Oct. 14, 1958 R. W. WOODWARD ET AL 2,856,130

PRINTING INPUT AND OUTPUT DEVICE FOR A COMPUTER

Filed June 29, 1954 2 Sheets-Sheet 1

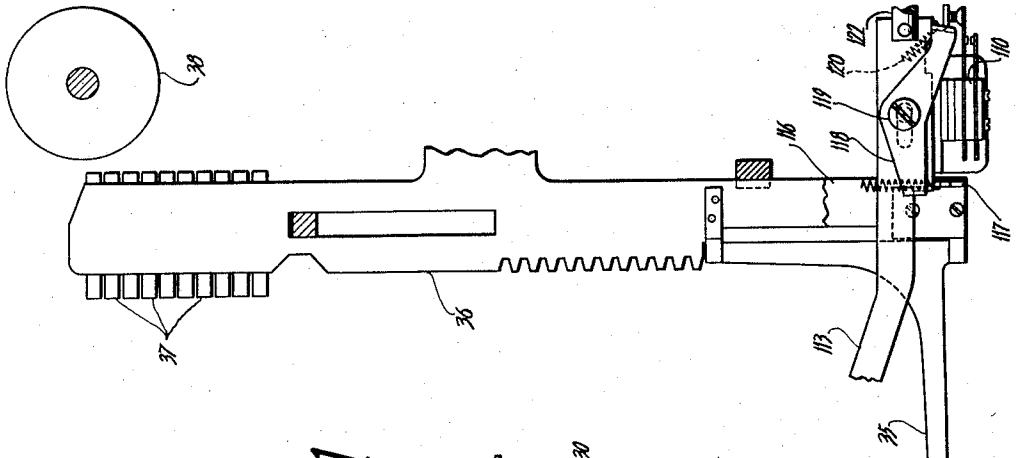


