

July 6, 1943.

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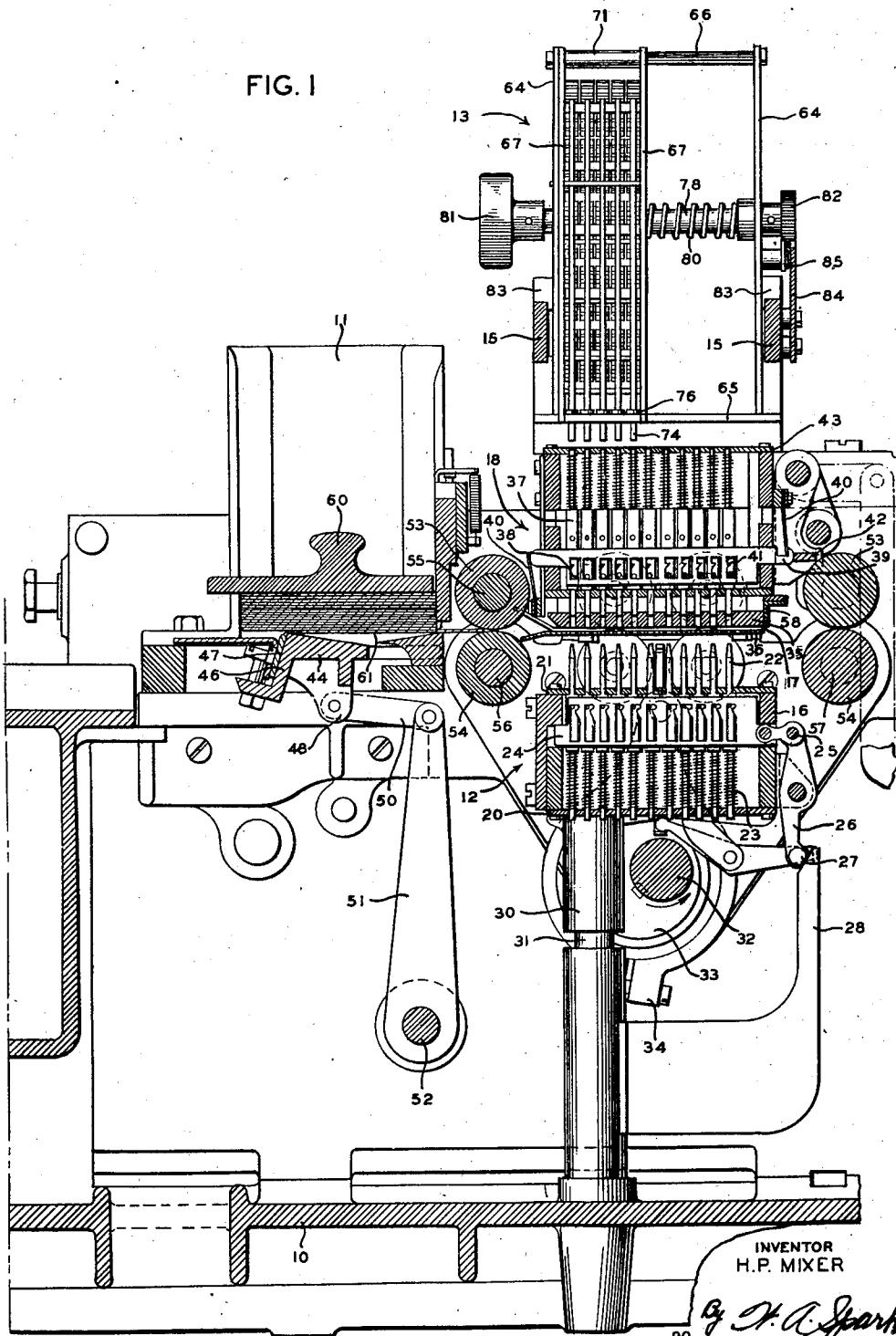
2,323,833

