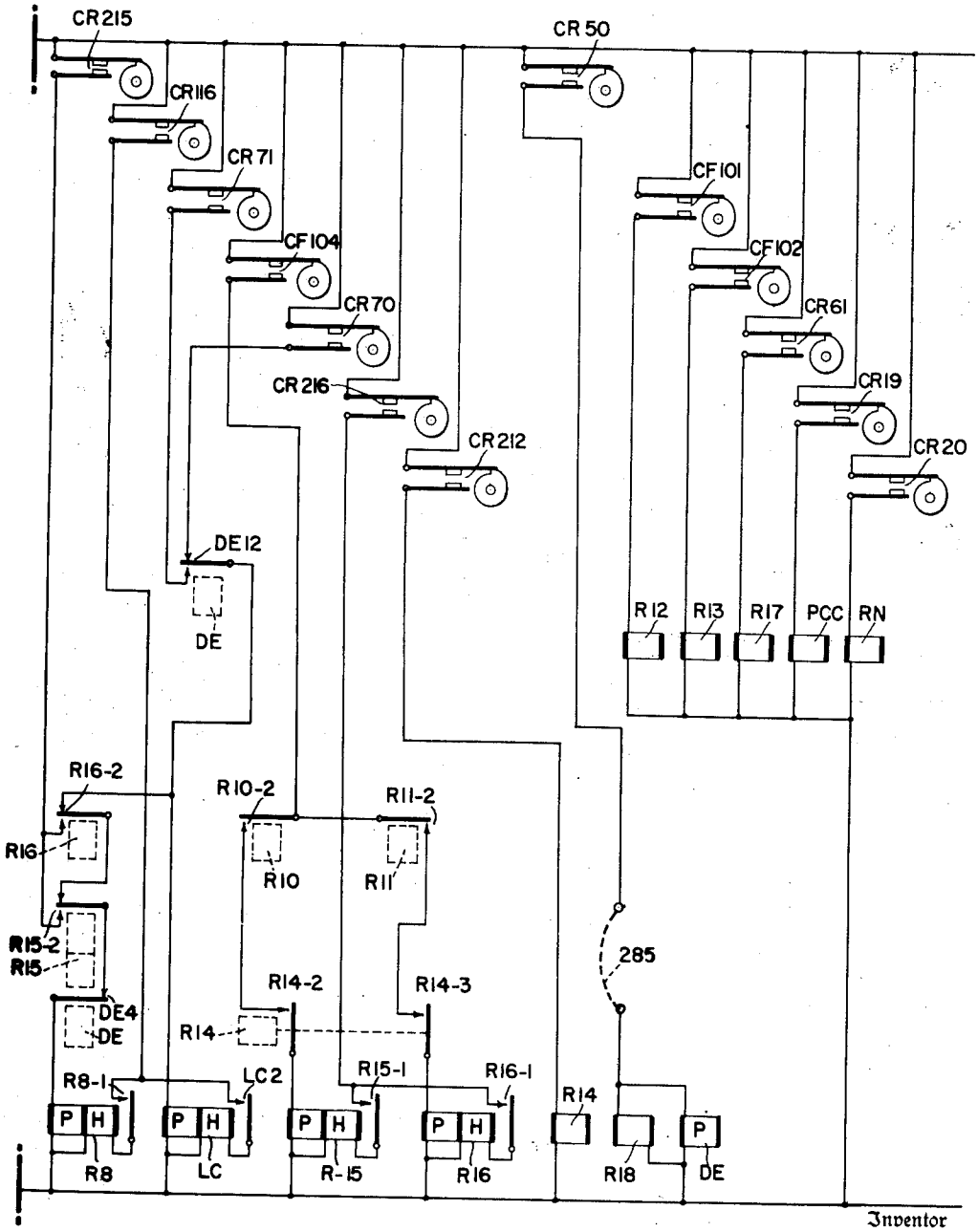


FIG. 11d

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Patented Nov. 10, 1953

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UNITED STATES PATENT OFFICE

2,658,683

ACCOUNTING MACHINE FOR HANDLING NONDECIMAL ENTRIES

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Application June 12, 1951, Serial No. 231,112

7 Claims. (Cl. 235—61.9)

1

The present invention relates to improvements in fraction accumulating and printing devices and is more particularly concerned with means for accumulating and printing duo-decimal amounts, such as pence in the British monetary system. A preferred use of the present improvements is in its incorporation as a pence accumulator order in an accumulator which is modified in certain other orders to accumulate shillings and pounds, thus enabling the accumulator to function to receive entries according to the British monetary system.

The main object of the present invention is to dispense with the two columns or orders previously utilized to represent 1–11 pence and to have such control originate in a single control order, such as a single column of a perforated record, and to further provide a suitable control means exercised by the single column for setting a single printing member to print any of the digits 1–9, 10 or 11 pence. In this manner any printing member of a bank is adapted to print not only decimal digits 1–9 but fractions or duodecimal figures 10 and 11 as well.

A further object of the invention is to provide control means exercised by the printing member to initiate the accumulator entry of either 1–9 pence, and upon entry of 10 or 11, slightly earlier in the cycle, to thereby enter the desired number of pence.

A still further feature of the invention is to provide a selective control, preferably obtained from the 10 or 11 pence designation on the controlling record to condition the machine so that the 10 or 11 entry is initiated slightly earlier in the cycle. A further selective control as to which pence 10 or 11 is to be entered is also exercised by the appropriate 10 or 11 pence designation.

In some forms of accounting machines it is generally preferable to initiate accumulator entries under control of the printing mechanism when it is started to its digit representing position, thereby effecting and insuring a correspondence between the digit printed and digit to be entered. The present arrangement, as far as the entry of pence is concerned, also has this advantageous feature.

At times it is desired to omit printing in which case the present arrangement also provides for entry of amounts according to the sterling notation directly into the sterling accumulator, without entries being controlled by the printing mechanism.

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A feature of the invention in the above type of direct entry is to subdivide the entry of 10 and 11 pence into two entries, the first of which is a first entry of 9, and a second entry of 1 or 2, depending upon the entry of 10 or 11 pence. This second entry is determined by the pence designation on the perforated record, and is selectively effected under control of the 10 or 11 pence designations.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Figs. 1*a* and 1*b* when assembled together with Fig. 1*a* on the top disclose in side elevation one order of the printing mechanism and associated translator mechanism which are adapted to translate and print the values of pounds, shillings and pence.

Fig. 2 is a view in side elevation of the operating gears for the drive shafts of the printing and translator mechanisms.

Fig. 3 is a detail view in side elevation of any decimal order of the accumulator for adding pounds and units of shillings.

Fig. 4 is a view of some of the parts shown in Fig. 3 but in operated position.

Fig. 5 is a view of the accumulator order which is adapted to accumulate pence values.

Fig. 6 is a view of the accumulator order which is adapted to accumulate tens of shillings or halves of pounds.

Fig. 7 represents the code for selecting type.

Fig. 8 is a view of a portion of a card which is adapted to be perforated to represent pence, shillings and pounds.

Fig. 9 is a view showing a sample of printing adapted to be effected by the present printing mechanism for printing pounds, shillings and pence.

Figs. 10*a* and 10*b* comprise a timing diagram.

Figs. 11*a*, 11*b*, 11*c*, and 11*d* when assembled in the named order constitute the wiring diagram.

Card punching

The form of card which is preferably employed to control entries and printing in the present machine is shown in Fig. 8, columns 9–13 being appropriated to receive hole punchings representing pounds, shillings, and pence in the sterling or British monetary system.

Columns 10 and 9 are allocated to represent respectively units and tens of pounds by holes at 0–9 in each of these columns. Columns 11 and 12 are allocated to represent shillings 1–19, by a hole at 0–9 in column 12 to represent units of shillings and a hole in column 11 to represent 1 in the tens of shillings order. Thus, one or two columns are punched to represent 0–19 shillings. Only a single column, column 13, is necessary in the present machine for representing 1–11 pence. Index points 0–9 are punched to represent 0–9 pence. A hole at X represents 10 pence, and a hole at R represents 11 pence.

