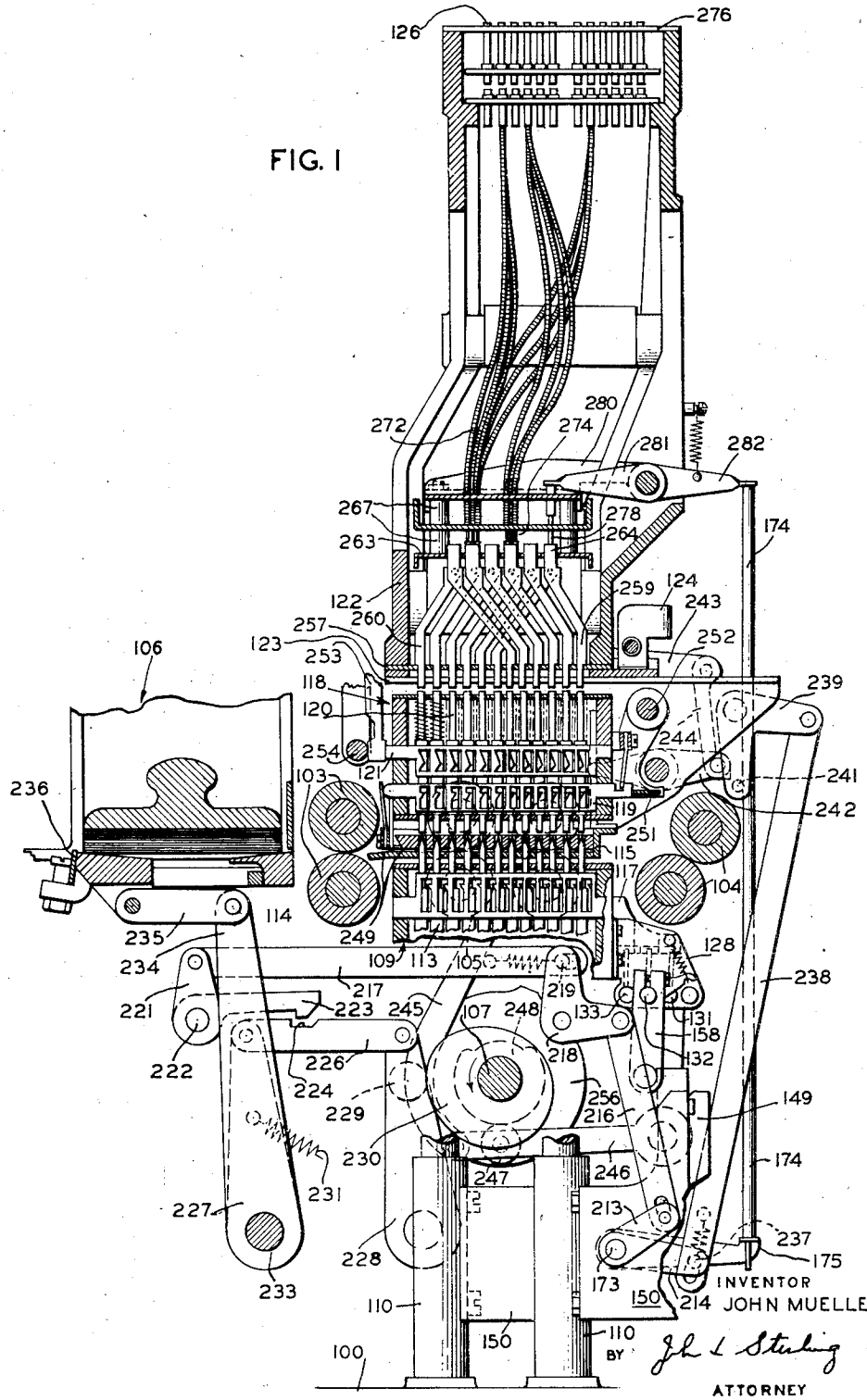
May 27, 1947. J. MUELLER 2,421,078

CROSS TOTALIZING MECHANISM FOR RECORD CONTROLLED TABULATORS

Filed Nov. 20, 1943 8 Sheets-Sheet 1

FIG. 1



