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 [33] **Japan**
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[54] **PRINTING DEVICE FOR A CALCULATING MACHINE**
8 Claims, 6 Drawing Figs.

[52] U.S. Cl..... **235/60.15,**
235/60.28, 101/93 R
 [51] Int. Cl..... **G06c 19/04,**
B41j 5/30
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60.28; 101/93 R

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ABSTRACT: A printing device for a calculating machine which comprises mounting a decimal mark carrier for carrying digit types and effecting a printing operation toward a platen, juxtaposing a decimal mark type actuator for setting said decimal mark type at a prescribed printing position with another digit type actuator for positioning required digit types, controlling the movement of both digit type actuators separately by number setting means, providing a sensing means for sensing the position of both actuators for each order, controlling the printing operation of said supporting member by the sensing action of said sensing means with mechanism for eliminating zeros, thereby enabling a number including a decimal fraction to be printed by depressing in turn the keys corresponding to the digits and decimal mark involved in said number in the sequence in which said digits and decimal mark are arranged, starting with those representing the higher orders.

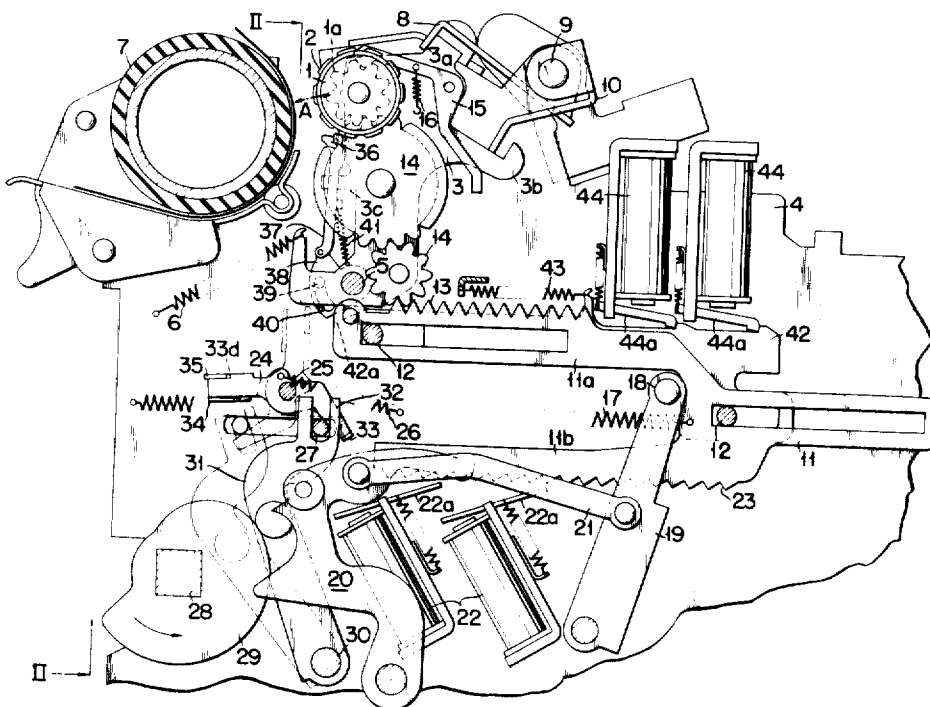
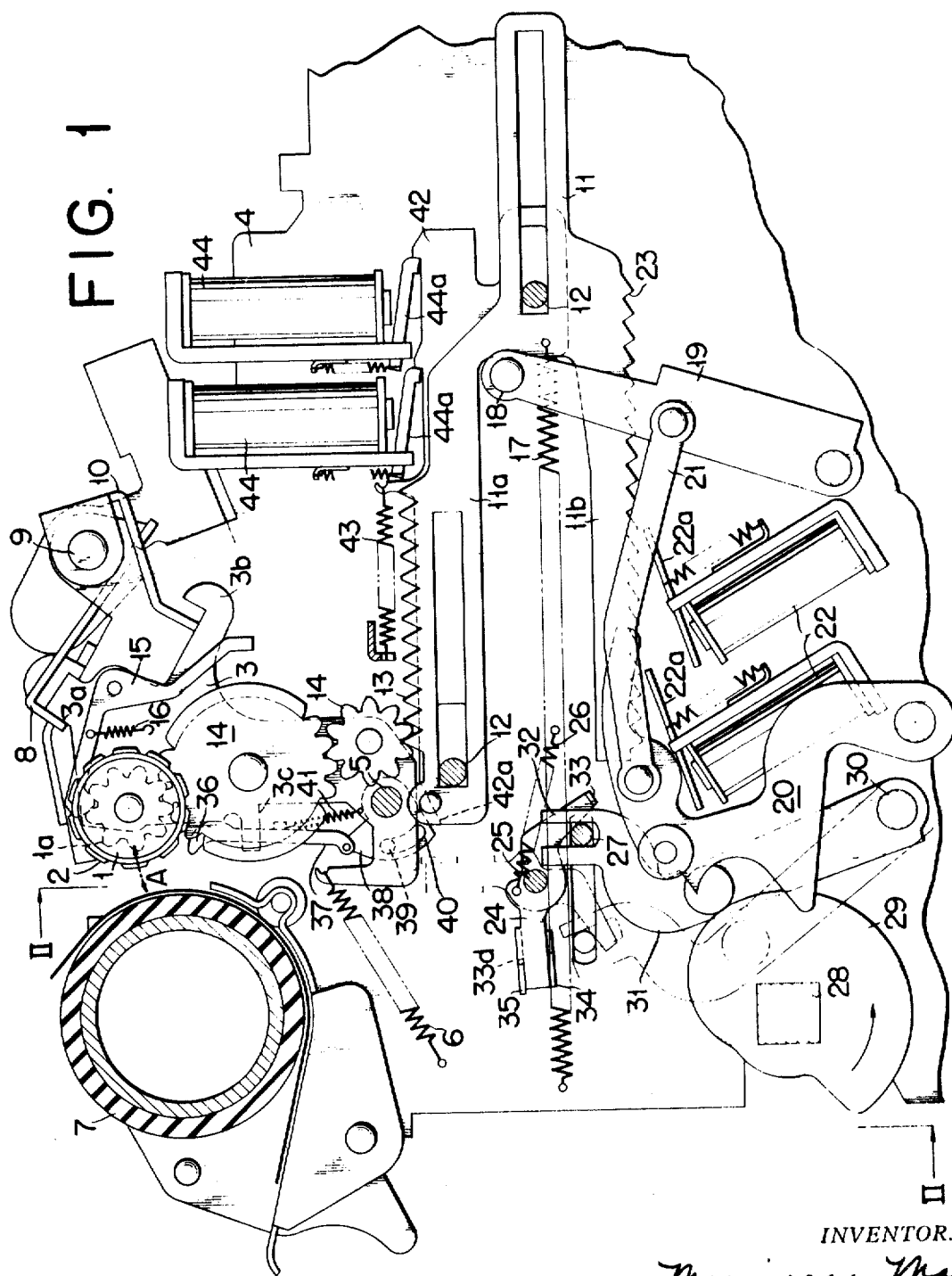