Translator and printing mechanism

The present machine is provided with a printing mechanism which is adapted to print, as shown in Fig. 9, the entered amounts in pounds, shillings and pence. The units pence order of the printer has a type wheel 60 which not only prints the pence 0–9 but on the same wheel (as shown in Fig. 1*a*) the numbers 10 and 11 are provided to print these pence amounts. The pence type 0–9, as well as the units and tens of shillings and all pounds orders, are selected by the card holes at 0–9 index point positions, but 10 and 11 type are not directly selected by the X and R holes since, as will be made clearer on, such holes select an impulse transmitting means which transmit impulses 9–4 or 9–3, and through a translator the pence printing wheel is rotated to a position to print the 10 or 11 pence type (see code of Fig. 7).

Reference character 22 in Fig. 2 represents a main drive shaft which is rotated one revolution for each machine cycle. The customary card feed shaft which drives the card feed mechanism is driven by shaft 22, and interposed between the card feed shaft and shaft 22 is the usual card feed clutch which is engaged, as is well known, by the energization of the usual CF clutch magnet (not shown).

In Figs. 1*a* and 2 reference numeral 38 designates the printing impression drive shaft which is driven with a uniform speed of rotation for each cycle of the operation of the machine. The main drive shaft 22 has secured thereto a gear 40 (Fig. 2) which drives a gear 41 secured to the printing impression drive shaft 38 to rotate the latter at a uniform speed of rotation one and a half revolutions for each revolution of drive shaft 22. Reference numeral 39 designates the type selecting drive shaft which rotates two and one-twelfth revolutions for each operating cycle. At times shaft 39 is driven with a uniform speed of rotation substantially synchronous with the drive shaft 38, but at other times the speed of rotation given to shaft 39 is decreased or increased with respect to the drive shaft 38.

In the columns where 0–9 is perforated such holes are analyzed when the card is in the second analyzing station, as will be described. For each card column a printing control magnet 51 is energized and in accordance with such holes a setup is made in the translator and interpreted as a delayed mechanical impulse which consists of the movement of an operating link 63 (Fig. 1*a*) at differential times. For the selection of type

1–9 determined by the holes 1–9 the operating link 63 is shifted to the left at differential times between 135–270° of the operating cycle as is shown in the timing diagram (Fig. 10*a*). During this time shaft 39 is being rotated at a uniform speed of rotation. The shifting of the operating link 63 at differential times is provided herein to transmit a differentially timed mechanical impulse to trip the type selecting clutch shown in Fig. 1*a*, now to be described in detail.

For each printing order there is pivoted on a rod 66 a triple arm member consisting of arms 64, 65 and a clutch release arm 67.

Shaft 39 has secured thereto a tube 68 which is fluted transversely along its periphery to provide clutch notches 69. Tube 68 constitutes the driving clutch member. Encircling the clutch tube 68 is a plurality of gears 70, there being one gear for each order of the printing mechanism. For mounting the gears 70 on the clutch tube 68, each gear has integral therewith a flange 72. To provide for the lateral spacing between the gears 70 the gears are guided by guide slots 71 formed in guide blocks 73, 74 and 75. By such spacing members the gears 70 are separated to allow independent rotation and to also locate a clutch pawl 76 which is pivoted on the related gear to cooperate with the clutch release arm 67. The clutch release arm 67 normally holds the clutch pawl 76 in such position that its tooth 77 is out of engagement with any of the clutch notches 69 of the clutch tube 68. When the clutch release arm 67 is rocked as a result of the actuation of the operating link 63 at a differential time, the clutch is engaged because a spring 78 attached to clutch pawl 76 will rock the latter in order that the clutch tooth 77 will engage a clutch notch 69 determined by the differential time the operating link 63 is actuated. The above described clutch is the printing type selecting clutch and causes the differential rotation of the printing wheel 60, since the gear 70 and the printing teeth of the type carrying wheel 60 are intergeared.

Figs. 1*a* and 1*b* show the arrangement of the printing devices for a single order and the machine is preferably provided with duplicate devices for printing a plurality of characters.

If the operating link 63 was shifted at about 138° as a result of a hole at the 9 index point position of the controlling column, the clutch release arm 67 would be rocked at this time and pawl 76 would be released and rocked by spring 78 so that clutch tooth 77 engages a clutch notch 69 and printing wheel 60 will thereafter continue to rotate to such position as to present the numeral type 9 to the printing line. The differential time at which the operating link 63 is actuated determines the extent of counterclockwise rotation of the printing wheel 60 from a rest position necessary to select the type 1–9 for printing. After the predetermined extent of rotation of the printing wheel 60 has been effected and the printing impression has been effected, with the type selecting clutch still engaged, the printing wheel 60 will continue to rotate until the free end of the clutch pawl 76 strikes the clutch release arm 67 which, in the meantime, has been brought to its normal position, by means of a compression spring 79 (Fig. 1*a*). When such disengagement is effected the printing wheel 60 is at the normal position shown in Fig. 1*a*.

Each printing wheel 60 is carried by an arm 81 loosely pivoted upon a rod 82 and provided with a rearwardly extending follower extension 84 which is operated by a cam projection 83 of a

cam disk 85 which constitutes a driven member of a printing clutch.

Shaft 38 rotates a clutch tube 86 fixed thereto and likewise encircling the clutch tube 86 is the driven clutch disk 85 upon which is pivotally mounted a clutch pawl 87. Clutch disk 85 and parts carried thereby are guided similarly to gear 70. Associated with the clutch pawl 87 is a clutch release arm 88. When the clutch engagement is effected between the clutch pawl 87 and one of the clutch notches of the clutch tube 86, the disk 85 will be rotated in a clockwise direction, whereby the cam projection 83 will cooperate with the follower extension 84 to rock arm 81 about the rod 82 against the action of the return spring 89. The engagement of the printing clutch now being described is effected when the print control magnet 61 for each order is again energized for numeral printing by an "N" impulse, as will be described.

When the printing clutch engagement has been effected, each cam 85 will cooperate with the related follower extension 84 to rock the associated printing arm 81 to force the printing wheel 60 against the usual inking ribbon and platen 90 around which platen is positioned the paper strip to be imprinted. As each arm 81 is rocked against the action of the spring 89, the printing wheel 60 is being rotated counterclockwise but since the printing wheel is now rolling over the gear 70, this rolling action will cause an equal and simultaneous rotation in a clockwise direction. Both of these opposite rotations will, in effect, cause the printing wheel to be immobile with respect to its rotation when it moves to the right to strike the platen 90, the type striking the platen squarely and firmly to cause a legibile impression.

After the printing operation, when cam extension 83 of the cam disk 85 passes by the follower extension 84, spring 89 will now be effective to return the type wheel carrying arm 81 to normal position and the extension 84 now bears against the circular peripheral edge of the cam disk 85.

After the printing operation, since the type selecting clutch is still engaged, the printing wheel 60 continues to rotate as previously stated until the clutch pawl 76 strikes the clutch release arm 67 which, in the meantime, has been positioned to normal, thereby disengaging the type selecting clutch when the printing wheels are at normal position.

The printing clutch continues its engagement for a complete rotation of the cam 85 and the clutch disengagement is effected by the engagement of the clutch pawl 87 with the clutch release arm 88.

As the free end of the clutch pawl 76 strikes the clutch arm 67 there is a tendency to cause the gear 70 to rebound counterclockwise. This action is prevented by the cooperation of a spring-pressed detent arm 96 with a shoulder 97 of a plate 98 secured to each gear 70. When the normal position of the clutch is obtained, the detent arm 96 will engage the shoulder 97 to prevent such rebound and retain the clutch parts in their normal position.

A somewhat similar rebound preventing mechanism is also provided for the printing clutch which consists of a spring-pressed detent arm 91 cooperating with the shoulder 99 of the cam disk 85.