ELECTRIC DECODING DEVICE

Original Filed April 25, 1936

4 Sheets-Sheet 1

FIG. 1



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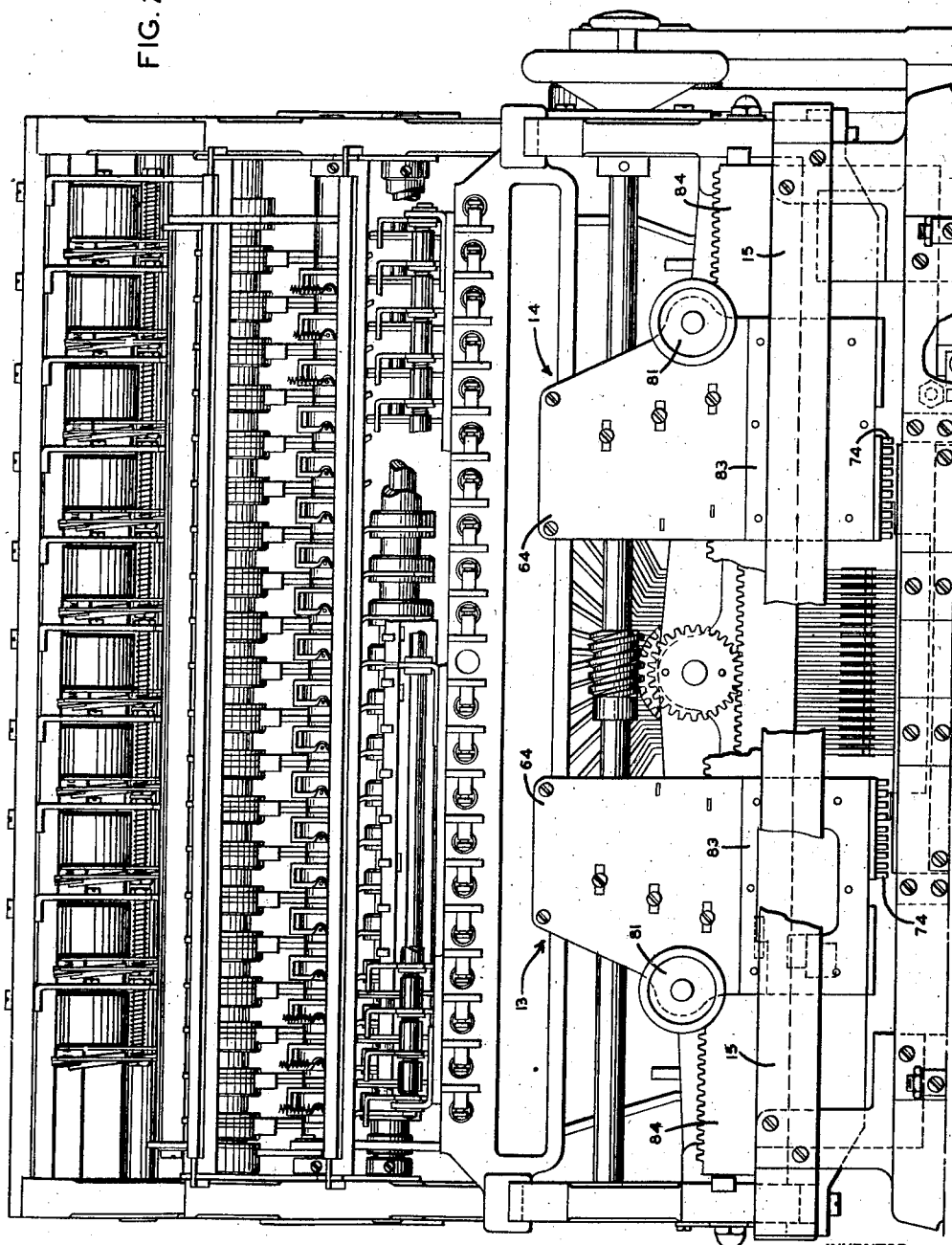
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4 Sheets-Sheet 2

FIG. 2



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ELECTRIC DECODING DEVICE

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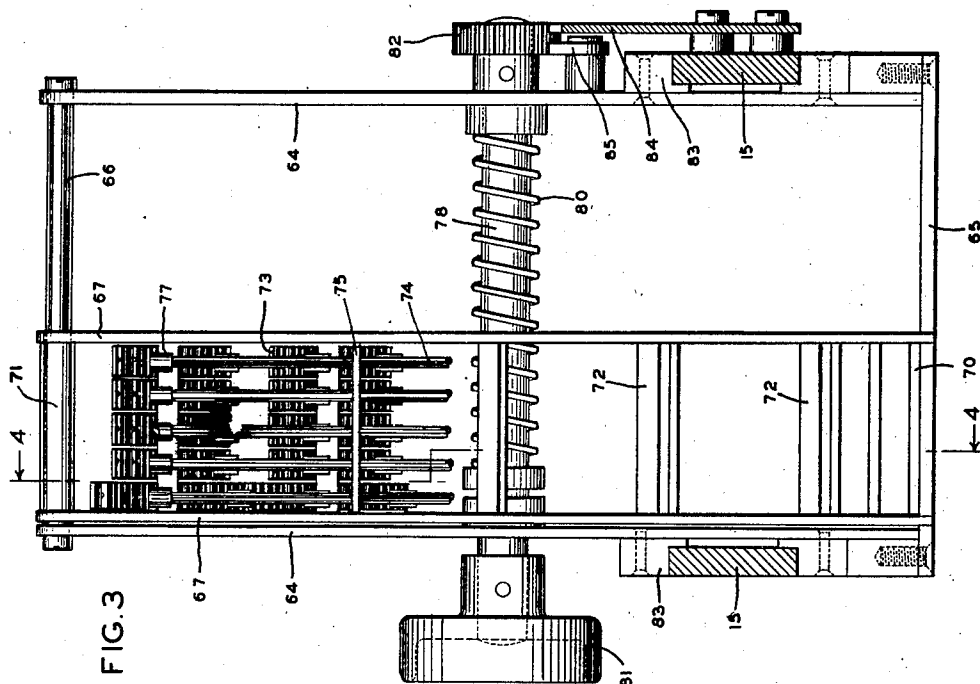