FIG. 1



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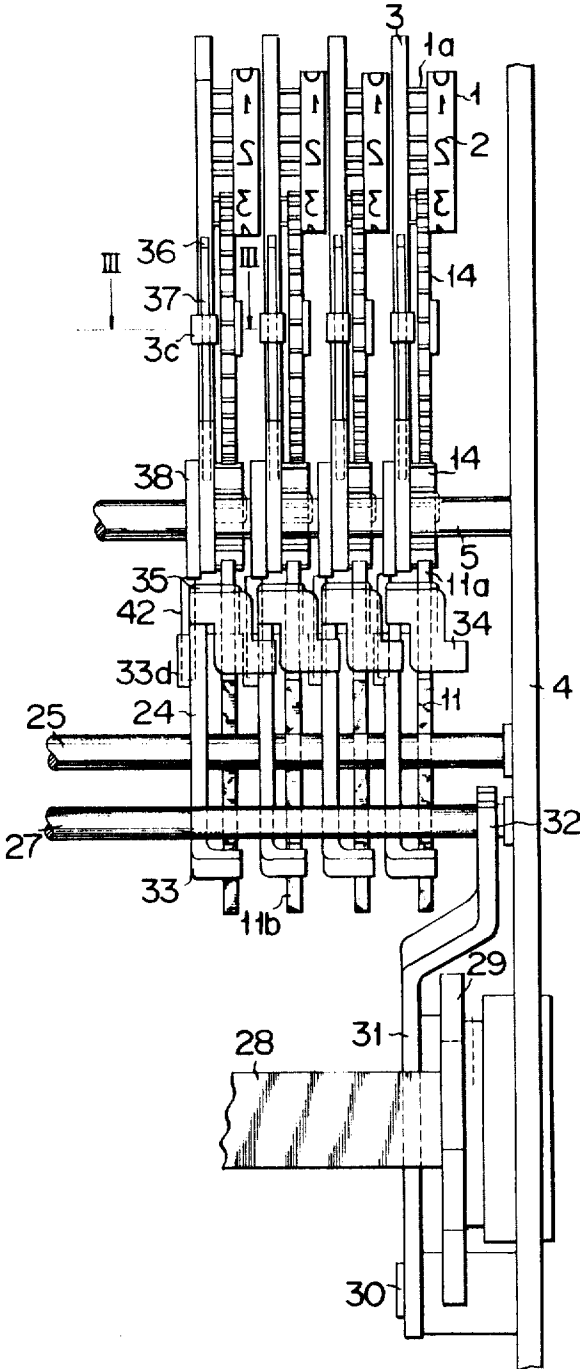
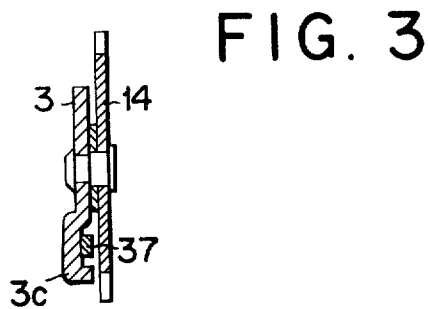
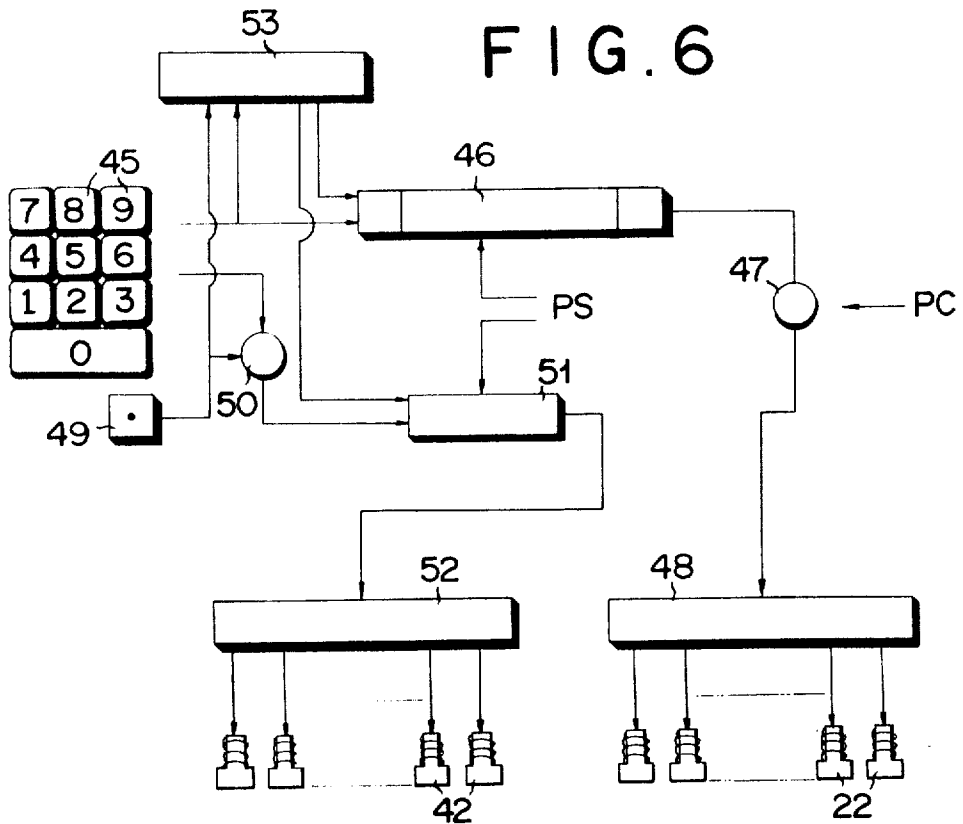