Cams 100A, 100B, 100C and 100D (Figs. 1*a* and 1*b*) are driven by driving means to be subsequently described one revolution for each cycle of operation of the machine. It will be noted that these cams differ in their cam contours and the particular cam portion which is effective in each point of the operating cycle is shown in the timing diagram of Fig. 10*a*. Each of the cams is provided with cam heights which are identified by three dotted circles associated with the cam 100A (Fig. 1*b*), which circles are of three different diameters and represent the heights of the cam contours as Low, Medium and High. The corresponding designation is shown in the timing diagram of Fig. 10*a* for such cams to identify the particular cam portion effective in each point of the operating cycle. The cams 100A, 100B, 100C and 100D may for convenience in construction be extended longitudinally to provide fluted cam rods having the configuration and outline in Fig. 1*b* to cooperate with a plurality of orders.

Each cam 100 cooperates with a related releasing and blocking member 110. The reason that the member 110 is also called a releasing member is that when elevated a predetermined distance by the Medium or High cam portion of the related cam 100 it will release the operating link 63 for movement but when in its normal lower position (due to the Low cam portion) it will block the link 63 against movement. Each member 110 is slidably mounted in a slot 101 of a guide block 102 and is further guided by a rod 104 which receives a guide slot 103 of the related member 110. Also pivoted on a rod 105 carried by the block 102 is a latch pawl 106. Interposed between the pawl 106 and the associated member 110 is a compression spring 107, the spring 107 functioning to urge the member 110 downwardly so as to always press against and contact with the cam contour of the related cam 100. Each member 110 is provided with a shoulder 108 cooperating with a lug 109 formed as an integral part of the link 63.

The link 63, referring to Fig. 1*a*, is slidably mounted in guide slots formed in a support plate 111 to support the link 63 at one end and guide its movement, and referring to Fig. 1*b* the other end of the link 63 is dependently hung by arm 113, which arm has a cam follower extension 118. A compression spring 114 fitting in a spring support and guide block for arm 113 urges the link 63 to the left and when such spring is effective for action under control of a cam 125 it serves as the source of a delayed mechanical impulse transmitted to link 63 at a differential time to rock the clutch release arm 67 to initiate rotation of a type wheel.

Recalling now that each cam 100 has cam contours of three different heights, it should be observed that when member 110 is at a position determined by the low portion of the cam 100, the shoulder 108 abuts lug 109 to block the link 63 from movement to the left, urged by compression of the spring 114. In attempting to do so lug 109 will bear against the shoulder 108 and urge the member 110 clockwise, which movement is restrained by the cooperation of an upstanding hooked portion 112 of member 110 against the latching end of the pawl 106. Assuming now that a cam has been rotated so that the Medium cam portion of the cam contour has raised the member 110, such difference in cam height with respect to the Low cam height will elevate shoulder 108 slightly further above the related lug 109 and by the continued cooperation of the hooked extension 112 of the member 110 with the extremity of

the pawl 106, clockwise movement of the pawl 110 will be still restrained.

Assuming now that the High cam portion has positioned the member 110 to its maximum height, the shoulder 103 will be still further above the lug 109 and the member 110 is now in such position that the compression spring 107 will be effective to rock the member 110 clockwise so that a hooked extension 112 will catch over the latch end of pawl 105, provided that at this time the pawl 106 is rocked counterclockwise due to the concurrent analysis of a hole in the card at the time the member 110 is in its highest position. If the pawl 106 is not rocked slightly counterclockwise, no latching of the member 110 will take place. Summarizing, whenever the High portion of a cam has elevated a member 110 to the highest position, such member will be latched if the related pawl 105 is concurrently rocked to latching position. If there is no rocking of the pawl 106 at this time, member 110 will not be latched, and will be subsequently free to move up and down in accordance with the successive cam contour as the related cam 100 rotates.

The above description has been confined to the operation of the parts under control of the cam 100A but it should be noted that identical operations are effected under control of the remaining cams 100B, 100C and 100D. For this reason, the description of operation need not be repeated for duplicate parts.

For the purpose of rocking the pawls 106 to latch those members 110 which are at their highest position at the time a hole is sensed in the card, it will be seen that referring to Fig. 1b each printing magnet 61 when energized attracts an armature 115 and rocks the same so as to shift a related connected link 116 to the left. Extending from the link 116 are four integral extensions 117, each of which cooperates with the related pawl 106. The result of this construction is that the impulse directed to the magnet 61 will attract its armature 115 to shift the link 116 and rock the four pawls 106 concurrently but only that pawl 106 is effective for latching the related member 110 if said member 110 has been elevated to its highest position. Therefore, one or more of the pawls 106 may be rocked idly at the same time without latching the related members 110.

To prevent the armature 115 from sticking to the core of the magnet 61 due to residual magnetism, it is desirable to provide means to positively restore the link 116 and armature 115 to normal by mechanical means timed with the rotation of the cams 100. To this end there is provided a magnet knockoff cam 120 (Fig. 1a) notched as shown. A follower arm 121 of a clutch release arm 124 cooperating with the cam 120 has a mechanical connection 122 with the link 116. At the time the magnet 61 is energized it will be observed that follower arm 121 cooperates with a notch 120a of the cam 120. Thereafter, such arm cooperates with the following cam portion 120b to rock arm 121, link 116 and armature 115, restoring the armature 115 to normal if it should remain attracted to the core under the above circumstances.

Referring now to Fig. 10a, it is obvious that at the time the card holes 9–1 are analyzed one or more cams 100 will have their High portions in cooperation with the latching members 110. At the time the 9 card hole is analyzed the High portions of cams 100A and 100C will be effective. At the time the 8 card hole is analyzed, only cam 100A will have a High portion effective at this time. For all of the cards holes 9–1, this condition may be represented by the following table:

TABLE I

Holes	Members 110 Latched
9	110A, 110C.
8	110A.
7	110B, 110C, 110D.
6	110B, 110C.
5	110C, 110D.
4	110B, 110D.
3	110B.
2	110C.
1	110D.

It is obvious from the above table that members 110 are latched singly or in predetermined combinations, so that at the termination of the analysis of the card holes 9–1, some of the members 110 will be latched and others will not be latched and therefore free to be positioned according to the contour of their cams during their subsequent rotation. It is explained that once a member 110 is latched it is not free to thereafter move upwardly and downwardly in accordance with the subsequent cam contour of the related cam, but remaining unlatched members can do so. After latching of members 110 in predetermined combinations the contour of the cams 100A, 100B, 100C and 100 D which are thereafter effective will determine the time in the operating cycle that the operating link 63 will be moved to the left in a manner now to be described in detail:

After one or more members 110 are latched in combination according to the holes analyzed as indicated in the preceding table, the further rotation of the cams 100 will raise and lower the remaining unlatched members 110 according to the cam contours of the respective cams, but during said further rotation of the cams the link 63 will be restrained against movement by one or more of such unlatched members until a point is reached in the operating cycle when the cams related to the unlatched members concurrently present cam operations of Medium height to the unlatched members. It will be recalled that since the latched members 110 are so positioned that they do not restrain the movement of the link 63 under the influence of the spring 114, and further, the elevation of any unlatched member by a cam portion of Medium height will also unlock the link 63, it is obvious that when both of these conditions exist for four of the latches 110 link 63 is then free to move under the influence of the spring 114 and cam 125. This will be made clear by reference to a particular example.

If, for example, the 9 hole is sensed, members 110A and 110C are latched due to the High cam portion of their respective cams 100A and 100C and such latching of members 110A and 110C occurs about 7½° of the operating cycle when the 9 hole is analyzed (see Fig. 10a). At this time, the members 110A and 110C are latched in the highest position so that they unlock the operating link 63 at such positions. However, cams 100B and 100D in their subsequent rotation continue to raise and lower the related unlatched members 110B and 110D and one or the other of such unlatched members 110B, 110D will restrain the operating link 63 from movement until about 138° of the operating cycle, at which time both cams 110B and 110D, through their Medium high cam portions, shift related latching members 110B and 110D to unlock the link 63. At this time cam follower extension 118

of the arm 113 will cooperate with the notch 125b designated "9" in both Fig. 1b and the timing diagram of Fig. 10a. Operating link 63 is now unlocked at four points and the movement of the link to the left is effected at about 138° by spring 114. The link will now operate the clutch release arm 67 and therefore engage the type selecting clutch to initiate the rotation of the printing wheel 60 to select the numeral type 9.