FIG. 3

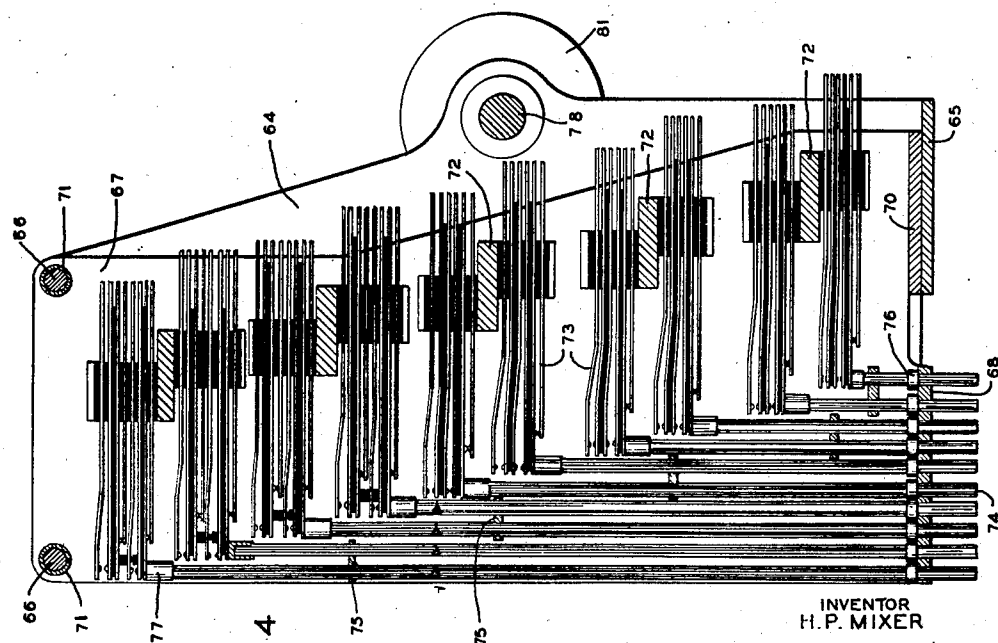


FIG. 4

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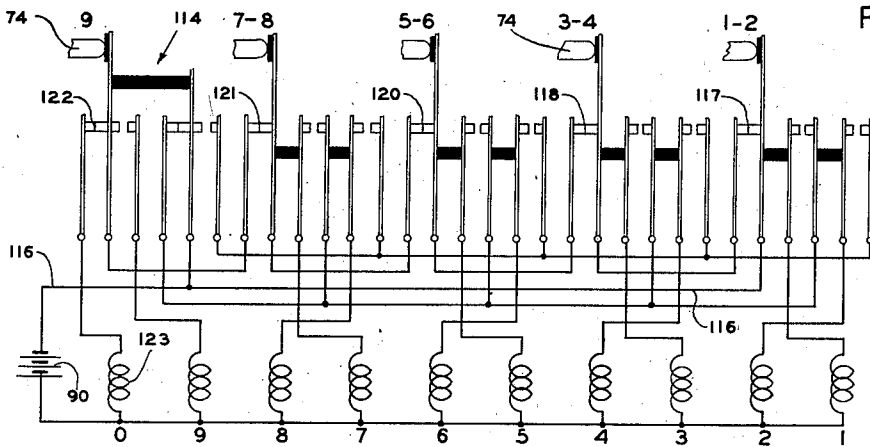