Fig. 1

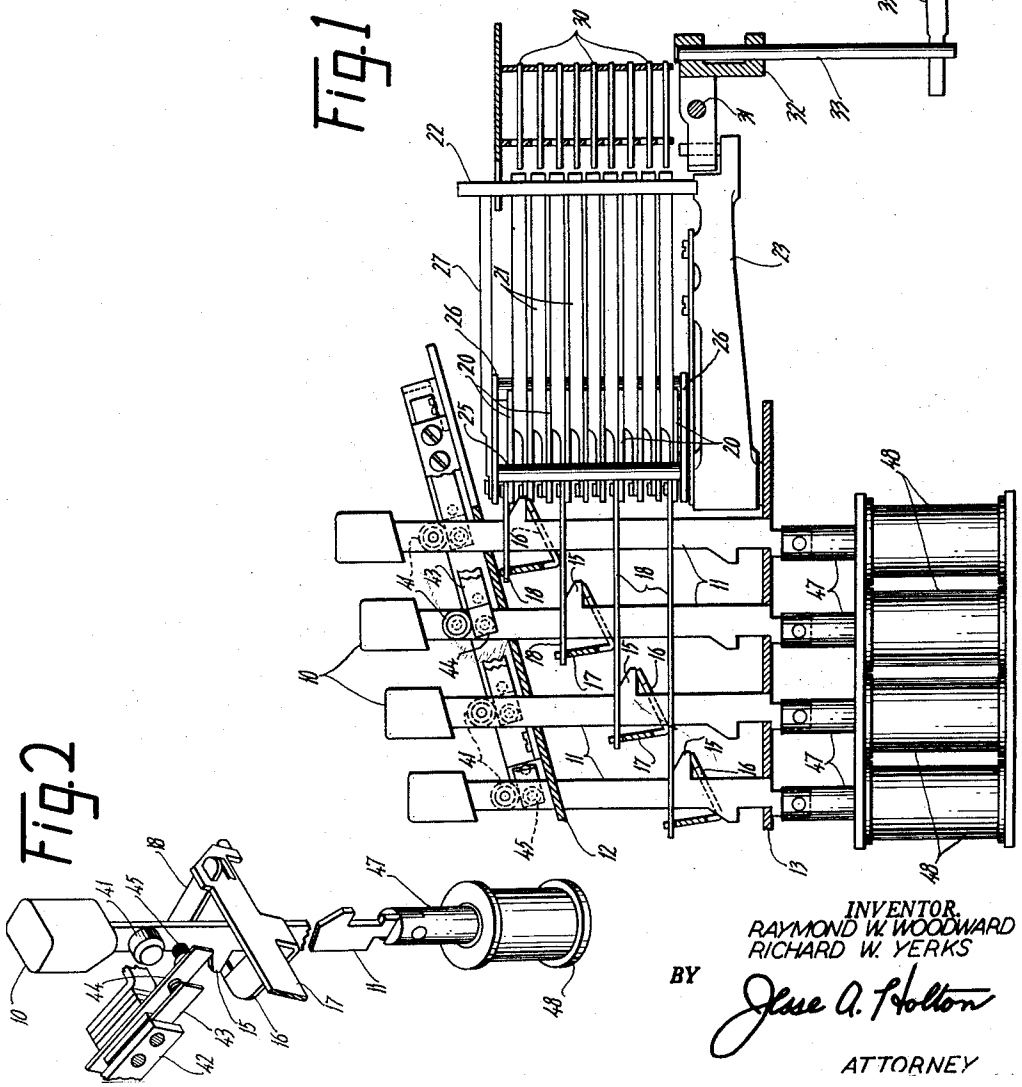


Fig. 2

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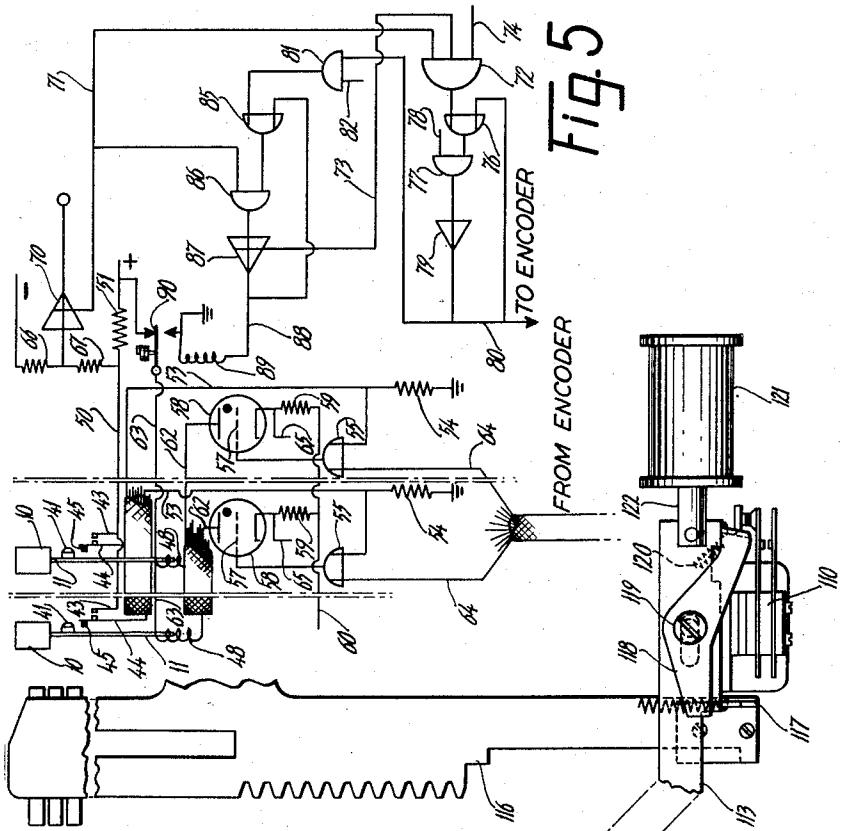