The type selecting clutch will be engaged at about 150° of the operating cycle and from the timing diagram (Fig. 10a) the type carrying wheel 60 will rotate 4, 4, 4, 4, 4, 4, 4, 4, 3 or thirty-nine teeth, and at about 345° of the operating cycle the 9 type will now be in position to print.

Reverting now to Fig. 1b, when the operating link 63 is moved to the left to effect the engagement of the type selecting clutch the cam follower extension 118 is in the bottom of the notch 125b of the cam disk 125 and further rotation of the cam 125 in a clockwise direction will, through the following inclined cam portion 125c, cooperate with the cam follower extension 118 to positively restore the operating link 63 to the right without, however, causing the unlatching of any latched member 110. At about 330°, an extra high cam portion 125d will shift link 63 to the right beyond the Fig. 1b position, and in so doing for those members 110 which have been latched lug 109 will engage the shoulder 123 of the respective member 110 to rock the same counterclockwise to unlatching position, spring 107 being compressed during this operation to rock the pawl 106 to normal position shown in Fig. 1b. With respect to any unlatched member 110, movement of the operating link 63 to the right at this time may also effect movement of such members 110 but the operation of such is ineffective.

It is desirable to provide means to insure that the clutch release arms 67 are at their normal position and will remain so when engaged by the extremity of the clutch pawls 76 to unlatch the latter from the ratchet teeth 69. Such means now to be described is independent of the springs 79. Referring to Fig. 1b there is pivoted on a shaft 128 a plate which has fixed thereto a comb plate consisting of spring-formed fingers 129 which bear against the lower extensions 65 of the clutch release arms 67. Attached to shaft 128 is a follower arm 130 carrying a roller 131, cooperating with a cam 132 secured to a drive shaft 143. From Fig. 10a it will be seen that a cam rise 132a operative at about 306° of the operating cycle is effective to cooperate with the follower roller 131 to rock the shaft 128 counterclockwise, pressing the spring fingers 129 against the related extensions 65 of the clutch release arms 67, positively retracting them to the normal position shown in Fig. 1a. Thus, it is insured that clutch release arms 67 will be in such position that they will be in the path of the free ends of the clutch pawls 76 to move them to unclutching positions.

A low portion 132b of such cam 132 is effective to enable the follower arm 130 to be rocked by a spring 133 to cooperate with such low portion 132b which releases the spring pressure on the clutch release arm 67 to free the latter for rocking to engage the type selecting clutch.

Upon transmission of the N impulse through circuits to be described, the second energization of the magnet 61 again attracts its armature 115 and shifts link 116. The latter thereupon rocks the clutch release arm 124 to unlatch the clutch release arm 88 of the printing clutch. At this time a low portion 120c (see Figs. 1a and 10a) of cam 120 cooperates with the cam follower extension 121 so as not to restrain the rocking of clutch release arm 124. When the clutch release arm 88 is unlatched, a depending extension 127 moves in a clearance portion 126 of said arm 124. Cam disk 83 will now rotate clockwise and the cam extension 83 will strike the follower extension 84 at the time the selected type is at the printing line to effect the printing impression.

It is undesirable to have the clutch release arm 88 released whenever arm 124 is rocked by link 116 the first time due to the analysis of card holes 1–9 and to this end a high portion 137a of cam 137 cooperates with arm 88 to block it against movement to release the printing clutch during the analysis of holes 1–9. When the N impulse is transmitted, as will later be described, the low portion of cam 137b (see Fig. 10a) will cooperate with clutch release arm 88 to permit its rocking to engage the printing clutch. After this the cam rise 137c of cam 137 will function to positively retract the clutch release arm 88 to normal position to cause disengagement of the clutch release pawl 87 after a complete revolution of the printing clutch. At the termination of the operating cycle a cam rise 120d of cam 120 functions to rock the clutch release arm 124 clockwise to again position it beneath the extension 127 of the clutch release arm 88, which previously has been elevated to the position shown in Fig. 1a. The cam rise 120d also shifts link 116 to restore armature 115 to normal if it should stick to the core of magnet 61.

While the operation of the machine has been described in connection with the selection of the 9 type under control of the 9 card hole, the same principle of operation for effecting the above results is involved for other holes as is evident from the following table:

TABLE II

Hole	Members 110 Latched	Mechanical Impulse at—	Cams 100 at Medium Cam Portion
		Degrees	
9	110A, 110C	138	100B, 100D.
8	110A	153	100B, 100C, 100D.
7	110B, 110C, 110D	168	100A.
6	110B, 110C	183	100A, 100B.
5	110C, 110D	198	100A, 100D.
4	110B, 110D	213	100C, 100A.
3	110B	228	100A, 100C, 100D.
2	110C	243	100A, 100B, 100D.
1	110D	258	100A, 100B, 100C.

It will be recognized from this table that the concurrent position of cams 100 at a Medium height cam portion for those cams which have not previously latched members 110, will determine the time the mechanical impulse is transmitted.

Gear drive for printer

In Fig. 2 reference numeral 38 designates the printing impression drive shaft which is driven at a uniform speed of rotation for each cycle of the operation of the machine. The drive shaft 22 has secured thereto a gear 40 which drives a gear 41 secured to the printing impression drive shaft 38 to rotate the latter at a uniform speed of rotation of one and a half revolutions for each revolution of drive shaft 22.

Shaft 39 represents the type selecting drive shaft which rotates $2\frac{1}{2}$ revolutions for each oper-

ating cycle. The shaft 39 is driven at times with a uniform speed of rotation synchronous with the drive shaft, but at other times the speed of rotation given to shaft 39 is decreased or increased with respect to drive shaft 38, in order to select the desired alphabet type of a selected group of alphabet type. This means to effect the variable drive of shaft 39 is disclosed in full detail in Patent No. 2,439,445, issued to H. S. Beattie, and since the alphabet printing is of no concern here it need not be described nor necessary to understand the present invention. With such variable speed drive the shaft 39 will rotate the type wheel at a decreased speed to present the selected numeral type to the platen at about 330° of the cycle, at which time the previously clutched printing cam 85 will have its cam projection 83 in position to strike the projection 84 to impress the selected numeral type against the platen 90.

The machine includes a driving means driven by the shaft 22 for rotating the cams 100A, 100B, 100C and 100D, 120, 125, 137 and 132 in synchronous relationship and such cams are driven one complete revolution for each operating cycle.

The driving means for driving cams 100A, 100B, 100C and 100D will now be described. Secured to shaft 22 is a gear 140 (Fig. 2) which, through a gear 141, drives a gear 142 secured to the drive shaft 143 for the cam 100D. Shaft 22 is extended to directly drive the cam 100C. Referring to Fig. 2 gear 140, through a gear 144, drives a gear 145 secured to the drive shaft 146 for cam 100B. Gear 145, through an idler gear 147, drives a gear 148 secured to the drive shaft 149 for the cam 100A. By such driving means the cams 100A, 100B, 100C and 100D are driven synchronously. Referring to Fig. 2 gear 144 has rotatable therewith a gear 150 which, through an idler gear 151, drives a gear 152 attached to the shaft 153 to which the cam 125 is secured.

Gear 150 also meshes with a gear 154 secured to a shaft 155 to which shaft the cam 120 is secured.

Also referring to Fig. 2 to drive shaft 38 there is secured a gear 156 which meshes with a larger gear 157 secured to a shaft 158 to which shaft the cam 137 is secured.

Thus, through the intergearing last described, the operating cams 120, 125, 132 and 137 are driven synchronously with the operating cams 100A, 100B, 100C and 100D.

