Nov. 23, 1937. H. G. JOHNSTONE 2,099,892

PERFORATING APPARATUS

Filed Jan. 15, 1935 2 Sheets-Sheet 1

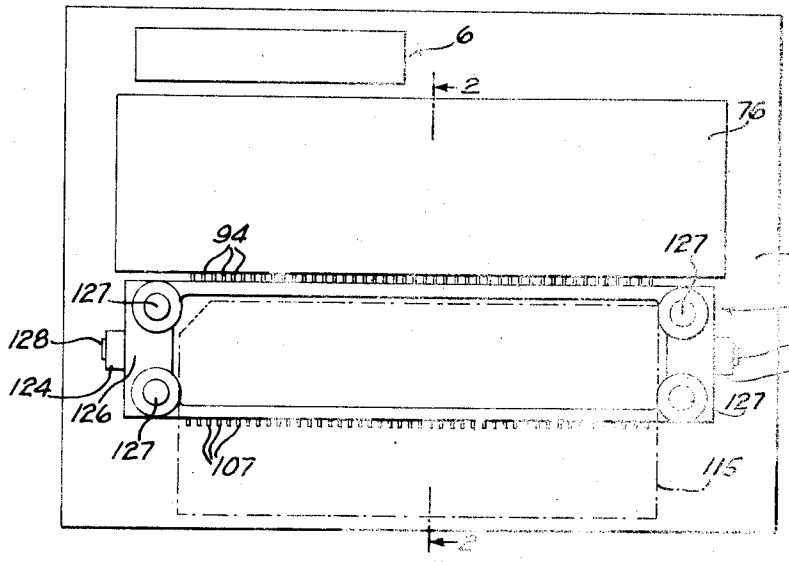

FIG. 1

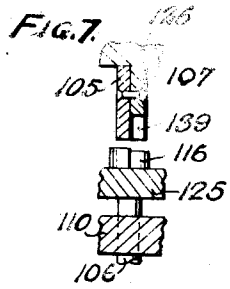

FIG. 7.

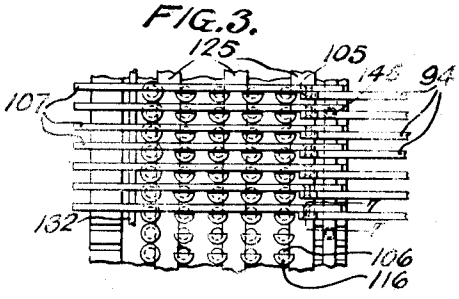

FIG. 3.

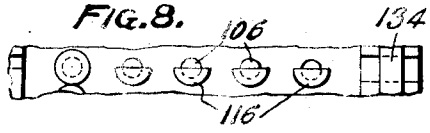

FIG. 8.