FIG. 5

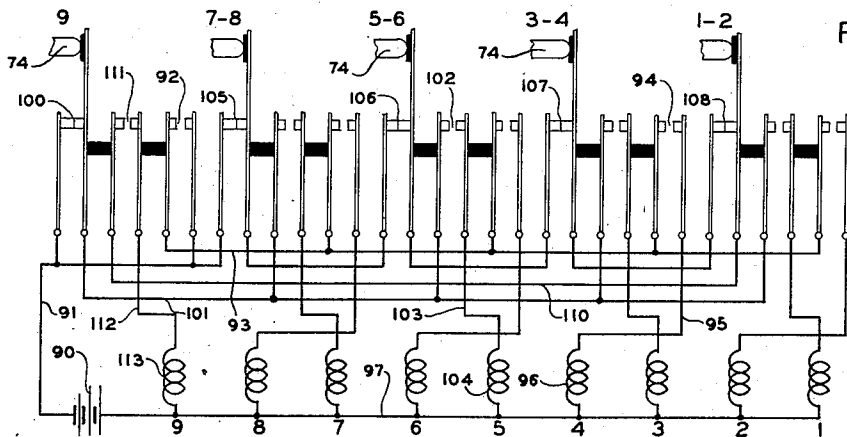


FIG. 6

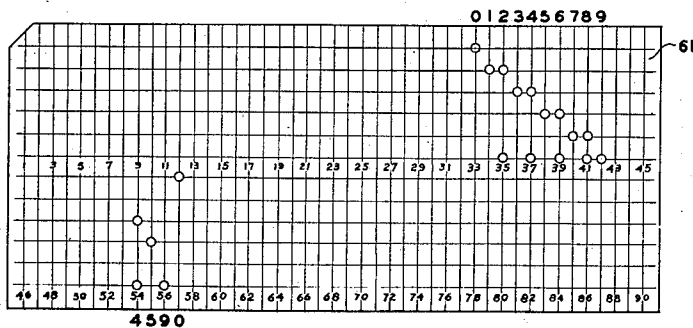


FIG. 7

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UNITED STATES PATENT OFFICE

2,323,833

ELECTRIC DECODING DEVICE

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Original application April 25, 1936, Serial No. 76,492, now Patent No. 2,214,029, dated September 10, 1940. Divided and this application May 17, 1940, Serial No. 335,685

2 Claims. (Cl. 235—61.6)

The present invention relates to decoding contact means as applied to accounting machines using punched data cards of the type which are fully described in my copending application, Serial No. 76,492 filed April 25, 1936, now Patent No. 2,214,029, issued September 10, 1940, of which the present application is a division.

The invention more particularly relates to electrical decoding devices which are adapted to sense a two hole five position code and translate it by closing contacts for completing individual circuits identified by one of nine digits.

The invention resides in the provision of a series of electrical contact units which are operated by a mechanical card sensing unit. The contacts are connected in such manner that one of nine conductors is energized whenever a coded digit is sensed in a punched data card.

One of the objects of the invention is to provide a decoding structure which will sense the standard Powers ninety column data cards and produce digit representations which may be used by a multiplying machine.

Another object of the invention is the provision of a contact decoding structure which may be placed directly above the mechanical sensing unit and produce decoded data directly without any loss of time or additional mechanical motion.

Another object of the invention is the provision of a plurality of decoding units which may be shifted from one part of the card field to another to add to the flexibility and convenience of data card sensing.

Still another object of the invention is the provision of a novel circuit arrangement whereby the decoding stack is short-circuited whenever there is no data sensed in the card, thus permitting a unique electrical impulse to be generated for use by the accounting mechanism.

Other objects and structural details of the invention will be apparent from the following description when read in connection with the accompanying drawings, wherein,

Fig. 1 shows a cross sectional view of an accounting machine sensing head with the decoding stack positioned above the record-retaining pins;

Fig. 2 is a front elevational view of part of an accounting machine showing two decoding stacks;

Fig. 3 is a side view of a decoding stack showing the construction in greater detail;

Fig. 4 is a cross sectional view taken along line 4—4 of Fig. 3;

Fig. 5 is a schematic diagram of connections of a multiplier stack;

Fig. 6 is a schematic diagram of connections of a multiplicand stack;

Fig. 7 is a plan view of a data card showing coded representations punched therein.

The decoding contact stack to be described in detail hereinafter is part of a multiplying machine disclosed in the parent application, now Patent No. 2,214,029. Fig. 2 shows the front portion of the multiplying machine with two decoding stacks 13 and 14 mounted thereon, one to sense and decode the multiplicand data, the second for a similar operation on the multiplier data. The usefulness of the decoding stack is not confined to a multiplying machine, however, but may be used in any accounting machine which uses a six position, three point code in its data representations and requires an electrical circuit for the handling of said data.

Fig. 1 illustrates the relative positions of the mechanical sensing head and decoding stack. Supported on the forward portion of the bed plate 10 are the card magazine 11 and the sensing mechanism 12. The decoding mechanism 13 is adjustably mounted on a pair of rails 15 directly above the sensing mechanism.

The sensing mechanism utilized in this machine is in general similar to that used in the Powers type of tabulator and is described in U. S. patent to W. W. Lasker No. 2,044,119. The sensing mechanism comprises the sensing head 16, the sensing chamber 17 and the record-retaining box 18, the elements of which are well known but will be briefly described.