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CROSS TOTALIZING MECHANISM FOR RECORD CONTROLLED TABULATORS

Filed Nov. 20, 1943 8 Sheets-Sheet 2

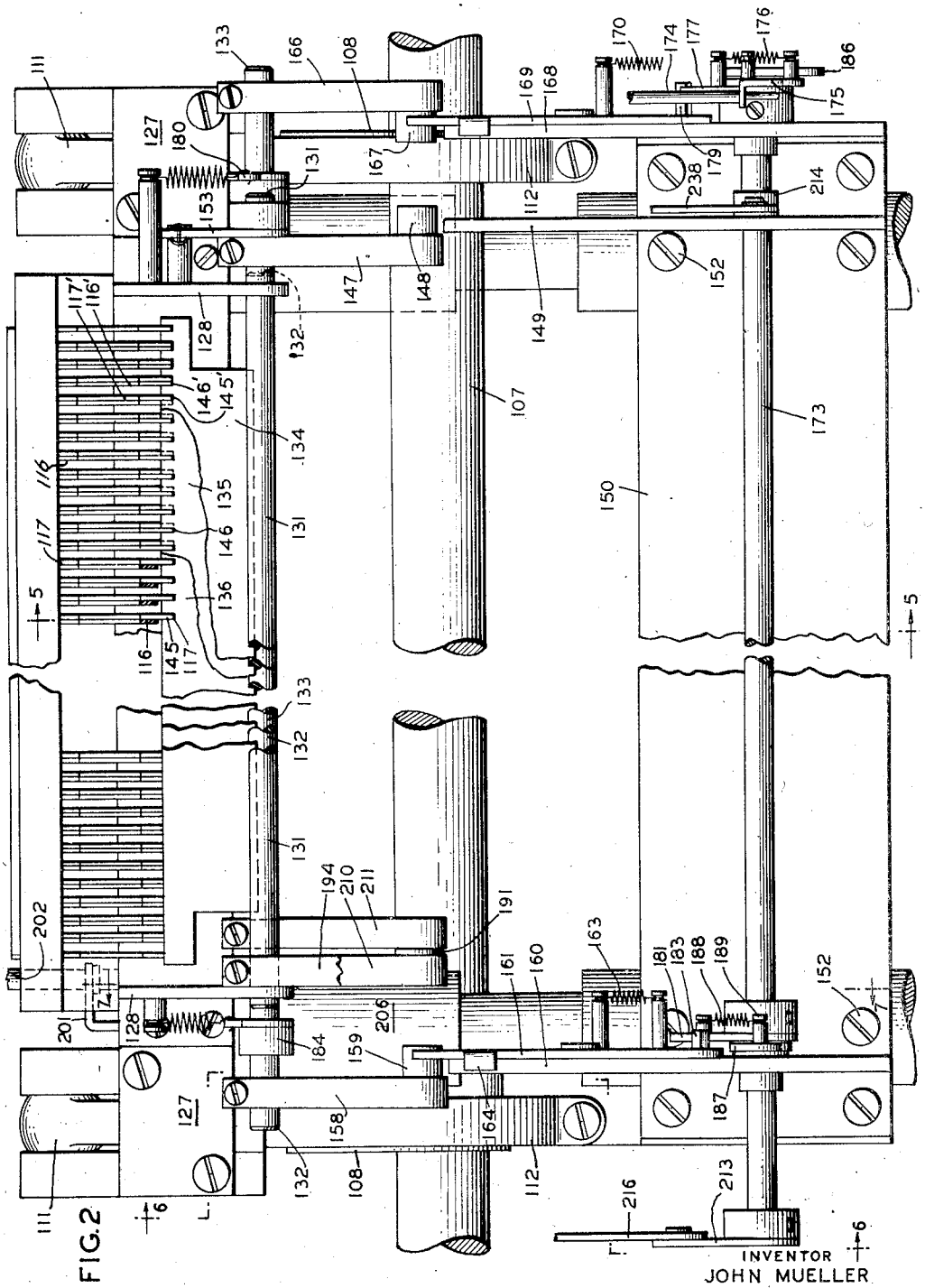

FIG. 2