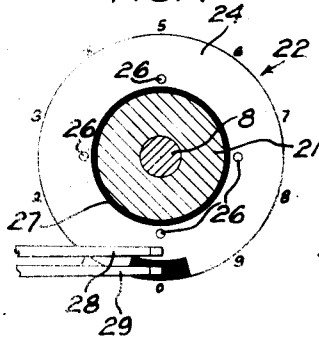

FIG. 4

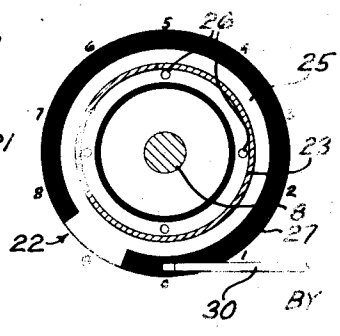

FIG. 5

INVENTOR
H. G. JOHNSTONE
BY H. A. Whitehorn
ATTORNEY

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PERFORATING APPARATUS

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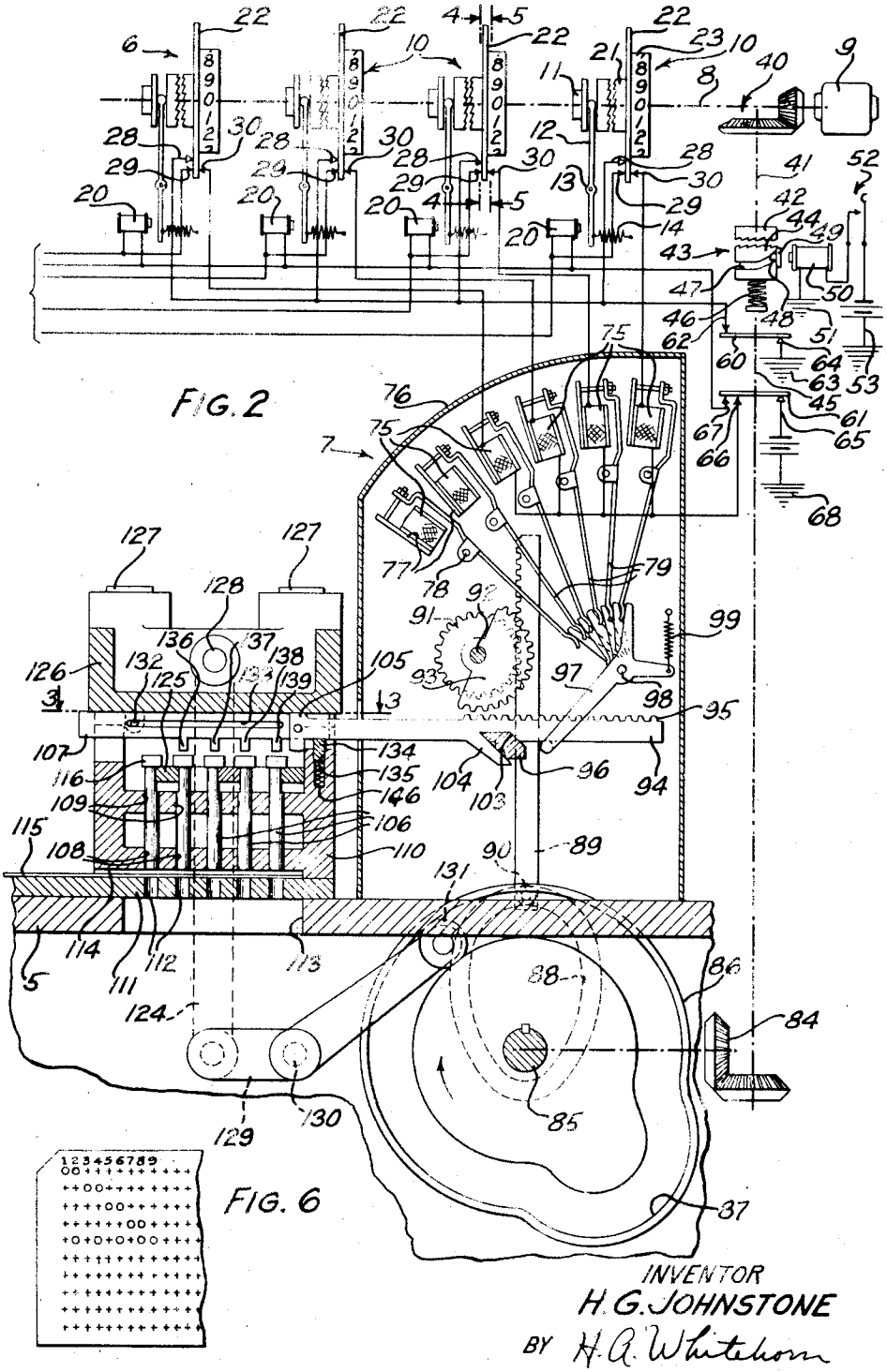

FIG. 2

FIG. 6

INVENTOR
H. G. JOHNSTONE
BY H. A. Whitehorn
ATTORNEY

Patented Nov. 23, 1937 2,099,892

UNITED STATES PATENT OFFICE

2,099,892

PERFORATING APPARATUS

Harold G. Johnstone, Chicago, Ill., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application January 15, 1935, Serial No. 1,840

3 Claims. (Cl. 164—115)

This invention relates to perforating apparatus, and more particularly to perforating apparatus for use in calculating machines for punching combinational hole representations of numbers in statistical cards.

It is an object of the present invention to provide a simple, inexpensive and efficient perforating mechanism.

In accordance with one embodiment, the invention contemplates the provision of means for reading information from a registering or accumulating device which registers the results of calculations as whole numbers, and a perforator controlled by such reading mechanism for perforating combinational hole representations of the numbers registered on the register or accumulator. The perforating portion of the mechanism comprises a plurality of perforator selectors advanceable through varying distances. Each of the selectors may select for actuation one or more of a plurality of perforators associated therewith and upon actuation the perforators will punch in a card the numbers indicated on the register.