Fig. 5

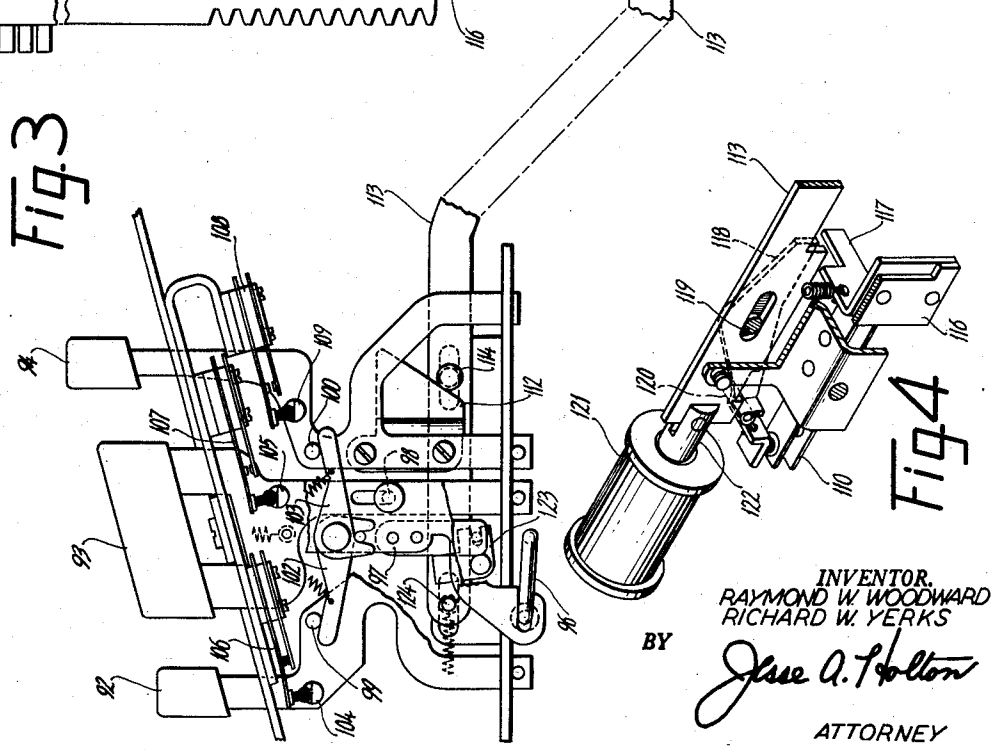


Fig. 3

Fig. 4

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PRINTING INPUT AND OUTPUT DEVICE FOR A COMPUTER

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Application June 29, 1954, Serial No. 440,014

2 Claims. (Cl. 235—145)

This invention is directed to a device for indexing and printing values to be entered into a computer device at a distance therefrom and more particularly to a printing mechanism by which values may be mechanically set up for printing and simultaneously electrically transmitted to a remotely located computer mechanism for entry therein.

It has been found when a mechanical printing device is used as the input device for an electrically controlled computer, that errors sometimes occur due to incomplete operation of an input key. Such errors occur because of the difficulty in setting adjustments such that an indexed digit is mechanically set up and electrically transmitted at the same time. If a digit key is depressed only far enough to control only one of these functions, obvious discrepancies and errors will occur. It is, therefore, necessary to provide a mechanism by which a key, when operated far enough to control one function, shall be positively depressed to perform its other function.

It is an object of the present invention to provide a mechanism which may be manually indexed to set up a value for printing and to simultaneously transmit the set up value to a computer for entry therein and to provide a feed back interlock to insure that the values as printed and as entered shall be identical.

It is another object of this invention to devise a printing mechanism for controlling a computer which in turn controls the printing mechanism to determine that the printed value shall agree with that entered into the computer.

With these and other objects in view, the invention comprises certain combinations of elements as set forth in the preferred embodiment described hereafter and shown in the appended drawings.

In the drawings,

Figure 1 is a side elevation of a section of the printing device of the invention,

Figure 2 is a perspective showing of one of the key mechanisms of the device,

Figure 3 is a side elevation of the operation control keys of the device,

Figure 4 is a perspective showing of a portion of Figure 3, and

Figure 5 is a schematic diagram of a portion of an electronic computer usable in cooperation with the present invention.