Sensing head

The sensing head 16 is a box-like structure of approximately the size of a record card, having a base plate 20 and an upper plate 21 between which are located forty-five columns of sensing pins 22, each column comprising eleven pins. (In the usual sensing head twelve pins per column are provided, but as will later be seen, the instant machine does not utilize the first or uppermost hole position of the card.) Each pin is held in its uppermost position by means of a spring 23 compressed between a collar on the pin and the lower sensing plate 20. In order to retain any sensing pin which has passed through the card in its uppermost position, relative to the sensing head, latching slides 24 are provided, one slide for each column of pins. These latching slides have cutouts with noses formed therein in a well known manner, and are slidably mounted

in the sensing head and operated through the medium of a ball 25, which is oscillated under control of a lever 26 and a roller 27 which is attached to the lower end of said lever and bears against a stationary cam plate 28. A latch controlled by the well known "card presence" sensing pin is also provided to prevent locking of the sensing pins when there is no card in the sensing chamber.

The sensing head is arranged to reciprocate vertically and is guided by sleeves 30 which project downwardly from the sensing head and slide on rods or posts 31 which are supported upon the bed plate 10. The reciprocation of the sensing head is caused by rotation of a sensing drive shaft 32 (Fig. 1), which shaft is carried in bearings in the side frames of the machine. This shaft extends across the machine directly under the sensing head 16.

Mounted on shaft 32 are two eccentrics 33 one of which lies under each side of the frame of the sensing head. Each eccentric 33 is provided with an eccentric strap 34 having a link like extension which is pivotally connected to a stud fixed to the side of the sensing head frame and thus, as the shaft 32 revolves, sensing head 16 moves up and down.

Shaft 32 is driven from a worm gear and clutch mechanism such that its movement is intermittent and is under control of a clutch tripping lever which is magnetically operated.

Immediately above the sensing head is a card sensing chamber 17 which is composed of two plates 35 and 36, which are perforated in the same manner as plates 20 and 21 of the sensing head and between which a card to be sensed is fed in a manner hereinafter described.

Supported immediately above the sensing chamber is a record-retaining box 18 which contains a plurality of record-retaining pins 37, which pins are arranged in forty-five columns of eleven each to cooperate with the similarly arranged pins in the sensing head. Pins 37 are adapted to be locked in their uppermost positions by the cooperation of extrusions or pins 38 thereon, with latching slides 39. Two latching slides are provided for each column of pins, one of the two slides serving to retaining the five pins associated with the upper ninety-column zone in their operative position, and the other to retain the five pins associated with the lower ninety-column zone. All of the latching slides 39 are normally held in their right-hand positions (as seen in Fig. 1) through the medium of spring combs 40, half of which bear against projections at the left-hand end of the slides, and the other half of which lie in notches at the right-hand end of the slides. The latching slides 39 are moved to the left against the pressure of the spring combs 40 by the action of the extrusions 38 on the pins 37, with cam faces 41 in the cut-out portions of the slides. When a pin has passed above the cam 41 the slide is returned to its normal right-hand position by the spring, and the pin 37 is then held in its raised position. At a predetermined moment in each sensing cycle, a restoring ball 42 is pressed against the right-hand projections of all the slides, thereby returning them to the left against their spring tension and releasing all locked pins.

Assuming now that a card lies in the sensing chamber, and that the shaft 32 has started to rotate, the sensing head 16 is first lowered slightly and then moved upwardly under control of eccentrics 33 until the sensing pins come in contact

with the record card in the sensing chamber directly above them. At this point the shaft 32 has rotated about 90°. Upon further rotation the sensing head continues to rise and any sensing pin 22 which finds a hole in the card continues upwardly as the sensing head rises, while any pin which meets an unpunched portion of the card is forced downwardly (relative to the sensing head) against the tension of its spring 23. Immediately after those pins which find holes in the card pass through the card, the ball 25 is moved toward the left (as viewed in Fig. 1) and moves the latching slides 24 to the left, thus locking those pins which have passed through the card in their uppermost positions. As the sensing head continues to rise the locked pins press against the corresponding record-retaining pins 37 and move them upwardly against the tension of their associated springs, which are compressed between an upper plate 43 of the record-retaining box 18 and shoulders on the record retaining pins.

As the record retaining pins move upwardly, the extrusions 38 thereon meet the cam faces 41 in the cut out portions of the cooperating latching slides 39 and force the latching slides to the left. Shortly thereafter the extrusions pass beyond the cams and the slides are returned to the right by the spring combs 40 and lock the elevated pins in their raised positions. Due to the coordination of the cam plate 28 and the cam which controls the ball 42 for operating the latching slides 39, those slides are moved to the left just prior to the locking of the pins 37 in their uppermost positions. This movement of the ball 42 will release all pins 37 which were locked during the previous cycle and prepare them for re-operation and locking.

Operation of the record-retaining pins 37 is effective to raise certain rods and close certain contacts within the decoding mechanisms which lie above them.