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CROSS TOTALIZING MECHANISM FOR RECORD CONTROLLED TABULATORS

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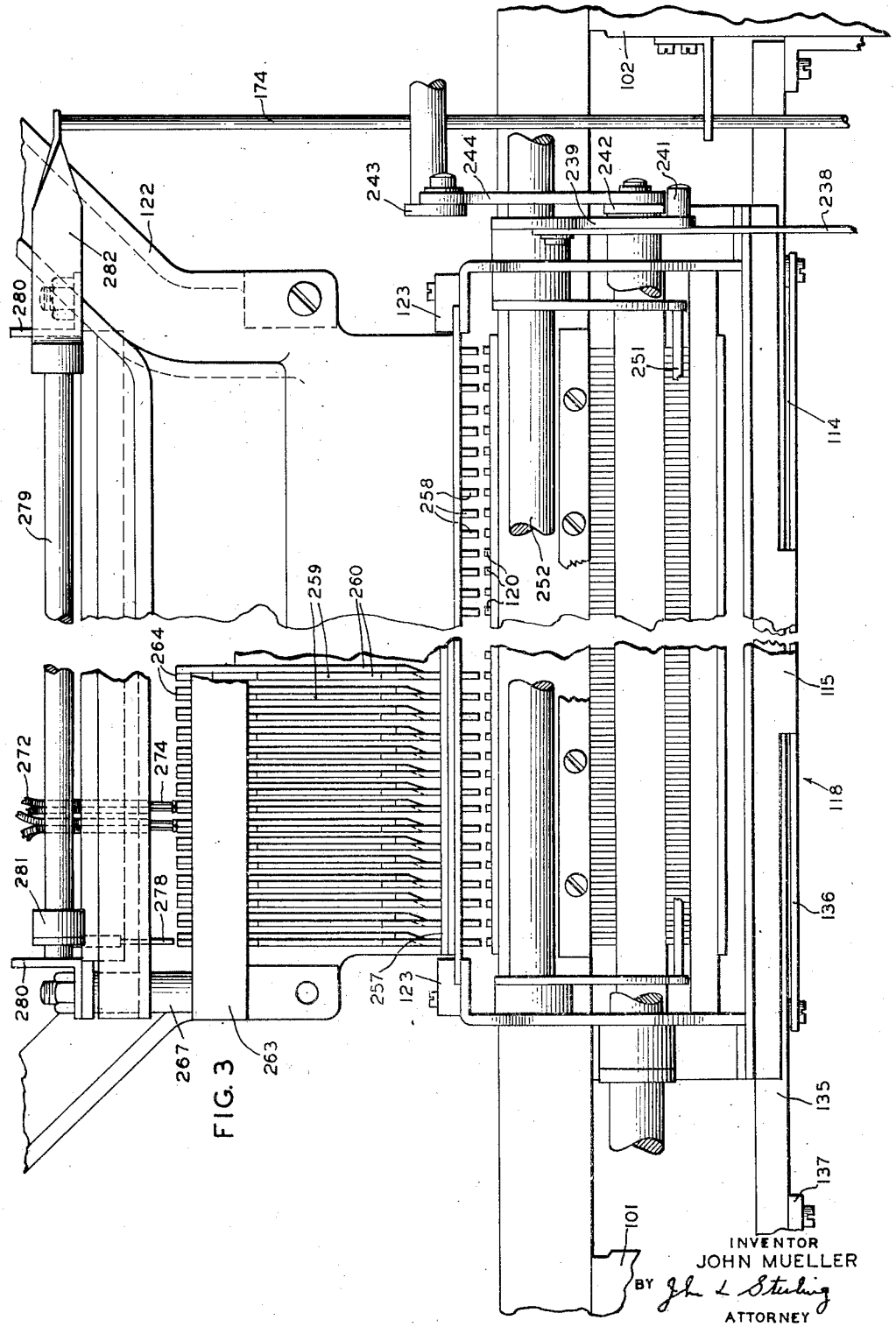