The input-output device of this invention is modified from a commercial adding machine of the well known "Underwood Sundstrand" type but obviously any type of indexable ten key printing device may be used with only minor modifications. The computing mechanism controlled by the disclosed input-output device may be either electrical or electronic and is to be capable of receiving digital inputs in decreasing denominational order and of utilizing these inputs as addresses, instructions, or for addition or subtraction, such as the "Elecom" electronic computers.

Referring now to the accompanying drawings, Figures

1 and 2 show a plurality of digit keys 10 each on a stem 11 slidable in top and bottom plates 12 and 13. Each key stem 11 has a lug 15 in engagement with an ear 16 projecting rearwardly from a rocking cradle 17 all of which cradles are pivoted in side plates, not shown, to press rearwardly, when rocked, one of the links 18, each link pivoted at its rear end on one of a group of levers 20. Also pivoted on each lever 20 is a push rod 21, all rods 21 being slidably supported at their rear ends in a post 22 secured to a swinging arm 23. A post 25 in engagement with the rear edges of levers 20 is secured between top and bottom levers 26 for operation by any lever 20. An escapement rod 27 connected to the upper lever 26 is also supported at its rear in post 22 to operate an escapement arm, not shown, to enable a one step advance of swinging arm 23 for each depression of a key 10.

In alignment with the rear ends push rods 21 at each position of arm 23 is a column of settable index pins 30 to be set rearwardly by operation of keys 10 to represent a set up value. Slidably mounted on a shaft 31 below pins 30 and connected to arm 23 is a slidable guide 32 supporting a plurality of tail pins 33 secured to arms 35 of type bars 36. During a machine cycle, arms 35 and type bars 36 are released to move upwardly until their respective tail pins 33 engage an aligned set pin 30 and arrest bar 36 thereby aligning a type 37 of bar 36 with the usual type hammers for printing on platen 38. The mechanism thus far described is the same as that set out in U. S. Patent No. 1,583,102, issued May 4, 1926, to Oscar J. Sundstrand and embodied in the commercial "Sundstrand" adding machine to which reference is made for further details of construction not fully disclosed herein.

To transmit to an associated computer, the digits which are set up in pins 30 by keys 10 to be printed by type 37, each key stem 11 has secured thereto a bevelled stud 41. Secured to the top keyboard plate 12 is a plurality of switches 42 which may be electrically connected to the computer to control the digital values entered therein. Each switch 42 comprises, Figure 2, a stationary blade 43 and a movable blade 44 having an insulating stud 45. The bevelled stud 41 of each key stem 11 during depression of a key 10 will contact the stud 45 to close the switch 42. The relationship of studs 41 and 45 is such that switch 42 will be closed before the push rod 21 associated with the operated key 10 has fully set the aligned pin 30.

Secured to the lower end of each key stem 11 below plate 13 is an armature 47, each armature being positioned in a coil 48 of one of a group of solenoids fixed to the machine base, not shown. These coils 48 are energized as will be later described under control of the switches 42 through the associated computer to fully depress an operated key 10 while the digit value is being entered into the computer, thereby positively setting the stop pins 30 and insuring that the printed and computed values are the same.

A portion of one form of electronic computer which may be used to control the energization of solenoids 48 is shown in Figure 5. In the circuit shown, the stationary contact blades 43 of all switches 42 are connected to a common wire 50 which is connected through a resistor 51 to a source of positive voltage. The movable contact blades 44 are individually connected by leads 53 to one end of resistors 54 all of which are grounded at their other ends. The leads 53 are each connected through a buffer circuit 55 to the grid 57 of a thyratron tube 58. The cathodes of all thyratrons 58 are connected through resistors 59 to a common cathode voltage lead 60 and the anodes are individually connected through cabled leads 62 to one side of the

coil 48 associated with the digit key stem 11. The other leads of coils 48 are connected to positive voltage lead 63 which may be deenergized at an appropriate time to terminate conduction in any thyratron tube. As thus far described, it will be evident that upon depression of any key 10, the voltage of lead 50 will be applied through switch 42 and buffer 55 to the grid of an associated thyratron 58 causing it to become conductive. The current passing through the thyratron energizes the coil 48 and thereby positively depresses key 10 to the fullest extent and holds it there, thus insuring that the keys will be fully operated to index pins 30 for controlling printing of the value entered.