Card feeding means

The mechanism for feeding cards into the card chamber, holding them there while sensing is performed, and ejecting them from the chamber after the sensing operation is complete, will now be described. Lying in front of the sensing mechanism is the card magazine 11, the bottom of which is formed by a picker plate 44 having a forward table-like projection 45. Projecting from the plate 44, a distance substantially equal to the thickness of a record card, is a picker knife 47 which serves to move a card from the magazine into line with the feed rolls in a manner shortly to be described.

Extending downwardly from the mid-portion of the picker plate 44 is a lug 48 to which is pivoted a short link 50 which extends rearwardly and is pivotally connected to an arm 51 which is secured to the picker shaft 52. The shaft 52 is rocked through the medium of a cam follower and cam (not shown) which are operated by the shaft 32 in the manner customary in Powers tabulators and other accounting machines.

At the rear of the card magazine and with their contact line aligned with the card throat is a pair of feed rollers 53 and 54. These feed rollers are mounted on shafts 55 and 56, the lower one of which is supported in bearings in the side frame castings and the upper one of which is supported in pivotally mounted bearings which are adjustable with relation to the lower shaft by the manipulation of adjusting screws. Shaft 56 car-

ries at its outer end a worm wheel (not shown) which meshes with a worm mounted on the main shaft of the machine. Shaft 56 also carries, external to the main side castings, power drive connections which drive a similar shaft 57 at the rear of the sensing chamber which also has card rollers attached thereto for transporting a card which has been ejected from the sensing chamber. Other card rollers, driven in a similar manner but placed so as to contact the edge of the card instead of its central position, serve to transport a card into the sensing chamber and to position it against a card stop 58. When the sensing operation has been completed, the card stop is removed from the path of the card and the card rollers move the card rearwardly out of the sensing chamber.

From the above it will be seen that cards to be sensed are stacked and inserted in the magazine 11, being held against picker plate 44 by means of a weight 60 which is placed on top of the stack. When the machine starts, the picker knife moves forward enough to carry one card through the throat at the bottom of the magazine and move it into a position to be engaged by the feed rollers. The rollers transport it into the card chamber where it continues to be urged rearwardly until it comes in contact with the card stop 58 which at this moment is in its lowered position. The card remains against the card stop until the sensing head has been elevated and lowered when the sensing pins will again be clear of the card, at which time the card stop is elevated and the card is ejected to an eject basket or to some other card operating mechanism.

Decoding mechanism

The perforated data card used in this machine is well known in the art as the ninety column card. This card 61 is divided into two zones, as illustrated in Fig. 7, the upper and lower, each of which includes forty-five columns of five rows of sensing holes. In the code used, each odd digit is represented by a single hole in the card while each even digit is represented by two holes in the card, one of which is that hole which alone would represent nine and the other of which is that hole which alone would represent the next lower odd digit (i. e., nine and three equals four). Sometimes the uppermost hole in each zone is utilized to designate zero, while at other times, zeros are not punched and the tabulator or other machine with which the card is used is so constructed as to print a zero to the right of a significant numeral when no hole appears in the corresponding column. In the present instance the latter is true and when there is no hole in the uppermost position of either zone, zeros are automatically registered.

As will be obvious from the description, the sensing mechanism merely determines whether a hole appears in any position of the card and does not serve to translate the card coding into a digital count. It is for the purpose of performing this translation that the decoding mechanism or units are provided.

The instant machine shows two decoding units 13 and 14 (Fig. 2) which are mounted directly above the record-retaining box 18 and are adjustable transversely so that the data to be used by the machine may be taken from any field or zone of the card.

Details of one of the two decoding units are shown in Figs. 3 and 4. The particular unit shown in these figures is for a multiplier stack

used in a multiplying machine and has an extra set of contact points in the nine position, the use of which will be described later. The construction of a stack for a multiplicand factor is the same as shown except for the type and number of springs in the nine position. This difference is indicated in the wiring diagrams, Figs. 5 and 6.

Each decoding unit comprises a pair of vertical plates 64 which are secured together at the base by a plate 65 and at the top by a pair of rods 66 having shoulders formed thereon for maintaining the plates in parallel relation to form a unitary structure or carriage.

Mounted between the plates 64 and slidable on rods 66 is a box-like frame containing a plurality of contacts and pins. The frame comprises a pair of side members 67 secured together at the base by a perforated plate 68 and a slide plate 70. Securing the members together at the top is a pair of sleeves 71 which are positioned on rods 66. The side members 67 are further secured together by cross bars 72 which are located in echelon formation as shown in Fig. 3. Secured to the top and bottom of each cross bar 72 is a stack of contact springs 73. There are five of these stacks in ten vertical rows and each stack is operated by a vertical pin 74. There are five rows of ten pins each. The lower ends of pins 74 are guided in perforated plate 68 and in their intermediate portion by cross bars 75. Each pin is provided with a limiting shoulder 76 and an insulated cap 77. Each decoding unit is capable of sensing digits from ten columns of either the upper or lower zone of a ninety column card.