Accumulator

The form of accumulator fully shown and described in the Patent to Lake et al., No. 2,328,653 is shown in Figs. 3–6 and modified to accumulate amounts representing pence and shillings. The accumulator orders which are adapted to receive amounts in pounds and units of shillings are unmodified decimal orders as shown in Figs. 3 and 4. The order adapted to receive tens of shillings is a units receiving wheel receiving a unit carry from the units of shillings wheel, and adapted by its carry mechanism to effect a unit carry to the units of pounds wheel when it goes from 1–0. The pence accumulator wheel is adapted to receive 1–11 pence. Upon addition of a unit pence to 11 pence the units carry mechanism thereof effects a unit carry to the units of shillings wheel.

In Figs. 3 and 4 the driving shaft 713 is suitably geared to the card feed drive shaft so as to make one revolution for each cycle of operation. For each denominational order of the accumulator shaft 713 has a gear 714 secured thereto which drives the accumulator wheel clutch mechanism. Each decimal order of the accumulator has a ten-toothed ratchet 715 which is free on a post 716 and integral with a ten-toothed gear 717 driven by gear 714. Rotatably carried by post 716 is a spoked wheel or disk 720 also having ten teeth 720*a* adapted to be engaged by a tooth 721*a* on the long arm of a clutch lever 721 to hold the disk against rotation in a counterclockwise direction.

At the side of disk 720 is an accumulator wheel 724 for the pounds orders and the units of shillings order which is rotatable on post 716 and provided with ten peripheral notches 724*a*. Wheel 724 for each decimal order may take any of ten rotative positions for the digit values 0, 1 . . . 9. A spring-pressed lever 725 engages with a notch 724*a* of wheel 724 to hold the accumulator wheel impositively and to align it in the value position into which it has been rotated. A transfer cam 726 is fixed to the side of wheel 724 and a stud 727 in wheel 724 extends through an opening in disk 720 to pivotally carry a clutch dog 730. A spring 731 urges the tooth of dog 730 to engage ratchet 715. In the position shown in Fig. 3 the clutch lever 721 is in declutching position, its tooth 721 is restraining rotation of disk 720 counterclockwise and dog 730 is clear of ratchet 715. The dog 730 is being held clear of the ratchet by coaction of a pin 730*b* on the dog with a cam edge 720*b* of disk 720.

When the clutch lever 721 is rocked clockwise to cause its tooth 721*a* to release the disk 720 for counterclockwise movement, the spring 731 is effective to rock the dog 730 into engagement with ratchet 715. During this movement of the dog 730 its pin 730*b* rides along the cam edge 720*b* and cams the disk counterclockwise until its tooth 720*a* previously engaged by tooth 721*a* is to the right of the latter tooth. The parts are then in the clutching position shown in Fig. 4, and the accumulator wheel 724 is coupled to the driving device 715, 717 for rotation. Through engagement of the pin 730*b* of the dog 730 with cam edge 720*b* the disk 720 is forced to rotate counterclockwise together with the accumulator wheel.

When the clutch lever 721 is rocked counterclockwise to a declutching position its tooth 721*a* intercepts a tooth 720*a* of disk 720 and stops the disk. Accumulator wheel 724 and dog 730 continue rotating while cam edge 720*b* of disk 720 cams the pin 730*b* outwardly until it is again in its outer position. As the pin 730*b* is cammed outwardly clutch dog 730 moves clear of ratchet 715 and declutches the accumulator wheel from the driving means. The accumulator wheel is then held and centered in its new value position by lever 725. A spring-urged latch 735 serves to hold lever 721 in either clutching or declutching position.

The clutch lever 721 has a short arm swiveled to the lower end of an armature 736 which is disposed between an advance magnet AM and a stop magnet SM. Energization of magnet AM rocks armature 736 clockwise to lower the free end of lever 721, and energization of magnet SM rocks armature 736 counterclockwise to raise the free end of lever 721. Concurrent energization of the AM and SM magnets, as will be described, will retain lever 721 in the position shown in Fig. 3 which inhibits rotation of the accumulator wheel 724.

When the accumulator wheel 724 of each decimal order is in its 0, 1 . . . 8 positions, the cam 726 holds a carry lever 737 pivoted at 738 in the position shown in Fig. 3, where a contact blade

739 (insulated from lever 737) takes a mid-position between contact elements 740 and 741. When the wheel is in its 9 position a tooth on lever 737 is dropped into a cut 726a of cam 726 and blade 739 contacts element 741. When the wheel 724 passes from the 9 to 0 position a rise 726b rocks lever 737 to cause blade 739 to engage contact element 740. When the lever is so rocked an arm 742 integral therewith is engaged and held by a spring-urged latch 743 which maintains the contact engagement between contact elements 739 and 740 until a pin 744 in gear 714 strikes an arm 745 integral with the latch 743 to release lever 742. The point in the cycle at which such unlatching occurs is indicated in the time chart of Fig. 10a.

The accumulator is also provided with a mechanical knockoff or declutching mechanism which comprises three pins 751, 752 and 753 secured to the side of gear 714 and adapted during rotation of gear 714 to ride in succession under an edge of clutch lever 721. Assume the clutch lever to be in lower position, when either pin 751, 752 or 753 engages lever 721, it cams it upwardly into the position of Fig. 3. The knockoff pins 751, 752 and 753 are effective at fixed points of the cycle as indicated in the timing diagram of Fig. 10a.

Fig. 5 shows the modification of a decimal order made for entering and receiving pence. In general, the ratchet wheel 715P has twelve teeth so that a complete revolution of the associated accumulator wheel 724P represents the entry of twelve pence. The usual drive gear 714 and driven gear 717 are also modified as to pitch diameter so as to provide the proper gear drive to ratchet wheel 715P. The transfer cam 726 is modified in respect to its notch 726a and cam portion 726b to provide a long or short carry. The tooth on lever 737 drops in notch 726a at the 11 position of the accumulator wheel 724P and when wheel 724P passes from 11–0 the rise 726b rocks lever 737 to cause blade 739 to engage element 740. Pence accumulator wheel 724P is provided with twelve aligning notches 724a. The pin 752 has the same time of operation as the pin 752 for a decimal order to effect the clutch disengagement after the entry of pence 1–11 (see Fig. 10a). The knockoff pin 753, effective after a units carry, also has the same time of operation as the pin 753 for a decimal order. There is no knockoff pin corresponding to the pin 751 which is provided in a decimal order.

Fig. 6 shows the modification of the usual decimal order for entering and receiving the tens of shillings, or halves of pounds. The gear drive and clutch are the same as for any decimal order, the major change being the alternating arrangement of notches 726a and cam portions 726b which make up the transfer cam 726. The accumulator wheel 724S is arranged to effect a carry whenever cam portion 726b rocks lever 737 to close contacts 739, 740, and this is effected at alternate and successive positions of accumulator wheel 724S. Thus, this order represents 1, or tens of shillings or 0, no tens of shillings. When the wheel goes from 1–0 a units carry is effected, as is well known, to the units of pounds order accumulator wheel. Knockoff pins 751, 752 and 753 are arranged so as to effect a clutch disengagement after each step of operation, whether the units is entered under control of a hole in the associated column of the card, or by a carry from the next lower order pence wheel 724P.

Initiation of accumulator entry

It is preferable to derive the start impulses directed to the AM magnets under control of the type wheel clutches, each of which it will be recalled is engaged under control of the analyzer or translator, so that the engagement of the printing wheel clutch to rotate the printing wheel to a selected digit position is substantially concurrent with the transmission of the start impulse sent to the AM start magnet. Reverting to Figs. 1a and 1b it will be recalled that the analyzer or translator causes a movement of the link 63 at differential points in the cycle, as is indicated in Fig. 10a. This causes the engagement of the printing wheel clutch at a differential time and after the engagement is effected type wheel contacts 182 (Fig. 1a) are closed at differential points in the cycle to transmit a start impulse to the accumulator start magnet AM of the same order.