A better understanding of the invention will be had by reference to the following detailed description, when considered in conjunction with the accompanying drawings, wherein

Fig. 1 is a plan view of a perforating mechanism comprising one embodiment of the invention;

Fig. 2 is a vertical sectional view taken along the line 2—2 of Fig. 1 in the direction of the arrows and having also shown therein schematically the circuit which controls the operation of the perforator;

Fig. 3 is a fragmentary horizontal sectional view taken on the line 3—3 of Fig. 2 in the direction of the arrows;

Figs. 4 and 5 are vertical sectional views taken on the lines 4—4 and 5—5, respectively, of Fig. 2 in the direction of the arrows;

Fig. 6 is a schematic view showing the combinational hole system of recording numbers;

Fig. 7 is an enlarged sectional view taken on the line 7—7 of Fig. 3 in the direction of the arrows, and

Fig. 8 is an enlarged fragmentary view of a row of perforators showing the construction of the heads of the perforators.

Referring now to the drawings wherein like reference numerals indicate the same parts throughout the several views, the numeral 5 designates a base plate mounted on suitable standards (not shown) and supporting a register unit designated generally by the numeral 6 and a punch unit designated generally by the numeral 7. The register unit disclosed herein is an electromagnetically controlled register including a continually rotating shaft 8 driven by a motor 9. The shaft 8 supports a plurality of accumulator units 10, each of which comprises a clutch member 11, keyed to and rotatable with the shaft 8 but slidable longitudinally thereof. Each clutch member 11 is normally urged to the left (Fig. 2) by a clutch lever 12 pivoted at 13 and urged about its pivot in an anti-clockwise direction by a contractile spring 14. The upper end (Fig. 2) of the clutch lever 12 extends into a slot formed in the periphery of the clutch member 11 and, upon energization of an electromagnet 20 which has for its armature the lower end of the lever 12, will be moved to the right to bring clutch member 11 into engagement with a clutch member 21, which is fixed against movement axially of the shaft 8, but which is freely rotatable thereupon. A center stop, not shown but of the usual type such as is shown in Figs. 4 and 5 of United States Patent 1,952,868, issued March 27, 1934, holds the clutch member 21 against rotation except when it is engaged by the clutch member 11.

The clutch member 21 has secured thereto a sequence switch 22 and a number wheel 23. Each sequence switch 22 (Figs. 4 and 5) is insulated from the shaft 8 and comprises a pair of disks 24 and 25 of conducting material electrically interconnected by rivets 26 and mounted upon opposite sides of a disk 27 of insulating material.

There are three brushes 28, 29 and 30 associated with each sequence switch 22. The brush 28 is always in contact with the disk 24 and is electrically connected with the disk 25 by means of the rivets 26. Brush 29 engages the disk 24 at all times except when the disk is in its normal or zero position, that is, when the number wheel 23 indicates zero. The brush 30 engages the disk 25 only at the 9 position. The circuits controlled by the sequence switches 22 will be described more in detail hereinafter in connection with the description of the operation of the device.

The shaft 8 through gearing 40 drives a shaft 41 to which is fixed a clutch member 42 forming a part of a single revolution clutch indicated generally by the numeral 43. The single revolution clutch 43 comprises in addition to the clutch member 42, a clutch member 44 slidably mounted on a shaft 45 but keyed to rotate with the shaft 45. The clutch member 44 is normally

urged into engagement with the clutch member 42 by a spring 46 and is provided with a cam slot 47 into which extends a camming pin 48 mounted on the armature 49 of an electromagnet 50. Electromagnet 50 has one side of its winding connected to ground at 51 and the other side of its winding is connected to a contact of a manually operable key 52 the other contact of which is connected to grounded battery at 53.

From the foregoing it will be apparent that momentary operation of the key 52 will connect grounded battery at 53 through the winding of the electromagnet 50 to ground at 51, causing the electromagnet 50 to attract its armature 49 and withdraw the camming pin 48 from the cam slot 47 whereupon the spring 46 will move the clutch member 44 into engagement with the clutch member 42 and upon release of the key 52 the camming pin 48 will be permitted to drop back into the slot 47 to cam the clutch member 44 out of engagement with the clutch member 42 at the end of a single rotation of the shaft 45. It will be apparent that each time the key 52 is operated momentarily a single revolution will be imparted to the shaft 45.