With the contact box positioned as shown in Figs. 1 and 3, the perforations in the lower zone of the card may be decoded. If it is desired to decode holes in the upper zone, the contact box is slid over the cross rods 66 until the box strikes the rear plate 64 in which position the pins 74 will be in line with the record-retaining pins of the upper zone of the sensing head.

The wiring of these contacts is such that whenever a pin in a position associated with an odd digit is operated, a circuit is completed over a wire associated with that digit and whenever the two pins associated with an even digit are operated, a circuit is completed over a single wire associated with that even digit. As was stated, each horizontal row comprises five contact stacks and is associated with a single column of a zone of the record card. Each vertical row of contact stacks is associated with the same digit code position for the ten record columns.

Referring now to Figs. 1 and 3, which show the appearance of one of the decoding units when viewed from the side, it will be seen that there extends through the unit, near the mid-point of one side thereof, a shaft 78 which is pressed forwardly by a spring 80 and has secured to the forward end thereof a knurled knob 81 and at the rear end a pinion 82.

Extending across the calculating machine and supported by brackets fixed to the side plates are two rails 15 on which ride guides 83 which are fixed to the outer faces of plates 64 of the decoding unit. Fixed to the rear rail 15 is a rack bar 84, which extends upwardly and meshes with the pinion 82. Fastened to the rear plate 64 of the decoding unit is a segmental rack bar 85 which meshes with the pinion 82 and acts as a stop member when the shaft 78 is in its forward position.

It will be seen from the above that when it

is desirable to move the decoding unit from one position to another to align with a field in the card from which a number is to be sensed, the knob 81 is pushed in, causing the pinion 82 to disengage from the segmental rack bar 85, after which the shaft is rotated in either direction and the unit, due to the cooperation of the pinion 82 and the rack bar 84, is moved transversely along the rails 15. Upon release or withdrawal of knob 81, the pinion again engages rack bar 85 and the unit is thus locked in position. Also, to position the contact stacks over upper or lower zones they are moved either forward or backward.

The contact stacks of each horizontal row are wired together in such a manner that the sensing of the card can be translated into a standard digital code. This wiring of the two contact stacks is shown in Figs. 5 and 6, each figure showing only one column stack capable of decoding a single coded digit.

Referring now to the card 61 shown in Fig. 7, the 54th to 57th columns in the lower zone have digit representations punched therein, signifying the number 4,490. If it is desired to sense this coded number and translate said data into electrical impulses in corresponding electrical circuits, a decoding stack is positioned above the pins corresponding to these columns in the record retaining box 18 as shown in Fig. 1 and the card is fed into the sensing chamber 17.

In Fig. 7 the entire numeric code is shown in the upper zone. This code indicates the numbers from "1" to "9," inclusive, by using the second to the sixth rows in the card. The first row is used only to represent "0" and since most calculating machines do not need to sense "0," this position is not sensed by the sensing mechanism and only five stacks of contacts are used in the decoding stack. Since this is the case, the first decoding pin is raised when a hole is sensed in the second row in the card, the second pin is operated by a third row hole and so on to the sixth row in the card where a hole will cause the fifth pin in the decoding stack to rise.

As an example of a coded number and the method of decoding it, reference is now made to the previously mentioned number 4,590, punched in the lower zone of the card. In the column which contains the coded "4" the third and sixth sensing pins will find holes and will cause the second and fifth decoding pins to be raised, thereby operating the spring contacts which lie above them.

Referring now to Fig. 6 which shows the connections for a multiplicand stack, the fifth decoding pin "9" and the second decoding pin "3-4" having been raised, a circuit may be traced as follows:

From the battery 90, over conductor 91, through contacts 92 which are closed because the "9" pin has been raised, over conductor 93, through contacts 94 which are closed because the "3-4" pin has been raised, over conductor 95, through the load circuit 96 which may be a relay or magnet, and back to the battery by way of conductor 97. Since the load circuit 96 is identified with the digit "4" the two hole combination has been properly decoded.

In the next or 55th column a digit "5" is coded as a single hole in the fourth row of the card, and when sensed the third decoding pin "5-6" will be raised. The decoding of this data may be followed by tracing a circuit from the battery 90 (Fig. 6), over conductor 91, through contacts

100, thence over conductor 101, through contacts 102 which are closed since the third decoding pin "5-6" has been raised, over conductor 103, through the load circuit 104, and back to the battery 90 over conductor 97. Since the load circuit 104 is identified with the "5" digit, the decoding is correct.