FIG. 2

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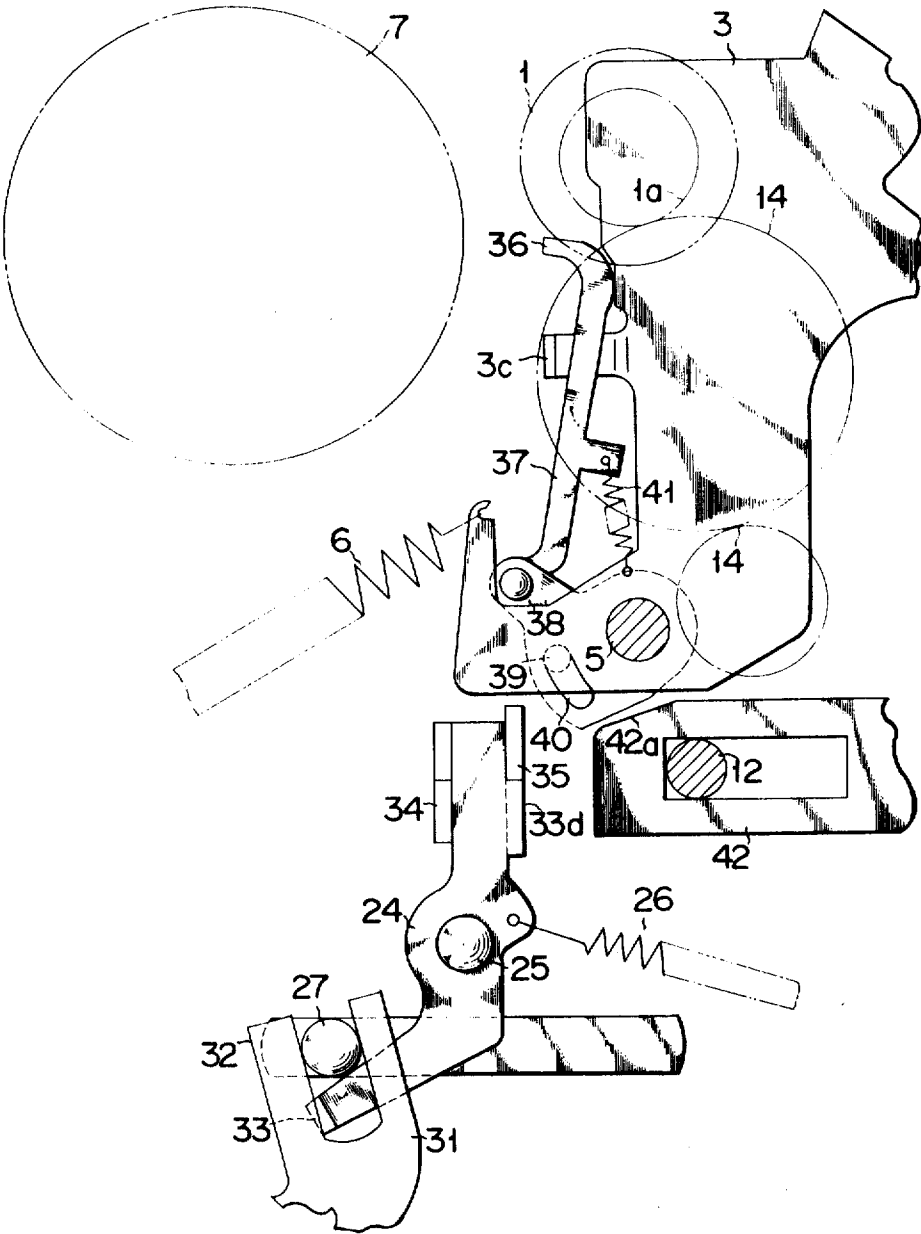
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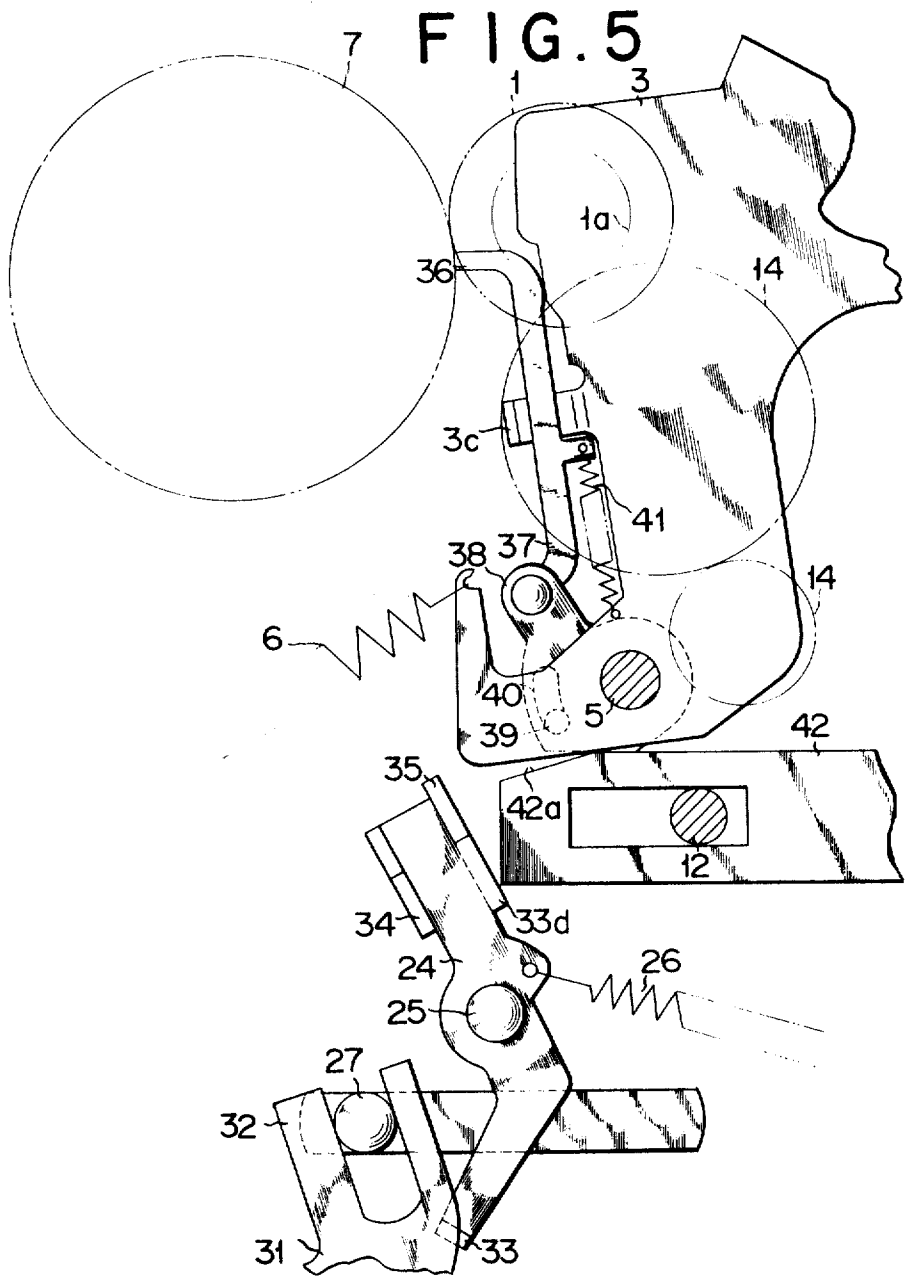
FIG. 4



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PRINTING DEVICE FOR A CALCULATING MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to a printing device for a calculating machine and more particularly to a printing device of this kind which enables a number including a decimal mark to be printed by depressing in turn the keys corresponding to the digits and decimal mark involved in said number in the sequence in which said digits and decimal mark are arranged, starting with those representing the higher orders.