Referring to Fig. 1a the plate 98 has an inclined cam edge 180 which cooperates with and rocks the detent arm 96 shortly after the clutch engagement has been effected. The lower arm 183 of detent arm 96 bears against the top blade of contacts 182. Thus, it is evident that after the engagement of the printing wheel clutch the slight clockwise movement of double arm 96 will close contacts 182. This closure occurs, of course, after the printing wheel clutch has been engaged and the times that contacts 182 are closed to transmit differentially timed impulses 0–9 are shown in Fig. 10b.

Card analyzing mechanism

The card analyzing or reading mechanism utilized to control entries in the form of accumulator shown herein is shown only diagrammatically in Fig. 11a since the details of the analyzing mechanism are fully shown and described in the patent to G. F. Daly et al., No. 2,510,559, issued June 6, 1950.

Two reading stations are provided so that when the card is at the first reading station column 13 of the card can be analyzed to determine the presence of an X or R hole to enter 10 or 11 pence. The card is analyzed again at the second reading station to determine the presence of holes at 0–9 in the entry controlling columns 9–13.

In general, a reciprocating frame carries a plurality of insulated metal strips 261 to which are secured analyzing brushes 262 which encounter the perforations and complete the electrical circuit. For each card column the set of brushes 262 makes contact through the perforations in the card column to extensions 263 of commutator contact points 264. A brush readout 265 driven by a shaft rotatable synchronously with the other drive shafts makes successive contact with the contact points 264 to transmit impulses in the order 9, 8, 7, 6, 5, 4, 3, 2, 1, 0, X, R at differential times, as shown in the timing diagram of Fig. 10b for "CB."

The above described arrangement of analyzing brushes and readout commutator is duplicated for each card column and the assembled arrangement is duplicated for both reading stations.

The current supply comprises line wires 266 and 267, and current to each commutator (Fig. 11a) is supplied by a circuit from line side 266, through circuit breaker contacts CB, wires 269 to the current supply ring 268 of each readout commutator. Thus, according to the perforation a timed impulse is transmitted by the readout

commutator to a plug socket 270, one allocated to each readout commutator and thus for each card column.

Entries in accumulator under control of type wheel contacts 182

There will now be described the manner of effecting entries in the sterling accumulator under control of the type wheel clutches. The plug sockets 270 associated with columns 9–13 have plug connections 271 (Fig. 11*a*) to plug sockets 272. The operation for columns 9, 10, 11 and 12 will now be described. Impulses transmitted according to the perforations in columns 9, 10, 11 and 12 are directed over the plug connections 271 to sockets 272, thence through the normally closed relay contacts LC*b*—*e* and DE*b*—*e* to plug sockets 273 from which plug connections 274 are made to plug sockets 275. For column 13 the circuit when 1–9 pence are to be entered is from plug socket 272, and through the following relay contacts now in the position shown R15–3, R16–3, R8–2, R18–2 and R3–3 to plug socket 273. Thence for all orders from plug sockets 273 by plug wires 274, plug sockets 275 through the normally closed PCC*a*–*e* relay contacts, the normally closed RN*a*–*e* relay contacts, to the translator control magnets 61, to line side 267. The relay contacts are designated *a*–*e* and pertain to the five denominational orders, *a*=pence; *b* and *c*=units and tens of shillings; *d* and *e* units and tens of pounds.

Thus, impulses are transmitted to energize the magnets 61, and in the manner previously described the printing type wheels 60 will take positions representative of the digits designated by the card holes.

Printing is effected from the type wheels by a second impulse transmitted to the magnets 61 by the following circuit. The CR20 contacts (Fig. 11*d*) energize the RN relay between 180°–295° to transfer the RN*a*–*e* contacts (Fig. 11*c*). At about 183° CR104 contacts close to transmit an impulse by a circuit from line side 266, CR104 cam contacts (Fig. 11*c*), the RN*a*–e contacts now transferred, thence to magnets 61, to line side 267. As is well known in the form of printer shown this second impulse will cause the printing clutches to be engaged to effect printing from the selected numeral type.

As was previously described contacts 182 will be closed at differential times shown in the timing diagram so that impulses will be directed to the accumulator start magnets AM to engage the accumulator clutches to receive and accumulate the printed amount. These impulses are transmitted between 130°–285°. Between 150° to 285° CR19 cam contacts close to energize the PCC relay (Fig. 11*c*) to transfer the PCC*a*–*e* relay contacts.

At 150° of the cycle CR70 cam contacts (Fig. 11*b*) close to complete a circuit from line side 266, CR70 cam contacts, DE12 normally closed relay contacts, pickup coil of LC relay, to line side 267. A hold circuit is effected through the LC2 relay contacts, CR116 cam contacts, back to line side 266. CR116 cam contacts transfer the LC*b*–*e* contacts between 150° and 350°. Thus, individually timed impulse circuits are completed from line side 266, CB circuit breaker contacts (Fig. 11*a*), CR106 cam contacts (Fig. 11*c*), the associated contacts 182, relay contacts PCC*a*–*e* now transferred, plug sockets 275, over the same plug connections 274 to plug sockets 273. For the shillings and pounds order, thence through the normally closed contacts DE*b*–*e*, the transferred LC*b*–*e* contacts, wires 276, to the AM start magnets of such orders to line side 267.

In the above example, it is assumed that only pence 1–9 are entered, and not 10 or 11 pence, in which case for entry of 1–9 the impulse is directed from pence order type bar contacts 182 (Fig. 11*c*), plug socket 290, plug wire connection 280, plug socket 281 (Fig. 11*b*), the now transferred R8–3 relay contacts, as will be described, R18–2 relay contacts now normal, thence through R8–2 relay contacts now transferred as will be described, and wire 276 to the pence order AM accumulator start magnet. The impulse circuit to this start magnet is the same when either 10 and 11 pence are to be entered, as will be presently described.

When CR70 cam contacts close at 150° the impulse will also be directed through DE12 contacts now closed, through R16–2 and R15–3 contacts now in the position shown, through DE4 contacts now closed, pickup coil of R8 relay to line side 267. The R8 relay is held through its R8–1 hold contacts, and CR116 cam contacts to nearly the end of the cycle. By such means R8 relay is energized to operate its R8–2 and R3–3 contacts to enable the 1–9 impulse from pence order type bar contacts 182 to be sent to pence order accumulator start magnet AM to enter 1–9.

Circuits for printing 10 or 11 pence when designated by X or R in column 13

Sensing of the X or R holes which represent 10 or 11 pence respectively is effected at the first reading station, one machine cycle prior to the 10 or 11 entry effected in the second machine cycle. To this end the plug socket 270 (Fig. 11*a*) pertaining to column 13 has a plug wire connection 277 ending at a plug socket 270, thus directing the impulse at X or R time to this socket to selectively energize the R19 relay, or R11 relay which are set up to represent 10 or 11 pence, as will now be described. It will be seen from the timing diagram of Fig. 10*b* and the circuit of Fig. 11*d* that the R13 relay is energized by CF102 cam contacts when both X and R impulses are being transmitted, and R12 relay is energized by CF101 cam contacts only when the R impulse is transmitted. If both relays are energized at the R impulse time the R impulse from plug socket 273 (Fig. 11*a*) is directed through the R13–1 relay contacts now closed, the R12–1 relay contacts now transferred, the R11 relay, to line side 267. When the X impulse is transmitted the R12–1 contacts will not be transferred at this time so that the X impulse will be directed through the R13–1 relay contacts, R12–1 normally closed relay contacts, to pick up coil of R10 relay, to line side 267. If either R10 or R11 relay is energized a hold circuit is provided through the respective "1" hold contact, cam contacts CF103, back to line side 266. As is well known "CF" contacts are closed only during card feed and card sensing cycles. Thus, either the R10 or R11 relay or both are maintained energized from the time of their energization to 330° of the same cycle. In the meantime, the card is transported to the second reading station.