In the next or 56th column a "9" digit is coded as a single hole in the sixth row of the card, and when sensed the fifth decoding pin "9" will be raised. The decoding circuit set up is as follows: From the battery 90, over conductor 91, through contacts 105, 106, 107, and 108 in succession, thence over conductor 110, through contacts 111 which are closed because the pin "9" has been raised, over conductor 112, through load circuit 113, and back to the battery 90. As the load circuit 113 is identified with the digit "9" the decoding is correct.

In the next or 57th column a "0" is coded as a single hole in the first row in the data card. Since there is no decoding pin above this row the decoding stack will not be operated and the circuit will remain open. In the calculating machine described in Patent 2,214,029, such a condition is suitable for sensing a multiplicand and arranging the circuits for a multiplying operation with a digit as sensed from a multiplier stack. However, the multiplier must be sensed by an operation which causes a circuit to be closed through an additional load circuit when a "0" or blank card is sensed. Such a decoding stack is shown in Fig. 5.

The contacts and circuits of Fig. 5 are the same as Fig. 6 except in the "9" position. In this stack 114 there are four sets of contacts instead of three, two of which are made and two of which are broken when the "9" pin is operated. The decoding operation for all numbers from "1" to "9" is the same as described above but when a "0" or blank card is sensed, the circuit is as follows:

From the battery 90 (Fig. 5), over conductor 116, thence through contacts 117, 118, 120, 121, and 122 in succession, through the load circuit 123 and back to the battery 90. The load circuit 123 may take a variety of forms depending upon the requirements of the data machine on which the decoder is used. If the machine happens to be a multiplying machine as disclosed in Patent 2,214,029, the load circuit is the winding of a stepping switch which steps the multiplying operation along to the next multiplier digit. If such a decoder stack were employed on an interpreter machine which simply prints the data punched in the card, the load circuit would be used as a magnet or relay to print a "0."

While I have described what I consider to be highly desirable embodiments of my invention, it is obvious that many changes in form could be made without departing from the spirit of my invention, and I, therefore, do not limit myself to the exact forms herein shown and described, nor to anything less than the whole of my invention as hereinbefore set forth, and as hereinafter claimed.

What I claim as new, and desire to secure by Letters Patent, is:

1. A decoding unit of the class described for decoding a two unit code sensed from a punched data card, comprising five contact units for each denominational order to be decoded, pins for operating the contact units, four of said contact units each comprising three pairs of contacts, two of which are normally open and one

of which is normally closed and one of said contact units comprising four sets of contacts, two of which are normally open and two of which are normally closed, said contacts being shifted from their normal condition when operated by said pins, ten magnets for translating the decoded data, each of said magnets corresponding to one of the digits 1 to 9 and 0, an odd digit magnet and the next higher even digit magnet being associated with each of said four contact units and the 0 and 9 magnets being associated with said one contact unit, circuits connecting one side of each of said magnets to a source of current and the other side of the 1 to 8 magnets to the normally open pairs of contacts of the associated four contact units, a circuit connecting the normally closed pairs of contacts of said four contact units in series and through a set of normally closed contacts of said one contact unit to the 0 magnet, means connecting the 9 magnet, a normally open set of contacts of said one contact unit and said last mentioned circuit, whereby the 9 magnet will be energized when said contact unit is operated alone and the 0 magnet will be energized when no contact unit is operated, circuits connecting the pairs of contacts connected to odd digit magnets to the other set of normally closed contacts of said one contact unit, other circuits connecting the pairs of contacts connected to even digit magnets to the other set of normally open contacts of said one contact unit, whereby an odd digit magnet will be energized when one of said four contact units is operated alone and the next higher even digit magnet will be energized when this operation is accompanied by operation of said one contact unit.

2. A decoding unit of the class described for

decoding a two unit code sensed from a punched data card, comprising five contact units for each denominational order to be decoded, pins for operating the contact units, each of said contact units comprising three pairs of contacts, two of which are normally open and one of which is normally closed, said contacts being shifted from their normal condition when operated by said pins, nine magnets for translating the decoded data, each of said magnets corresponding to one of the digits from 1 to 9, an odd digit magnet and the next higher even digit magnet being associated with four of said contact units, and the 9 magnet being associated with the fifth of said contact units, circuits connecting one side of each of said magnets to a source of current and the other side of the 1 to 8 magnets to the normally open pairs of contacts of the associated four contact units, a circuit from said source of current connecting the normally closed pairs of contacts of said four contact units in series and through one of said normally open pairs of contacts of said fifth contact unit to the 9 magnet, whereby the 9 magnet will be energized when said fifth contact unit is operated alone, circuits connecting the pairs of contacts connected to odd digit magnets to the set of normally closed contacts of said fifth contact unit, other circuits connecting the pairs of contacts connected to even digit magnets to the other set of normally open contacts of said fifth contact unit, whereby an odd digit magnet will be energized when one of said four contact units is operated alone and the next higher even digit magnet will be energized when this operation is accompanied by operation of said fifth contact unit.

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