Mounter upon the shaft 45 are a pair of sequence switches 60 and 61. These switches 60 and 61 are similar to the switches 22, from which they differ only in the position of the contacting surfaces and arrangement of brushes. The sequence switch 60 has associated therewith a brush 62 which engages a conducting portion of the sequence switch 60 in all positions thereof except normal position. The brush 62 is connected to all of the brushes 28, and as soon as the shaft 45 is moved out of normal position the brush 62 will connect ground at 63 through a brush 64 always in contact with the conducting portion of the sequence switch 60 to the brushes 28 associated with the sequence switches 22.

The sequence switch 61 has three brushes 65, 66, and 67, associated therewith and serves to connect grounded battery at 68 through the brush 65 always in contact with a conducting portion of the sequence switch 61 to the brushes 66 and 67 as soon as the shaft 45 moves out of normal position, since the brushes 66 and 67 engage a conducting portion of the sequence switch 61 at all positions except normal. The brush 67 is connected to one side of the winding of each of the electromagnets 20 and the brush 66 is connected to the winding of each of a plurality of electromagnets 75.

The electromagnets 75 control the operation of the punch unit 7 and have the other side of their windings connected severally to the brushes 30 associated with the sequence switches 22. The electromagnets 75 are mounted in an arcuate staggered relation in a housing 76, being supported directly upon a plurality of bars 77 extending longitudinally of the housing 76 and secured to the ends thereof. A plurality of rods 78 equal in number to the number of the bars 77 serve as fulcrums about which armatures 79 associated with the electromagnets 75 may be rocked upon energization of the electromagnets 75.

The shaft 45 through gearing 84 drives a shaft 85 which constitutes the main drive shaft for the punch unit and which is suitably journaled beneath the base plate 5. There are mounted upon the ends of the shaft 85 a pair of cams 86 each having cam grooves 87 and 88 therein, whereby the moving parts of the punch are actuated. A cam roller 90 is positioned in the cam groove 88 and is mounted upon the end of a rack 89. The rack 89 meshes with and drives a gear 91 fixed to a shaft 92. The shaft 92 also has a gear segment 93 fixed thereto which extends longitudinally of the housing 76 and is associated with a plurality of selector bars 94 which have teeth 95 thereon adapted to engage with the teeth of the gear segment 93.

There are a plurality of selector bars 94, one being provided for each column of cards to be perforated and having associated therewith an electromagnet 75 and cooperating equipment. The right end of the selector bars 95 (Fig. 2) are supported upon a bar 96 extending longitudinally of the housing 76 and are so positioned as normally to be out of engagement with the teeth of the gear segment 93. Upon energization of an electromagnet 75 its associated bar is lifted into engagement with the teeth of the gear segment 93 by one of a plurality of bell crank levers 97 which are normally urged to rotate about their pivot 98 by contractile springs 99 and which have an arm thereof positioned in the path of the armatures 79 of electromagnets 75. The underside of the selector bars 94 are cut out at 103 so that when the bars are in normal position they are out of engagement with the gear segment 93, but upon momentary energization of an electromagnet 75 its associated selector bar will be raised into engagement with the teeth of a gear segment 93 and as soon as the selector bar is advanced a very small distance by the gear segment, the underside thereof will take a position on top of the bar 96 so that the release of the electromagnet 75 will not permit the bar to fall out of engagement with the gear segment until the gear segment drives the selector bar forward and then back to its normal position. As any or all of the selector bars approach their normal position in moving toward the right (Fig. 2) a cam arm 104 formed on the underside of each selector bar 94 will engage the inclined left hand surface (Fig. 2) of the bar 96 to cam the teeth 95 out of engagement with the teeth of the gear segments 93.

The left hand end (Fig. 2) of each selector bar 94 has an enlarged portion 105 which serves as a hammer for actuating perforating pins 106, and has pivoted thereto a toothed bar 107. The perforating pins 106 are mounted in 45 columns of 5 pins to a column and are adapted to perforate by combinational representations any one of the digits 1 to 9 in any column. The perforating pins 106 are mounted in apertures 108 and 109 in a guide box 110 which rests upon a die plate 111 mounted directly upon the base 5. The die plate 111 is provided with a plurality of apertures 112 in direct vertical alignment with the apertures 108 and 109 of the guide box 110, and the base 5 is cut out as shown at 113 to permit scrap formed in punching cards to fall into a suitable receptacle (not shown). A slot 114 is formed between the die plate 111 and the guide box 110 to permit the insertion of card 115 to be perforated. In the embodiment of the invention disclosed herein only one half of the card is under control of the punch, but it will be obvious that suitable card stops could be provided to permit punching in either or both halves of the card without departing from the scope of the invention.