CR212 cam contacts (Fig. 11*d*) close to energize the R14 relay between 308° and 330° of the cycle which relay closes its R14–2 and R14–3 relay contacts (Fig. 11*d*). With either R10–2 or R11–2 relay contacts now closed, depending upon whether 10 or 11 pence is to be entered, a circuit to pick up either R15 or R16 relays is closed when CF104 cam contacts close at 315°, from

line side 266, CF104 cam contacts, through either R10–2 or R11–2 relay contacts, the R14–2 or R14–3 contacts to the pickup coil of the R15 or R16 relay, to line side 267. The R15 relay is a 9–4 impulse control relay and R16 relay a 9–3 impulse control relay and comprise means to transmit 9–4 impulses or 9–3 impulses, for printing the 11 or 10 pence respectively.

A hold circuit for either the R15 or R16 relays is through the R15–1 or R16–1 hold contacts, cam contacts CR216, back to line side 266. It will be seen that CR216 cam contacts hold either R15–R16 relay energized for the remainder of the cycle it was picked up, and up to 290° of the next cycle, during which cycle the card is being analyzed at the second reading station.

It should be noted that 1–9 impulses directed to plug socket 272 for the pence order pass through the normally closed R15–3, R16–3, R8–2, R18–2 and R8–3 contacts, as previously described to transmit an impulse to the magnet 61 for the pence order when 1–9 pence are to be printed and accumulated. When either 10 or 11 pence is to be printed and accumulated the opening of either contacts R15–3 or R16–3 will open this impulse circuit and cause either CR202 or CR201 cam contacts to transmit 9–3 or 9–4 combinational impulses to the magnet 61. The impulse circuit for 9–3 impulses when R15 relay is energized is from line side 266, CR202 cam contacts, R15–3 relay contacts now transferred, R16–3 contacts now normal, R8–2 relay contacts now normal, R18–2 contacts now normal, R8–3 contacts now normal, plug socket 273, plug wire 274, plug socket 275, PCCa contacts now normal, RN*a* contacts now normal, pence order print control magnet 61, to line side 267. As will be described, this will effect printing of 10 pence. For printing 11 pence R16–3 relay contacts would have been transferred and CR201 cam contacts would have transmitted 9–4 combinational impulses to pence order print control magnet 61 by a similar energizing circuit.

A 9–4 combination impulse will condition the translator to cause link 63 to be shifted at about 105° of the cycle (see Fig. 10*a*), thus engaging the type wheel clutch to cause a rotation of the pence printing wheel 60 to select the "11," whereas the 9–3 combination causes a movement of link 63 later in the cycle (see Fig. 10*a*) so that type wheel 60 is rotated a lesser extent to select the "10" type on the pence printing wheel 60. The manner in which type are selected under control of the translator was previously described for digit type 1–9, and for 10 and 11 type the operation is quite similar, except for the earlier engagement of the type selecting clutch. It should be noted that movement of the operating link 63 to the left during the time that the 9–4 or 9–3 impulses are transmitted, which movement might be permitted if all of the four members 110 for this order are either latched or elevated so as to be above the lugs 109, is restrained by a cam portion 125*a* of cam 125 (Fig. 1*b*). As shown in the timing diagram of Fig. 10*a*, during the transmission of 9–4 or 9–3 impulses, the high portion 125*a* of cam 125 will restrain movement of the operating link 63 to the left.

Entering 10 or 11 pence in pence order of accumulator

With either the R16 or R15 relays energized and their respective R16–2 or R15–2 contacts transferred, cam contacts CR215 close at 120° of the cycle the card is at the second reading station to complete a circuit from line side 266, cam contacts CR215, R16–2 or R15–2 relay contacts, the DE4 relay contacts, the pickup coil of R8, to line side 267. R8 relay closes its R8–1 hold contacts to complete a hold circuit back to line side 266 through the CR116 cam contacts, maintaining R8 relay energized up to 350° of this cycle.

The type wheel contacts 182 associated with the pence order close after R8 relay is energized at about 127° for initiating the entry of 11 pence, and at 142° for initiating the entry of 10 pence, both times being much earlier in the cycle than for entering digits 9–1. Since PCC relay is picked up later at 150° when CR19 cam contacts close to energize PCC relay, it will be evident that the normal position of relay contacts PCC*a* for the pence order would prevent an impulse from being transmitted to the pence order AM accumulator magnet. For this reason, one side of contacts 182 of the pence order terminates at a plug socket 290 between which and a plug socket 281 a plug connection 280 is made. Now it will be seen that impulses are transmitted by contacts 182 of the pence order, over plug wire 280, through R8–3 contacts now transferred, R18–2 contacts now normal, R8–2 contacts now transferred, wire 276 to the AM magnet of the pence order. The accumulator wheel is set into rotation one or two points prior to entry of a 9 digit to enter by a continuous operation 10 or 11 pence. Since the mechanical knockoff which occurs by pin 751 at 150° for decimal orders does not take place in the pence order, due to the absence of such a pin, the wheel continues to rotate until the mechanical knockoff is effected by pin 752.

Units carry circuit

The units carry circuit is well known and for this reason is only generally described. At 295° CR61 cam contacts pick up the R17 relay which closes its *b–c* relay contacts ("*a*" contacts not being necessary) to enable the transmission of a carry impulse by the CR76 cam contacts at 305°. Thus, if blade 739 made contact with contact point 740 when "12" was entered in the pence order the impulse would be directed through the "*b*" contacts to the AM magnet of the units of shillings order, to carry a unit. This is a "short carry." If this shillings order was standing at 9 with blade 739 in contact with contact point 741 the unit carry would be extended through the "*c*" contacts to the AM magnet of the tens shillings order. This would be a "long carry." Similarly carries are directed and made in each of the other orders. Pin 753 (Fig. 10*a*) is adapted to disengage the accumulator clutches in each order that a carry has been made, as is well known.

Direct entry of non-decimal amounts

While it is preferable to cause accumulating operations to be initiated under control of the type wheel clutches, it is sometimes desirable to cause entries to be made directly under control of the perforated record, especially when it is desired not to print the entered amounts.

In direct entries the impulses derived from the readout commutators are transmitted directly to the AM start magnets. The plug wires 271 from the second reading station to plug sockets 272 are retained, as well as the plug connection 277 for determining 10 or 11 pence entries. The

plug connections 274 and 280 are omitted to render the printing mechanism inoperative. For this type of operation a plug connection 285 (Fig. 11*d*) is made to pick up the R18 relay and the DE relay at 330° by cam contacts CR50 and hold them energized up to 285° during the cycle the card is at the second reading station.

In the manner previously described either the R10 or R11 relay is energized upon sensing an X or R hole at the first reading station to thereby pick up the R15 or R16 relay to enter 10 or 11 pence. The R15 and R16 relays select respective cam contacts CR202 or cam contacts CR201 for transmission of combinational impulses, as previously described.

The DE relay opens its DE4 contacts to prevent the energization of the R8 relay and the operation of its contacts R8–2 and R8–3 since they should not be operated in direct entry operations.

For direct entries it is necessary to pick up the LC relay a little earlier in the entry cycle than for indirect entry operations. To this end DE relay transfers its DE12 contacts, thereby completing a circuit when CR71 cam contacts close at 135° from line side 266, CR71 cam contacts, DE12 contacts now transferred, to the pickup coil of LC relay to line side 267. CR116 cam contacts hold LC relay energized up to 350° of the cycle. When LC relay is energized it transfers its LC*b–e* contacts.

However, reverting to cam contacts CR201 and CR202, it will be seen that they each transmit a "9" impulse at about 5°, which is coincident with a 9 impulse transmitted by a commutator readout. By the following exemplary circuit it will be evident that CR201 or CR202 start the rotation of the pence accumulator wheel at the "9" time; line side 266, CR202 cam contacts, R15–3 relay contacts now transferred, R16–3 contacts now normal, R8–2 contacts now normal, R18–2 contacts now transferred, wire 276 to the AM start magnet of pence order. If the R16 relay was energized and its contacts R16–3 transferred CR201 cam contacts will transmit the "9" start impulse to the same AM start magnet. It should also be noted that cam contacts CR201 will transmit a second impulse at 82° and CR202 will transmit a second impulse at 97°, but neither of these will be effective since the pence accumulator wheel is already in rotation. The pence order accumulator wheel rotation continues until an impulse is transmitted to the stop magnet SM of the pence order to terminate the rotation of the pence accumulator wheel after a "9" entry by the following described circuit. As shown in Fig. 11*b*, CR209 cam contacts transmit an impulse to the SM magnet for the pence order by a circuit from line side 266, through DE7 relay contacts, CR209 cam contacts, SM magnet, line side 267. Energization of SM magnet will declutch the pence order accumulator wheel after the entry of "9." The remainder of the entry of a digit "1" or "2" for 10 or 11 pence is effected in the second half of the cycle, as will now be described.