In the prior art devices for printing a decimal mark, the decimal mark is treated in the same manner as digits insofar as printing is concerned and allowed to occupy one full space or a decimal mark in a given location is printed before a number is entered in number setting means. A printing device of the present day for a calculating machine generally involves zero eliminating means and zero printing means, namely, means for eliminating zeros of any higher order than the first non-0 digital order put printing zeros of any lower order than said non-0 digital order. A printing device involving the aforementioned decimal mark printing mechanism is also included in this category.

Where a decimal fraction, for example, 0.01 is printed, the former type of the prior art printing device treats a decimal mark in spacing in the same manner as each digit. Accordingly, when numerical characters ".", "0" and "1" are previously set in this sequence, then there can be printed the aforementioned number as "0.01". The latter type defines the position of the decimal mark in advance between the second and third orders from the right and thereafter sets digit "1" or digits "0" and "1," thus printing the first mentioned decimal fraction as "0.01" or "0.01." However, the former type of the prior art device has the drawbacks that the decimal mark itself occupies one full space to reduce the order carrying capacity of the printing device by that extent, and the digits between which the decimal mark is interposed are separated too wide to be easily read. On the other hand, the latter type is also handicapped by the fact that the position of a decimal mark is defined before the number is set. Accordingly, it is necessary to define the position of a decimal mark in the number and set the corresponding order position of a calculating machine, namely, there is required a complicated step of setting said decimal mark. Further, there has to be accurately defined the interrelationship between means for setting the position of the decimal mark and the aforesaid zero eliminating means, so that the latter type of the prior art device has the drawback of complicating the arrangement of a calculating machine.

SUMMARY OF THE INVENTION

The present invention has been accomplished to eliminate the aforesaid shortcomings encountered with the prior art and provide a novel type of printing device which comprises mounting a decimal mark type on a type carrier for carrying digit types and effecting a printing operation toward a platen, juxtaposing an actuator for setting said decimal mark type at a prescribed printing position with the digit actuator for the digit types with which the decimal mark type is assembled, controlling the movement of both actuators separately by number setting means, providing a sensing means for sensing the position of both actuators for each order, controlling the printing operation of said type carriers by the sensing action of said sensing means, providing each of said sensing means with mechanism for eliminating zeros, thereby enabling a number including a decimal fraction to be printed by depressing in turn the keys corresponding to the digits and decimal mark involved in said number in the sequence in which said digits and decimal mark are arranged, starting with those representing the higher orders.

BRIEF EXPLANATION OF THE DRAWINGS

FIG. 1 is a side view of the printing device of the present invention;

FIG. 2 is a back view on line II—II of FIG. 1;

FIG. 3 is an enlarged sectional view on line III—III of FIG. 2;

FIGS. 4 and 5 are enlarged side views of a digit type carrier dismembered from said printing device; and

FIG. 6 illustrates a control circuit using an electromagnet for setting digit types at a printing position.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. 1 to 6 represent a printing device to be used with an electronic computer. Throughout the figures, numeral 1 denotes a type wheel carrying digit types 2 representing 0 to 9 which is rotatably supported by a digit type carrier or hammer plate 3. Said hammer plate 3 is pivoted to a stationary shaft 5 on a machine frame 4 and urged toward a platen 7 by a spring 6, and arrested at its normal nonprinting position shown in FIG. 1 by a trigger 8 engaging the shoulder 3a of said hammer plate 3 to be used in common to all hammer plates 3. Said trigger 8 rotates about a stationary shaft 9 on a machine frame 4 together with a restoring ball 10 engaging a hooked portion 3b projecting ahead of said hammer plate 3. When said trigger 8 and restoring ball 10 rotate clockwise, said hammer plate 3 is released and starts a printing operation toward said platen 7 by the force of said spring 6 to impress on printing paper a digit represented by the type set at point A on the printing line of said platen 7. When said trigger 8 and restoring ball 10 turn anticlockwise, said hammer plate 3 is brought back to its normal nonprinting position.

The setting of a digit-type at a printing position is effected by a digit-type setting member or digit-type actuator 11 assuming a horizontally thrown Y-shape. Said digit-type setting member 11 is supported on guide rods 12 to slide back and forth. On the upper arm 11a of said digit-type setting member 11 is provided a rack 13. Said rack 13 is connected to said type wheel 1 by a gear train consisting of two intermediate gears 14 and a pinion 1a fixed on one side of said type wheel 1, thereby setting a desired digit type at a printing position A according to the distance through which it slides. Once set in position, said type wheel 1 is secured in place by a detent 15 and spring 16 registering with said pinion 1a. Said digit type setting member 11 is normally urged rearward (to the left side of FIG. 1) by a spring 17 and actuated by a common restoring bar or bail rod 18. This restoring bar 18 is supported between a pair of arms 19 (only one of them is shown in FIG. 1) pivoted to said machine frame 4. Each of said arms 19 is connected by a connecting bar 21 to a contact arm 20 which reciprocatingly rotates by means of a cam (not shown). Said digit-type setting member 11 is controlled by an electromagnet 22 actuated by signals from the later-described calculating mechanism. The setting armature of said electromagnet 22 is actuated while said digit-type setting member 11 is operated, and arrests said digit-type setting member 11 by engagement with saw teeth 23 formed on the underside of the lower arm 11b of said setting member 11 so that a desired digit type is brought to a printing position.