The upper ends of the perforating pins 106 are provided with heads 116, the left hand pin 106 has a circular head and the four right hand pins have semi-circular heads. All of the pins 106 are slotted to receive stripper bars 125 which extend

longitudinally of the machine and prevent the pins from turning in the apertures 108. The stripper bars are secured at their ends to a ram 126 slidably supported on guide pins 127. The ram 126 has links 124 pivoted thereto at each end as indicated at 128, the lower ends of which links are pivotally connected to a pair of bell cranks 129 which in turn are pivoted to the base 5 at 130. The bell cranks 129 carry at their right ends (Fig. 2) cam rollers 131 which are positioned in the cam grooves 87 and upon rotation of the cams 86 the bell cranks 129 will be rocked about their pivots 130 to move the ram 126 downwardly and then upwardly at a predetermined time in the cycle of operation of the shaft 85.

The underside of the ram 126 has secured thereto a bar 132 which extends into slots 133 in the toothed bars 107 and holds the bars up against the underside of the ram 126. The right hand end (Fig. 2) of the bars 107 and the left hand end of the selector bar 94 are urged upwardly and into engagement with the lower surface of the ram 126 by pins 134 mounted in holes 135 in the guide box 110 and urged upwardly by compression springs 146 also positioned in the holes 135.

The toothed bar 107 has its teeth 136, 137, 138 and 139 so spaced that when the selector bar 94 and toothed bar 107 are moved to the left 1, 3, 5 or 7 places, the teeth will not engage the head of the left hand pin 106; whereas, when the bars 94 and 107 are moved to the left two spaces the tooth 136 will be in direct vertical alignment with the left hand pin 106, when the bars are moved four spaces to the left the pin 137 will be in direct vertical alignment with the left hand pin 106, when the bars are moved 6 spaces to the left the tooth 138 will be in direct vertical alignment with the left hand pin 106 and when the bars 94 and 107 are moved to the left eight spaces the tooth 139 will be in direct vertical alignment with the left hand perforating pin 106. The enlarged portion 105 of the selector bar 94, will, when the selector bar is moved either one or two places to the left, have a portion thereof in vertical alignment with the first pin 106 at the right (Fig. 2); when the selector bar is moved either three or four places to the left (Fig. 2), the enlarged portion 105 thereof will be in vertical alignment with the second perforating pin 106 from the right. When the bars are moved either five or six places to the left the portion 105 will be in alignment with the third perforating pin 106 from the left, when the bars are moved either seven or eight places to the left the portion 105 will be in vertical alignment with the fourth perforating pin 106 from the left, and when the selector bar 94 is moved 9 places to the left the enlarged portion 105 thereof will be in vertical alignment with the head of perforating pin 106 at the extreme left of the group of perforating pins.

The system of recording numbers has been shown in Fig. 6 wherein the numbers 1 to 9 are shown punched in successive rows from left to right.

There are provided 45 columns of perforating pins, each having a selector bar 94 and toothed bar 107 individual thereto, associated with each of which there is a bell crank 97 and an electromagnet 75 as well as a register unit comprised of a sequence switch 22 and a number wheel 23 with their appurtenances.

It is believed that a better understanding of the invention will be had by assuming that the register units shown in Fig. 2, have entered therein the digits 9, 7, 6, 2, as whole numbers. The input circuits of the registers have not been shown since they would unduly complicate the disclosure and do not pertain to this invention; but they may be of any known type.