If 11 pence are to be added it will be recalled that the R16 relay would be energized and the R16–3 contacts in transferred position at the time CR201 cam contacts again close at 257° in the cycle to transmit a second start impulse to the AM start magnet of the pence order. This impulse is so timed with relation to knockoff pin 752 of the pence order that "2" will be entered, thereby entering in two entry operations 9 and 2, or 11 pence. If 10 pence are to be added CR202 will transmit an impulse at 272°, enabling only a unit to be entered before clutch disengagement is effected by the knockoff pin 752.

With respect to the decimal orders it will be recalled that their entries occur during the first half cycle only, and that only in the pence order is a successive entry effected for entering 10 or 11 pence. If neither 10 nor 11 pence are to be entered then entry of 1–9 pence occurs only in the first half of the cycle. In the event that the pence column is perforated at 0 to represent 0 pence, the commutator will transmit an impulse at about 142°, but it will be seen that this is coincident with the impulse transmitted by CR209 cam contacts. Transmission of impulses to the SM and AM magnets in the pence order simultaneously nullifies each other and the accumulator wheel clutch will remain disengaged.

Zero print control

From Fig. 9 it will be seen that zeros are printed in the units of pounds order, the units of shillings and the pence orders, but omitted in the tens of shillings order. To effect this selectively zero print the zero print control shown and described in the application of H. S. Beattie et al., Serial No. 131,004, filed December 3, 1949 may be utilized, and is not shown here since it forms no part of the present invention. In general, the 0 is printed in the units of pounds order under control of the zero hold in the related column when the next higher order or tens of pounds column represents a significant digit 1–9. Where the 0 is not to be printed, as in the tens of shillings order, this intercontrolled plugging is omitted. The zero is printed in the pence column, units of shillings column, dependent upon printing a significant digit 1–9 in the next higher order column. The above zero print control will cause printing on a result sheet as shown in Fig. 9.

While there have been shown and described and pointed out the fundamental novel features of the invention, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and 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 record having 10 pence designated by a designation at X, and 11 pence by a designation at R, a plurality of combinational impulse emitters, one for emitting a combination of impulses for controlling the entry of 10 pence and another for emitting a different combination of impulses for controlling the entry of 11 pence, means for analyzing said X and R designations, means controlled by said analyzing means to select an associated emitter to emit a combination of impulses, an accumulator wheel, an accumulator wheel clutch magnet, and means under control of each of said emitters to energize said accumulator clutch magnet by differentially timed impulses derived as a result of the operation of a selected emitter to advance said accumulator wheel to enter 10 or 11 according to the emitter selected.

2. In a machine controlled by a perforated rec-

ord having X and R designations and digit designations 1–9, a plurality of emitters each for transmiting a 9 differentially timed impulse and another differentially timed impulse to enter 1 or 2, means for sensing X and R designations, other means for sensing 1–9 designations, means controlled by said X and R designation sensing means to select an associated emitter, an accumulator wheel, an accumulator wheel clutch, a control magnet therefor, impulse means controlled by said 1–9 designation sensing means to energize said control magnet by single differentially timed impulses representing 1–9 to engage said accumulator wheel clutch to rotate said accumulator wheel to 1–9 digit representing positions, and other means for causing said control magnet to be energized by said 9 impulse from each emitter to engage said accumulator clutch to enter 9 by one entry, and dependent upon the emitter selected by said other impulse to engage said accumulator wheel clutch to rotate said accumulator wheel additionally to enter 1 or 2.

3. In a machine controlled by a perforated record having digit designations 1–9 and X and R designations representing 10 or 11 entries, means for sensing said X and R designations, other means for sensing said digit designations 1–9 after said first named sensing means, a printing member having type 1–9 and 10 and 11, means under control of said second named sensing means when designations 1–9 are sensed to position said printing member to print 1–9, and under control of said first named sensing means to position said printing member to print 10 or 11 when designations X and R are respectively sensed, an accumulator wheel, and means under control of said printing member for effecting a rotation of said accumulator wheel to enter by a continuous operation digits 1–9, 10 or 11.

4. In a machine controlled by a perforated record having digit designations 1–9 and X and R designations representing 10 or 11 entries, means for sensing said X and R designations, other means for sensing said digit designations 1–9 after said first named sensing means, a type wheel having type 1–9 and 10 and 11, positioning means therefor, means under control of said second named sensing means when designations 1–9 are sensed to cause said positioning means to position said type wheel to print 1–9, and under control of said first named sensing means to cause said positioning means to position said type wheel to print 10 or 11 when designations X and R are respectively sensed, an accumulator wheel, an accumulator wheel clutch, a control magnet therefor, and contact means closed when said type wheel is positioned to transmit an impulse to said control magnet to engage said accumulator clutch for effecting a rotation of said accumulator wheel to enter by a continuous operation digits 1–9, 10 or 11.

5. In a cyclically operable machine controlled by a perforated record having digit designations 1–9 and X and R designations representing 10 or 11 entries, means for sensing said X and R designations in one cycle, other means for sensing said digit designations 1–9 after said first named sensing means in a following cycle, a printing member having type 1–9 and 10 and 11, means under control of said second named sensing means when designations 1–9 are sensed to position said printing member in said following cycle to print 1–9 and under control of said first named sensing means to position said printing member in said following cycle to print 10 or 11 when designations X and R are respectively sensed, an accumulator wheel, and means under control of said printing member for initiating a rotation of said accumulator wheel at differenial points in said following cycle to enter digits 1–9, and at points earlier in said following cycle than when 9 is entered for initiating a rotation of said accumulator wheel digits to effect an entry of 10 or 11.

6. In a machine controlled by a perforated record having X and R designations and digit designations 1–9, a plurality of emitters each for transmitting a different combination of impulses than the other, means for sensing X and R designations, other means for sensing 1–9 designations, a printing member having digit type 1–9 and 10 and 11, positioning means therefor, a translator controlled by said emitters for translating and converting combinations of impulses to a single differentially timed equivalent to control the position of said printing member, means under control of said 1–9 designation, sensing means for causing said positioning means to position said printing member to select digit type 1–9, means under control of said X and R sensing means to select an associated emitter for transmitting a combination of impulses to said translator, said translator deriving a differential timed equivalent to control said positioning means to position said printing member to select type 10 or 11, an accumulating means, and means under control of said printing member and in accordance with the 1–9, 10 or 11 type selected for causing said accumulating means to receive an entry corresponding to the type selected.

7. In a machine controlled by a perforated recording having X and R designations and digit designations 1–9, a plurality of emitters each for transmitting a different combination of impulses than the other, means for sensing X and R designations, other means for sensing 1–9 designations and transmitting differentially timed impulses singly, a printing member having digit type 1–9 and 10 and 11, positioning means therefor, a translator controlled by said emitters for receiving said single differentially timed impulses and said combinations of impulses for converting them to a single differentially timed equivalent to control the position of said printing member, means under control of said translator when single differentially timed impulses are received for causing said positioning means to position said printing member to select digit type 1–9 and when combinations of impulses are received for causing said positioning means to position said printing member to select type 10 or 11, means under control of said X and R sensing means to select an associated emitter for transmitting a combination of impulses to said translator, an accumulating means, a control magnet therefor, and differentially timed impulse means under control of said printing member for causing, in accordance with the 1–9, 10 or 11 type selected, the energization of said control magnet and operation of said accumulating means to effect an entry corresponding to the type selected.

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