The digit types thus set at a printing position impress a number on printing paper when said hammer plates 3 are released from said trigger 8. In this case it is required to prevent zeros of any higher order than the first non-0 digital order of said amount from being printed. This zero eliminating function is carried out by a sensing lever 24 provided for each digit-type setting member 11. Said sensing lever 24 is pivoted to a shaft 25 mounted on said machine frame 4 and rotated clockwise by a spring 26. Said sensing lever 24 is further operated by an actuating bar 27 supported on said machine frame 4 so as to slide back and forth. Said actuating bar 27 is interposed between two forked portions 32 at the end of a rotating arm 31 which rotates about a shaft 30 on said machine frame 4 by means of a cam 29 positioned on a main drive shaft 28. When the printing device stops, said sensing lever 24 is held at its normal position indicated by the solid line of FIG. 1, and when said printing device is put into operation, said sensing lever 24 reciprocates between said normal position and that defined by two dot-dash lines.

Said sensing lever 24 is a two-armed type. One of its arms has a sensing section 33 for detecting the position of the lower arm 11b of said digit plate setting member 11. The other arm has a protuberance 34 projecting toward another sensing lever associated with the next higher order to engage the rear edge of the latter and a detent 35 for said hammer plate 3. When said digit-type setting member 11 stands at a position for setting other digits than zero, said sensing section 33 of said sensing lever 24 engages the upper edge of the lower arm 11b of said digit-type setting member 11 to prevent its rotation. And when said digit-type setting member 11 is brought to a position for setting zero, said sensing section 33 is freely allowed to rotate up to a position defined by the two dot-dash lines of FIG. 1. When the sensing lever of a given higher order is prevented from its rotation, that of the next following order is also prevented from its rotation, because the protuberance of the latter engages the former. When the aforementioned sensing lever 24 freely rotates as the result of the movement of said actuating bar 27, said detent 35 enters the field of the printing operation of said hammer plate 3 to prevent it. When said sensing lever 24 is prevented from its rotation, said detent 35 is removed from the field of the printing operation of said hammer plate 3 to allow said operation. As apparent from the foregoing description, said sensing lever 24 detects whether said digit-type setting member 11 is brought to a position of setting zero or other digits so as to control the printing operation of said hammer plate, and even where the zero of a lower order is set for printing, enables it to be printed, if, at this time, other digits than zero involved in a higher order are set for printing. It will also be apparent that said sensing lever 24 prevents zeros of any higher order than the first non-0 digital order from being printed.

A decimal mark type 36 is disposed at the upper end of a decimal mark type carrier 37 and associated with said type wheel 1 so as to be printed by the lower order side of the digit. Said decimal mark type carrier 37 is pivoted at its bottom end to a segmental intermediate member 38 pivoted to said hammer plate 3 and is guided in a state interposed between a guide member 3c projecting rearwardly of said hammer plate 3 and gear 14 as shown in FIG. 3 so as to be vertically movable when said intermediate member 38 rotates. This intermediate member 38 is limited in movement by a shaft 39 and arcuate hole 40 and so arranged as to bring said decimal mark type 36 indicated by the solid line of FIG. 1 to a nonprinting position by a spring 41 engaging both said decimal mark type carrier 37 and hammer plate 3. Under such condition, the bottom end portion of said intermediate member 38 inclines rearward to project downward from the bottom end of said hammer plate 3 so as to be actuated by a decimal mark type setting member or decimal-type actuator 42 adjacent to and movable parallel with said digit-type supporting member. Like said digit-type setting member 11, said decimal mark setting member 42 is guided to slide between the operative and inoperative positions by said guide rods 12 and is further provided at the end with a rearwardly inclining actuating section 42a so as to be normally urged backward by a spring 43. Said decimal mark type setting member 42 is controlled by an electromagnet 44 actuated by signals from the later-described calculating mechanism. Said electromagnet 44 has an armature 44a which normally engages a projection 42b formed on the upper end edge of said decimal mark type setting member 42 so as to hold said setting member 42 in an inoperative position shown in FIGS. 1 and 4 against the force of a spring 43 and, upon receipt of signals from said calculating mechanism, releases said decimal mark type setting member 42 to bring it to an operative position shown in FIG. 5. In this position, the actuating section 42a of said decimal mark type setting member 42 registers with the bottom end of said intermediate member 38 to rotate it, and pushes up said decimal mark type setting member 37 so as to set said decimal mark type 36 at a printing position.

Said sensing lever 24 is provided with another sensing section 33d for sensing the position of said decimal mark type setting member 42 assembled with said hammer plate 3. When

said decimal mark type setting member 42 is brought to an operative position, said sensing section 33d engages, as shown in FIG. 5, the end of said decimal mark type setting member 42 to arrest the rotation of said sensing lever 24 and remove said detent 35 from the field of the printing operation of said hammer plate 3. Accordingly, even when said type wheel 1 is so set as to print the type 0, said type 0, as well as, a decimal mark type, is printed. If a number to be printed represents a decimal fraction, for example, 0.01, then it is printed as 0.01, preventing, as apparent from the previous description, zeros of any higher order than the first non-0 digital order of said decimal fraction from being printed. To maintain the force of impressing said decimal mark type, it is made to strike said platen 7 with the upper back side of said decimal mark type setting member 37 kept in contact with the rear edge of said hammer plate 3.