FIG. 3

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CROSS TOTALIZING MECHANISM FOR RECORD CONTROLLED TABULATORS

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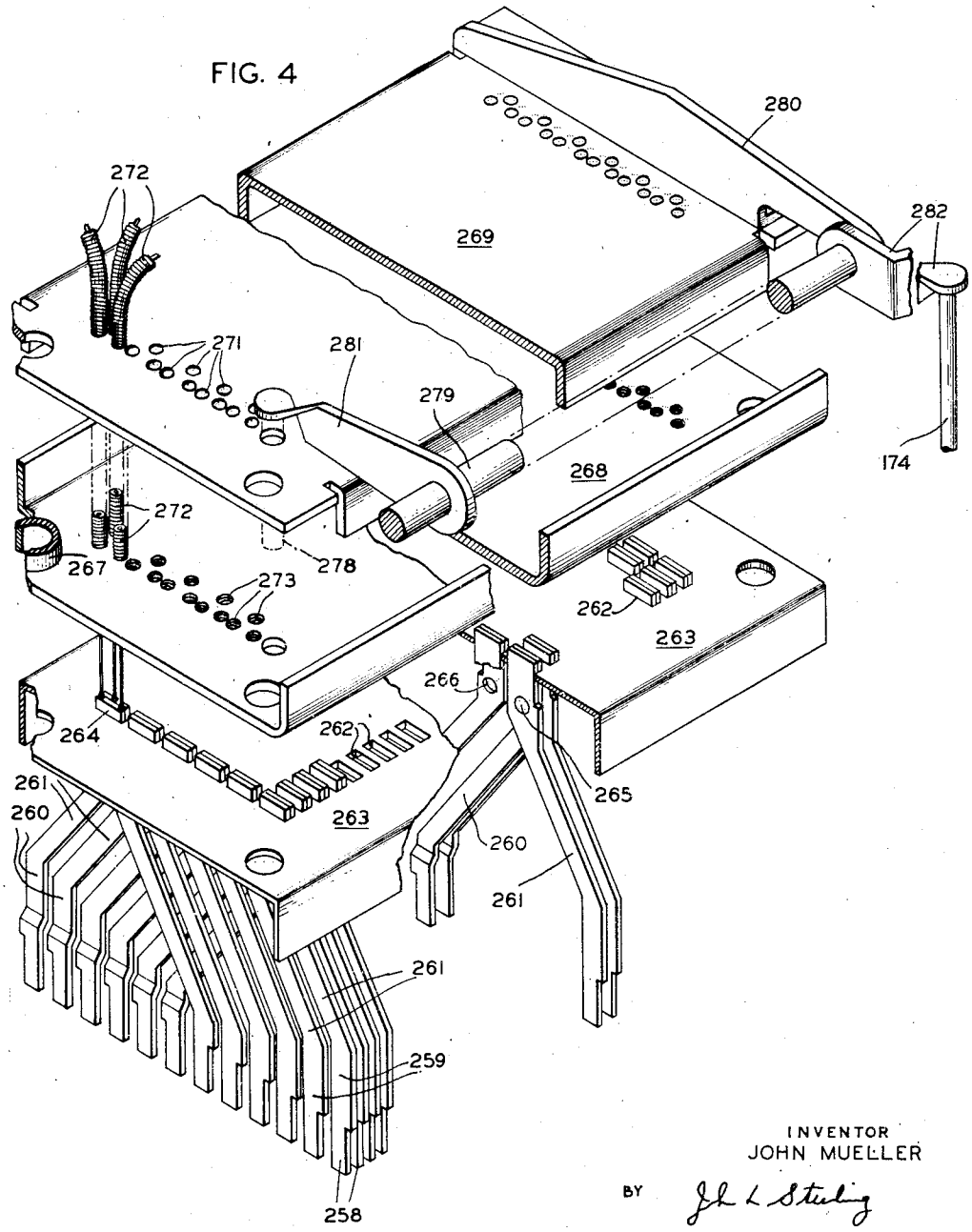
FIG. 4