The thyratrons 58 may also be fired by voltages applied to their grids 57 by individual leads 64 connected to buffers 55 to enable coils 48 to independently operate keys 10 to print a total value under control of the computer.

As the voltage at the cathode of a thyratron 58 rises when the tube is fired, this voltage may be used to control the digital entry into the computer circuits and leads 65 individually connected to the thyratron cathodes are provided for this purpose. It will be understood that buffers 55 are well known devices in the electronic field and will permit a voltage applied to any input lead to be applied to the output lead without any effect on other input leads. A gating device as used in a hereinafter described part of the circuit is a device in which all of the input leads must be at a positive voltage before the output lead may become positive. These buffers and gating devices may be the same as those disclosed in the application of Samuel Lubkin, Serial No. 370,538, filed July 27, 1953, and entitled "Electronic Digital Computer."

To extinguish a fired thyratron 58 and permit release of an operated key 10 after the computer has received the transmitted digital value, a timing circuit is provided. Connected between lead 50 and a source of negative bias voltage are two resistors 66 and 67 in series. An amplifier 70, similar to those of the above Lubkin application, is connected at its input end to the junction of resistors 66 and 67 and is so connected that when the input voltage becomes more negative as it does when any switch 42 is closed, output lead 71 will be shifted from a negative to a positive voltage. This voltage on lead 71 is applied to a gate 72 which it will be remembered can pass a positive voltage only when all input leads are positive as will be later set out with reference to amplifier 87. Input lead 73 is normally positive but lead 74 becomes positive only momentarily at the start of a set up cycle when the computer is conditioned to receive a value input. At this time all leads to gate 72 are positive and a positive signal passes through buffer 76 to a gate 77. The other input 78 to gate 77 is normally positive, going negative only when the computer has received a digital value, and the signal will pass through gate 77 and amplifier 79 to make positive an output lead 80 which permits the computer to receive a set-up digit value. Lead 80 forms the other input to buffer 76 and when positive serves to continue feeding a positive voltage to gate 77 and amplifier 79 after input 74 becomes negative, thus constituting a holding circuit until lead 78 is made negative. The positive voltage of lead 80 is also applied to a gate 81 which, at a time just before a set up cycle ends, receives a positive voltage pulse on its lead 82. The positive output of gate 81 is passed through a buffer 85 to a gate 86 the other input 71 of which was made positive when a key was depressed and therefore the combination of positive inputs to gate 86 passes to the input of an amplifier 87. The output 88 of amplifier 87 then becomes positive and is fed back to buffer 85 to maintain the amplifier input positive so long as lead 71 is positive due to a key being held depressed. Lead 73 previously referred to is a negative output of amplifier 87 and becomes negative when a positive input is applied to amplifier 87. This negative voltage is applied to gate 72 and prevents a second digital set up cycle by holding lead 80 at its negative value. The positive lead 88 energizes a relay coil 89 to move the contact 90 supplying voltage to thyratrons 58 to a ground contact thereby extinguishing the thyratrons and releasing keys 10. If a key 10 is held depressed manually, the more negative voltage applied to the input connection of amplifier 70 is continued to hold output lead 71 at a positive voltage. This positive voltage on lead 71 is applied through gate 86 as above set out to the input of amplifier 87 to energize relay coil 89 and prevent firing of any thyratron, and only when the depressed key is released does the circuit return to its original voltage condition.

This timing circuit is thus set by depression of a digit key to energize the associated computer over lead 80 for one set up cycle and at the end of that cycle, the fired thyratron is extinguished and the computer input disabled until the depressed key is released.