There will now be described the operation of controlling the movement of said digit-type setting member 11 so as to bring the desired one of the digit types formed on said type wheel 1 to a printing position and also the movement of said decimal mark type setting member 42 so as to set said decimal mark type 36 at a printing position. As previously described, said digit-type setting member 11 is controlled in movement by said electromagnet, said decimal mark type setting member 42 is similarly controlled by said electromagnet 44, and these electromagnets are actuated by signals from said calculating mechanism.

FIG. 6 presents the input and output sections of said calculating device. A number to be printed is first recorded in a register 46 by the depression of numerical keys, namely, a number setting operation. Ordinal digits of said number are read out serially from the lowest order digit by supplying shift pulses PB to the register 46. In synchronization with the movement of said digit-type setting member 11, said digital output is supplied to a digit distributor 48 through a gate 47 opened by clock tones PC conducted from said printing device so as to actuate said electromagnet 22. Said register 46 and digit distributor 48 perform a circulatory operation in synchronizing relationship, one cycle of said circulatory operation being completed while said gate 47 is opened. A device for generating said clock tones PC, though not shown, may consist of any known method which comprises, for example, providing a contact on the actuating bar 27 of said digit-type setting member 11 and juxtaposing many contacts with the pitches of said rack 13 in the direction in which said digit-type setting member 11 travels. In this case, said clock tones are generated in turn according as the contacts of said actuating bar 27 are brought into contact with those of said digit setting member 11 as the result of their movements. With the present invention, the setting of zeros at a printing position can be effected prior to the start of said printing device or by supplying the first clock tone to a certain length of time after said start. According to the foregoing embodiment, when the printing device stands at rest, the digit 9 is brought to a printing position and the digit 0 is set to be printed upon receipt of the first signal after the start of operation. And said electromagnet 22 arrests said digit-type setting member 11 when it travels up to the position where it sets the digit type which is equal to that digit of the number which was previously recorded in said register 46.

The setting of a decimal mark is effected by the depression of the decimal key. While a number involving a decimal mark is set to be printed the depression of said decimal key 49 opens a gate 50. The number of subsequent depressions of said digit keys 45 is counted by a counter 51. Upon completion of said number setting operation, therefore, there is counted in said counter 51 the number of orders lower than the decimal mark involved in the number previously recorded in said register 46. When the recorded number is read out, said digit shift pulses are also supplied to said counter 51 to cause the amount recorded in said counter 51 to be subtracted one by one upon receipt of each pulse. As soon as the amount recorded in said counter 51 is reduced to zero, its counted output therefrom is

supplied to a digit distributor 52 operated synchronizingly with said digit shift pulses so as to energize said electromagnet 44 corresponding to the decimal mark type setting member 42 of the required order. Accordingly, said decimal mark type setting member 42 is disengaged from the armature 44a of said electromagnet and brought to an operative position by the action of said spring 43. Namely, the opening of said gate 50 due to the depression of said decimal key 45 allows a decimal mark to be attached to the number recorded in said register 46. Thereafter, the position of the order at which said decimal mark is previously set is shifted due to the counting of a number in said counter 51 as the result of the subsequent digit setting operation of said digit keys.

The number recorded in said register 46 is also transmitted to a calculating means 53 to be used in calculation. The number transmitted from said calculating means 53 to said printing device is again recorded in said register 46 as in the case where said number is initially set therein, and the number of lower orders than said decimal mark is counted by said counter 50. The readout of the aforementioned amount from said counter 50 to the printing device is effected in the same manner as in the case where said number is initially read out from said register 46. It will be apparent that the setting of said digit-type setting member 11 and decimal mark type setting member 42 defines the printing position of the digit type and decimal mark types, and after said setting, said sensing lever 24 is actuated and said trigger 8 is released, thereby starting the printing operation.

There has been described the concrete embodiment where the present invention is applied to an electronic calculating machine. However, the invention may also be employed with great ease in a mechanical calculating machine. In the latter case, a number setting mechanism consists of a pin carriage customarily used in a mechanical calculating machine. There is disposed a decimal mark type setting pin between two rows of digit-type setting pins arranged in said pin carriage at a point corresponding to said decimal mark type setting member. Said digit and decimal mark type setting members are so modified as to have their movement controlled by these pins, and the depression of said decimal key only allows said decimal mark type setting pin to be brought to an operative position regardless of the ordinal shift of said pin carriage. With such arrangement, said decimal mark can be set in said pin carriage by depressing said decimal key according to the sequence of digits involved in the number initially set by said digit keys, and the position of the order at which said decimal mark is previously set can be shifted according to the subsequent depression of digit keys, enabling a number including a decimal mark to be properly printed.