When it is desired to clear the register unit 6 and to punch, on a statistical card, combinational hole representations of the numbers registered in the register unit, this may be accomplished by depressing the key 52, thereby to close the circuit for operating electromagnet 50. Electromagnet 50, upon operating, will operate the single revolution clutch 43 thereby causing the shaft 41, through the clutch 43, to drive the shafts 45 and 85 through one complete revolution. As the shaft 45 moves out of normal, the brush 62 will pick up the ground at 63 through sequence switch 60 to place ground on all of the brushes 28 and simultaneously therewith grounded battery at 68 will be connected through sequence switch 61 to the windings of all of the electromagnets 75 and to one side of the windings of all of electromagnets 20. The sequence switches 22 at this time are all out of normal position and therefore each of their associated brushes 29 will be engaging the disks 24 and since ground is connected to the disks 24 through brush 28 and sequence switch 60, the electromagnets 20 will all be energized to move the clutch members 11 into engagement with the clutch members 21 to rotate the sequence switches and number wheels until they arrive in normal or zero position; whereupon the circuits to the electromagnets 20 will be broken as each number wheel reaches zero position due to the brush 29 engaging the disk 27 of insulating material. As each sequence switch passes through its 9 position in its travel forward to zero, the ground from sequence switch 60 through brushes 62 and 28 will be connected through brush 30 to electromagnet 75 to complete the circuit to that electromagnet causing it to attract its armature and raise the associated selector bar 94 into engagement with the segmental gear 93, which at this time will be rotating in a clockwise direction. The first bar to be picked up will be that one associated with the digit 9 stored in the first number wheel at the left (Fig. 2) of the register unit 6, and therefore the selector bar 94 and its associated toothed bar 97 will be advanced 9 positions, or to the extreme left hand position (Fig. 2) thereby to bring the enlarged portion 105 of the selector bar over the head of the extreme left hand pin 106 and to move the teeth 136, 137, 138 and 139 beyond the last peforating pin 106 at the left (Fig. 2).

While the selector bar 94 associated with the left hand sequence switch 22 (Fig. 2) was traveling to the left and after it had traveled two places, the electromagnet 75 associated with the second sequence switch 22 from the left (Fig. 2) would be energized due to the completion of a circuit similar to that described in connection with the extreme left hand sequence switch 22, and similar operations would take place in connection with the two sequence switches 22 at the right (Fig. 2). Thus, since the segmental gear 93 is common to all of the selector bars 94 and the selector bars are moved into engagement with the segmental gear at intervals dependent upon the number registered on the associated number wheels, the selector bars associated with the number wheels 23 from left to right (Fig. 2) would be advanced to the left (Fig. 2) 9, 7, 6 and 2 places, respectively, and would select for operation the 5th pin from the right representative of the digit 9, the 4th pin from the right

representative of the digit 7, the 3rd and 5th pins from the right representative of the digit 6, and the 1st and 5th pins from the right representative of the digit 2 in the columns associated with the respective number wheels. The operation of the selector bars for attaining this result has been set forth in connection with the detailed description thereof and need not be repeated here.

The setting up of the selector bars occurs in the first half revolution of the shafts **45** and **85** and as soon as all the selector bars which are to be advanced have been moved to their selected positions, the ram **126** will be moved downwardly due to the bell crank lever **129** being rocked about its pivot **130** by the cam roller **131** in a cam groove **87**. The ram will then be raised due to the configuration of the cam groove **87** and the rack **89** will be moved downwardly to return the selector bars to their normal position, and as each selector bar arrives in normal position, it will be camméd out of engagement with the segmental gear **93** by the cam arm **104** engaging the bar **96**.

The register will in this manner be cleared to zero simultaneously with the setting up of the punching mechanism to punch in a record by combinational hole representations, the numbers which had been stored in the register as whole numbers and the machine will be ready for new information to be put into the register.

What is claimed is:

1. In a perforating apparatus, a plurality of punches arranged in columns of five to a column and designed to be operated to punch combinations of holes representative of the digits one to nine, and a selector associated with a column of punches movable to any one of nine positions and adapted to select a different punch in each of positions one, three, five, seven and nine and to select one punch and one of the other four punches in the other four positions respectively.

2. In a perforating apparatus, a plurality of punches arranged in columns of five to a column and adapted to be operated to punch combinations of holes representative of the digits one to nine, a selector associated with a column of punches movable to any one of nine positions and adapted to select a different punch in each of positions one, three, five, seven and nine and to select one punch and one of the other four punches in the other four positions respectively, and an electromagnet for controlling the position to which a selector is moved.

3. In a combinational hole punch, a row of five punch pins, an elongated selector device, means for moving said device to any one of nine positions over said row, means carried by said device for selecting and striking the same pin in alternate positions of said device, means carried by said device for selecting and striking one or another of said pins at every position of the device, and means for actuating said device transversely.

HAROLD G. JOHNSTONE.