Inasmuch as the computer is remote from the printer unit as above described, it is necessary to have the computer operation controlled by the same keys which cause printing of the digital set up. As shown in Figures 3 and 4, there are three keys which cause printing of a set up value and these keys are connected to control computer operation. These keys are the address key 92, the add key 93, and the subtract key 94 and are mechanically the same as the motor keys of the "Underwood Sundstrand" adding machine and for this reason will be but briefly described. The motor which energizes the printing mechanism is controlled by a bent wire 96 pivoted at its rear end and having its front end in a slot of a slide 97 mounted for vertical movement. Slide 97 may be depressed by each motor key to start the printing cycle, key 93 having a stud 98 thereon, the stud being positioned in the bottom of a slot of slide 97 and each of keys 92 and 94 having a stud 99, 100 thereon in engagement with an arm 102, 103 pivotally connected to slide 97. To start a computer cycle at the same time as a printing cycle is started, keys 92 and 93 each have a stud 104, 105 thereon, each stud retaining open a switch 106, 107 associated therewith, and each switch when closed starting an appropriate cycle of the computer.

For enabling subtraction in the computer, key 94 is provided, but the switch 108 controlled by stud 109 on this key is not directly connected to initiate a cycle of the computer and instead merely prepares the computer, the actual subtraction operation being initiated at a later time. To provide the subtraction initiating impulse, another switch 110 is provided to be operated by a part of the printer during the printing cycle. Key 94 is provided with a cam 112 secured thereto, which cam during depression of key 94 will move rearwardly a slide 113 by contact of cam 112 with a stud 114 on the slide. Slide 113 is latched in its rearward position by a lever 118 which is spring pressed into a notch of slide 113, and the slide in its rearward position releases a symbol type bar 116 similar to type bars 36 but provided with different type faces, for one extra step of movement during the machine cycle to print a "—" signal. During this extra step of movement, an ear 117 will engage the front end of lever 118 which is pivoted on a stud 119 to depress its rear end to release slide 113 and to close the contacts of switch 110 to start the computer in its subtraction cycle. A spring 120 connected between the rear of lever 118 and a stationary machine part serves to normally hold lever 118 against the bottom of slide 113.

A magnet 121 with its armature 122 secured to the rear of slide 113 is provided to enable the computer to initiate a printing cycle for total taking by a rearward movement of slide 113, a lever 123 connected to cycle

initiating slide **97** being struck by a stud **124** on slide **113** to depress slide **97**.

The above description is of a preferred embodiment of my invention and is not to be taken as limiting the scope of the invention as set forth in the appended claims, as many variations of structure are obviously possible within the scope of the following claims.

What is claimed is:

1. A combined key set printing mechanism and electrically controlled computing device comprising a plurality of digital keys, a plurality of settable index members arranged in denominational rows, an index member setting mechanism between said keys and said members, a switch for each of said keys, said switch being operated by said key during key depression and prior to setting of an index member, a solenoid operatively connected to each of said keys and each said solenoid being energizable to depress its connected key to a fully depressed position, input receiving means in said computing device settable by said switches to energize the solenoid connected to the key which has been partially depressed to close a switch whereby said key is fully depressed to set one of said index members, and delay means in said computer to reset said input receiving means to deenergize said solenoid and release said depressed key for restoration to a home position after said computer has completed entry of the digit corresponding to the operated digital key.

2. A combined printing and computing machine comprising printing members, a field of settable index members arranged in parallel denominational rows to control said printing members, a plurality of digit keys,

each key being depressible to set said index members and setting members between each of said keys and said index members to set a stop member in a denominational row and to thereafter initiate a relative shift between said setting and index members and between said index members and said printing members, an electrically controlled computer digitally and denominationally settable by selective energization of a plurality of input circuits, a switch in each of said input circuits, a member on each of said digital keys to operate one of said switches by partial depression of said digital key, a solenoid connected to each digital key, a circuit closing member to energize each solenoid, and thereby fully depress the associated digital key, each circuit closing member being controlled for operation by one of said input leads, and means in said computer to restore an operated circuit closing member to normal condition and thereby deenergize an energized solenoid despite manual retention of a key in a depressed position.

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