What is claimed is:

1. In a printing device for a calculating machine a combination of a platen having a printing line,
 - a digit-type carrier carrying digit types of 0 to 9 for each of a series of orders,
 - a digit operatively connected to said digit-type carrier so as to bring one type to a printing position corresponding to the printing line of said platen,
 - means for controlling movement of said digit actuator to bring it to its type setting position upon setting a number in the machine,
 - operating means for the printing operation of each digit-type carrier,
 - sensing means for sensing whether said digit actuator is brought to a position for setting 0 or other digit types,
 - printing means provided with a detent which holds said digit type carrier in its nonprinting position when said sensing means senses that the corresponding digit actuator stands at a position for printing zero and adapted to effect the actuation of operating means of any lower order than the first non-0 digital order,
 - a decimal mark type carrier assembled with each of said digit-type carriers and adapted for printing operation together with said associated digit-type carrier,

- said decimal mark type carrier having a decimal mark type thereon,
- a decimal actuator disposed adjacent to and movable parallel with said digit actuator,
- said decimal actuator being connected to the decimal mark type carrier so as to bring the decimal type to a printing position from its normal position,
- said control means including decimal setting means for bringing said decimal actuator to its setting position, and said sensing means for the associated digit-type carrier being adapted to sense the set position of the decimal actuator and to release the detent so as to effect the operating means for the associated digit-type carrier to print a decimal fraction, whereby a decimal fraction can be printed.
2. In a printing device for a calculating machine, a combination of a platen having a printing line,
 - number setting means provided with keys representing digits of 0 to 9 which is successively shifted in position according as said keys are continually depressed so as previously to record said number in the printing device,
 - a digit-type carrier of each order which carries digit types of 0 to 9 and is capable of differentially moving the digit types corresponding to the digits previously set by said number setting means from the normal to the printing position,
 - a digit actuator provided for each digit-type carrier which, under control of said number setting means, moves said digit-type carrier so as to allow each of the types of digits previously set by said number-setting means to be brought to a printing position corresponding to the printing line of said platen,
 - means for urging each digit-type carrier toward said platen,
 - zero printing means of each digit-type carrier provided with a detent which brings said digit-type carrier to an inoperative position when the type 0 is set at a printing position and even when the type 0 of said digit-type carrier of any lower order than the first non-0 digital order is set at a printing position, operates all the digit actuators related to said succeeding digit-type carriers by being connected to the detents of other zero printing means,
 - a decimal mark type carrier assembled with a digit-type carrier so as to effect a printing operation toward said platen together with the latter,
 - said decimal mark type carrier carrying a decimal mark type which is capable of being set at a printing position from its normal nonprinting position,
 - said number-setting means including means for setting the printing position of a decimal mark by the depression of a decimal key,
 - the position of the order at which said decimal mark is printed being shifted according to the subsequent depression of digit keys,
 - a decimal mark actuator being disposed adjacent to and movable parallel with a digit actuator assembled therewith,
 - said decimal mark actuator being controlled by said decimal mark setting means and, when brought to a set position, releasing the detent of the assembled digit actuator, whereby, even when a number set by said number-setting means represents a decimal fraction and consequently the assembled digit-type carrier is brought to a position for printing the type 0, there can still be operated the actuator assembled with said digit-type carrier.
3. The printing machine according to claim 2 wherein said number-setting means is an electronic apparatus including a solenoid controlled by output from an electronic register.
4. The printing machine according to claim 3 wherein said decimal mark means is an electronic apparatus including a solenoid controlled by output from an electronic counter.
5. In a decimal fraction printing machine, a combination of a platen having a printing line,

a hammer provided for each of a series of digital orders which is movable from its normal nonprinting position to said platen for printing,
 a type wheel supported by said hammer and carrying digit types 0 to 9,
 a decimal mark type carrier carrying a decimal mark type, assembled with said hammer and adapted to effect a printing operation in conjunction therewith,
 a pair of actuators disposed adjacent to each other and movable in parallel relationship,
 one of said actuators being connected to said type wheel so as to set each of the digit types formed on said type wheel at a printing position corresponding to the printing line of said platen,
 the other of said actuators being connected to said decimal mark type carrier so as to bring said decimal mark type from its normal position to a printing position,
 an actuator for urging each hammer to said platen, and sensing means of said paired actuators for sensing their positions provided with a detent which, where there are sensed the type 0 setting position of the digit actuator and

and, when there is sensed the position of said digit actuator for setting types of other digits than 0, or the printing positions of said decimal mark actuator, causes said hammer to start its printing operation,

said sensing means being provided with a projection which is connected to the sensing means of each succeeding order and, when the type 0 of any succeeding order is set to be printed, releases the detent of the sensing means of any lower order than the first non-0 order, thereby enabling a decimal fraction to be properly printed.

6. The decimal fraction printing machine according to claim 5 wherein said sensing means rotate around a shaft and are operated by a common actuator.

7. The decimal fraction machine device according to claim 6 wherein said sensing means carry out a sensing operation upon completion of the type setting action of said paired actuators.

8. The decimal fraction printing machine according to claim 5 wherein said hammer is rotatably supported on a common shaft, and said decimal mark type carrier is pivoted to the end of an arm pivoted on said common shaft and guided by said hammer along said arm.