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CROSS TOTALIZING MECHANISM FOR RECORD CONTROLLED TABULATORS

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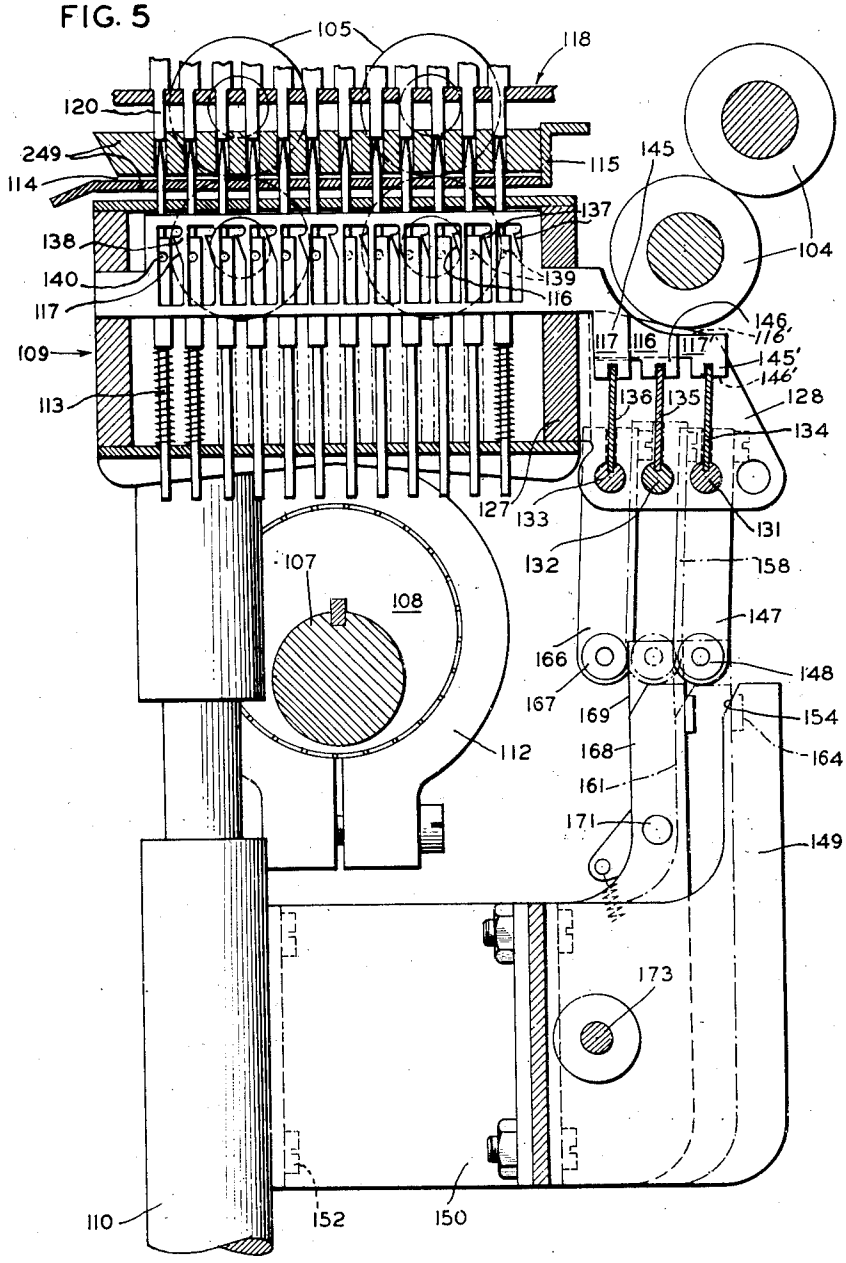
FIG. 5



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CROSS TOTALIZING MECHANISM FOR RECORD CONTROLLED TABULATORS

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FIG. 7

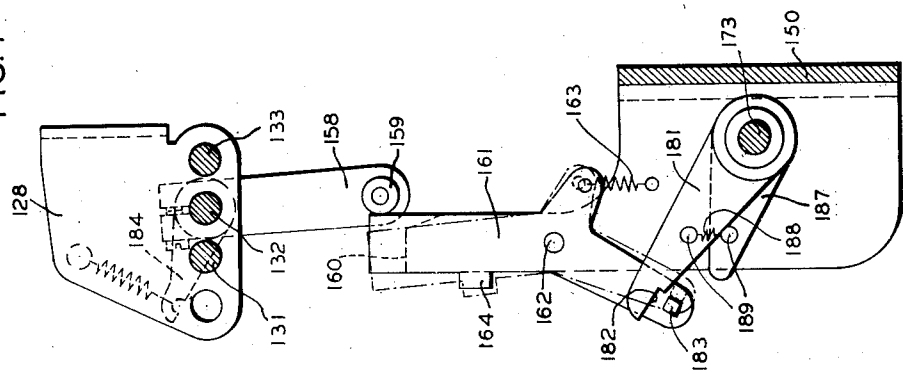
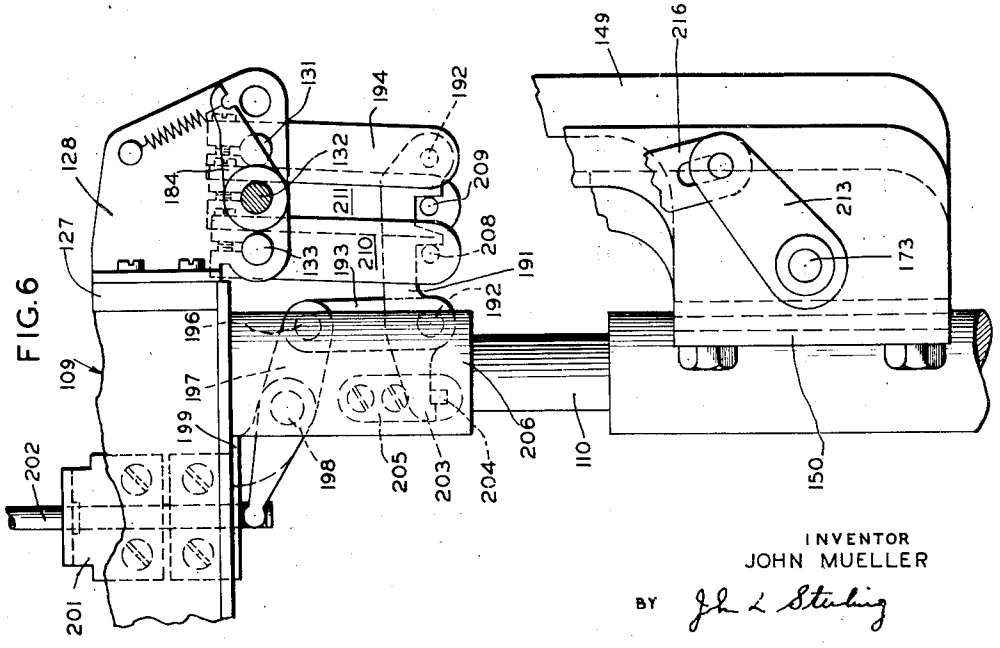


FIG. 6



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CROSS TOTALIZING MECHANISM FOR RECORD CONTROLLED TABULATORS

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FIG. 9

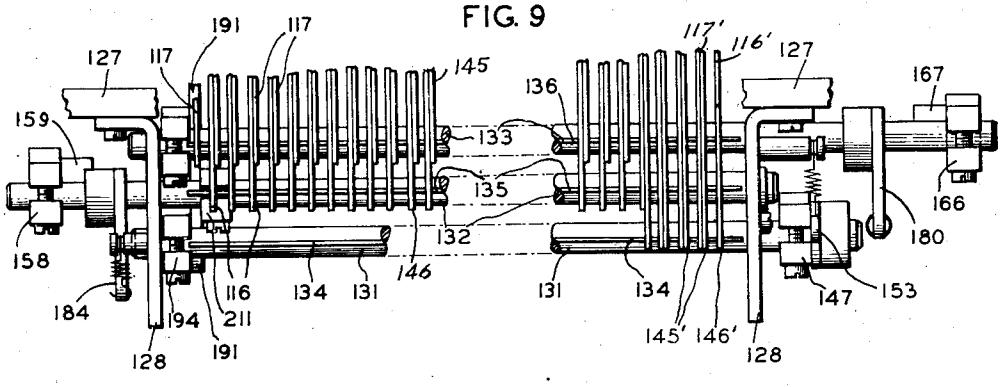
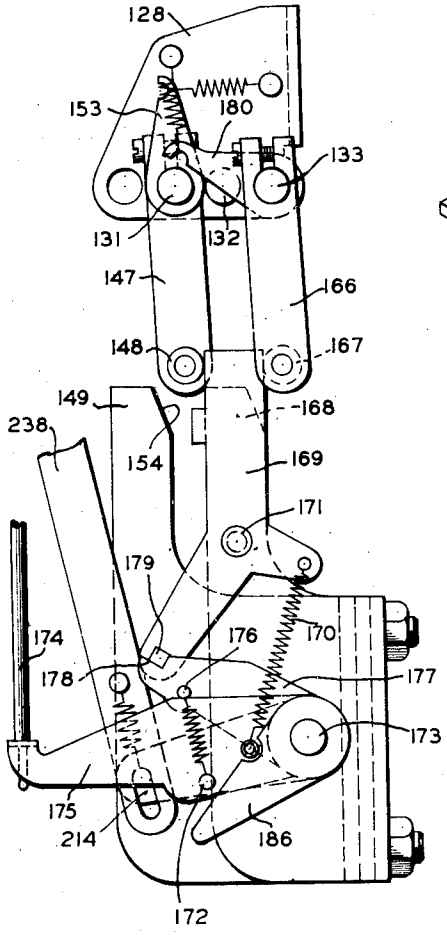


FIG. 8



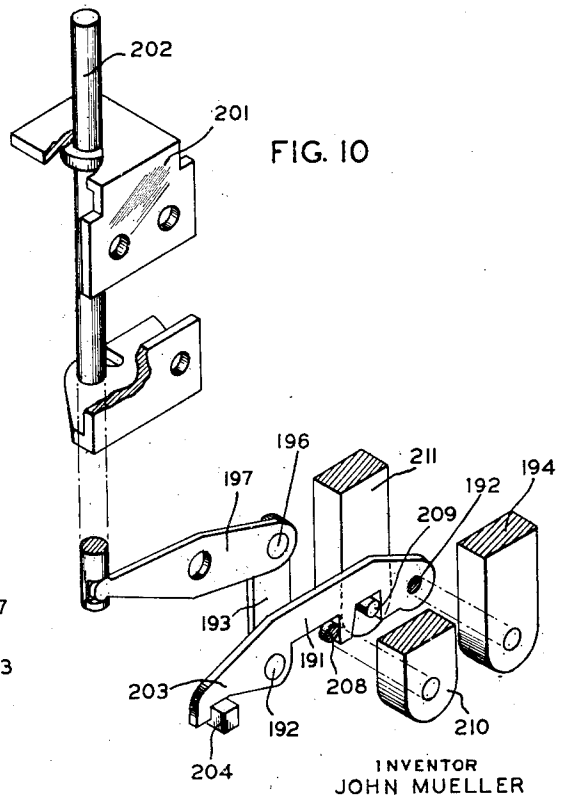


FIG. 10

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CROSS TOTALIZING MECHANISM FOR RECORD CONTROLLED TABULATORS

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FIG. 11

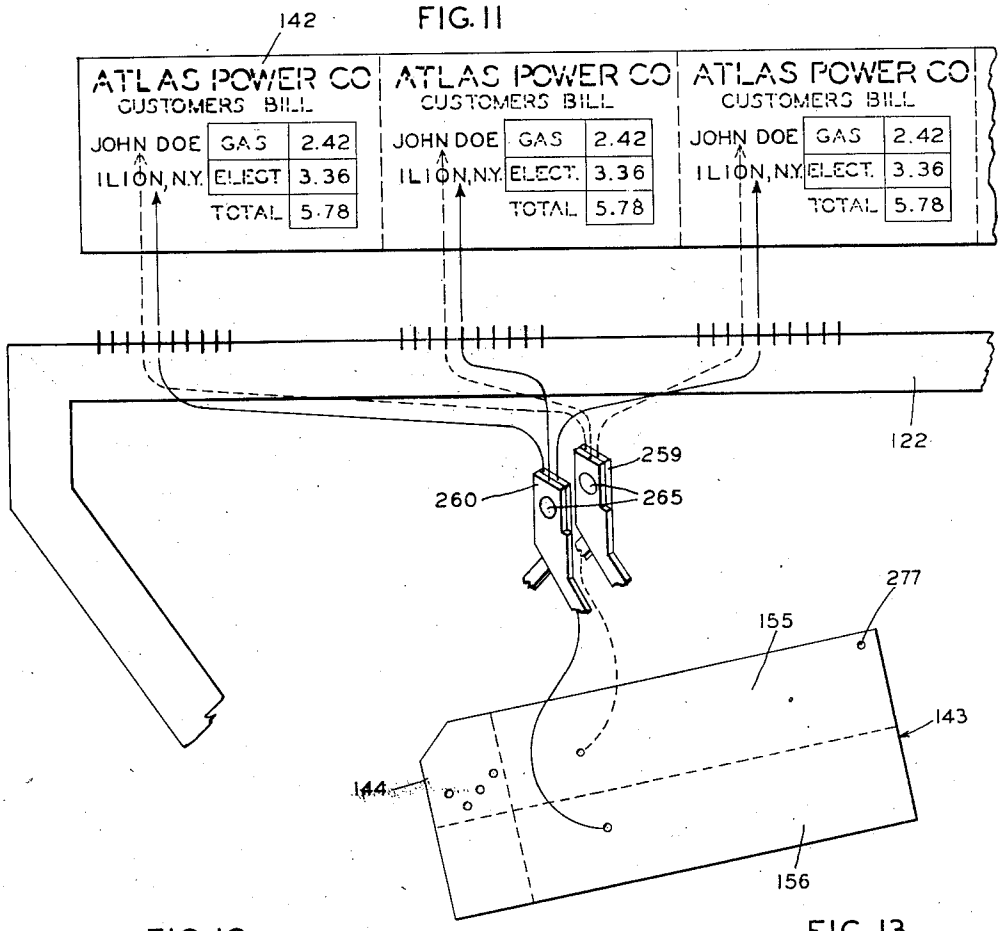


FIG. 12

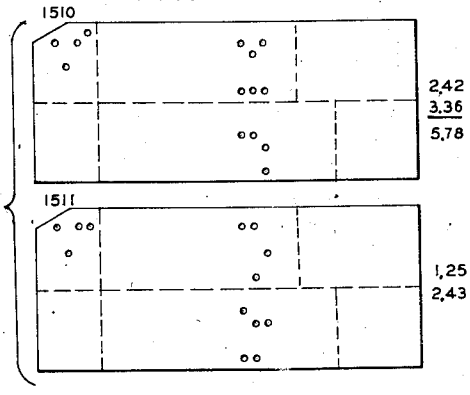
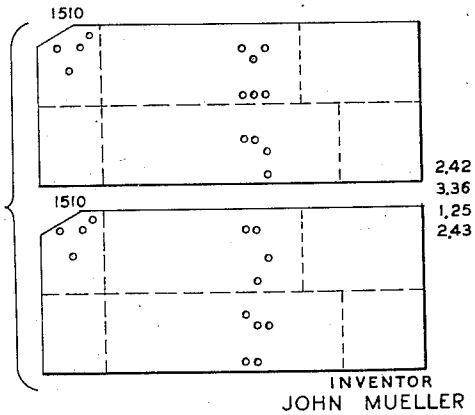


FIG. 13



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Patented May 27, 1947

2,421,078

UNITED STATES PATENT OFFICE

2,421,078

CROSS TOTALIZING MECHANISM FOR RECORD CONTROLLED TABULATORS

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Application November 20, 1943, Serial No. 511,003

12 Claims. (Cl. 235—61.6)

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This invention relates to record controlled tabulating machines, and particularly to mechanism adapted to print the perforated data of successively sensed, different areas of the same card, at a plurality of places on a record sheet.

In the well known Powers tabulating machine a ninety column data card is used, which is divided into upper and lower zones. Each zone has forty-five columns of six data index positions per column, or 270 code hole index positions. The sensing means, consequently, requires 540 sensing pins and a like number of set pins for registering, in a single sensing operation, the perforated data possible in the two zones of a single card. It has been found desirable to print on the same line of a record sheet or business form, duplications of data perforated but once in either an upper or lower zone of the card. This has required the extensive use of Y-wires and connectors, which limit the capacity of the machine, because it is evident that for a triplicate printing, for instance, three times 540 or 1620 Y-wire branches would be necessary. The number of wires that can be employed is limited by the space and facilities available in the machine.

It is an object of the invention, therefore, to provide a grouping means which will concentrate the data sensed from twelve index positions per column in the two zone area of a card, at six index positions per column in a substantially reduced single zone area.

A further object is to use the same wires in a connection box to transmit data from either zone of the card, and to group said wires in such manner relatively to the six index position per column area at which the sensed data is concentrated, that the total number of wires required is materially reduced, can be readily secured in place, and can be replaced or changed as desired with a minimum of effort and time.

Another object of the invention is to provide sensing pin locking means, so that different areas of a card can be sensed in successive machine cycles to print data from one area of the card at different places on one line of a record or business form, and from another area of the same card at different places on another line of said form.

Another object is to arrange the group of wires in the connection box so that printing of data from one area of the card may be done at two places on one line of the form, and from another area of the same card may be done at one place on another line of the form.

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Still further objects include the accumulation and totaling of different numerical amounts from different areas of the same card, as said areas are successively sensed, and which is referred to here as intra-card accumulating and totaling, as distinguished from like operations involving a number of cards. Also, pin locking means that may be conditioned for the sensing of different areas of a card in such manner that said locking means can readily be varied, thereby adapting the mechanism to different requirements that may be imposed by users of the machine, and changes in the zonal areas of the cards for doing different work. Also, additional objects of the invention contemplate the printing of the total at a plurality of locations on the same line of a business form; the control of total taking mechanism for intra-card totaling by the use of designation data fields; the progressive sensing of the zones or zonal fields of a single card by the control of mechanism whose action is initiated by one or more perforations in said card and the printing of a business form in two, three, or four subsequently detachable parts, with information duplicated in each part and taken from different fields of one or more cards.

Other objects and structural features of the invention will be apparent from the following description when read in connection with the accompanying drawing, in which

Fig. 1 is a front to rear vertical section of the connection box and card control sections of a standard Powers tabulator, looking from the left side of the figure, and showing the invention applied thereto;

Fig. 2 is a view in rear elevation of the analyzing or sensing unit of the card control section of the machine illustrated in Fig. 1;

Fig. 3 is a view in rear elevation of the registering or set-pin unit of the card control section of the machine shown in Fig. 1;

Fig. 4 is a view in perspective of a portion of the lower interior section of the connection box showing the parts in exploded relation;

Fig. 5 is a section on the line 5—5 of Fig. 2 showing the sensing unit mechanism and the card chamber portion of the registering unit;

Fig. 6 is a vertical section on the line 6—6 of Fig. 2 showing the sensing unit control mechanism in side elevation;

Fig. 7 is a vertical section on line 7—7 of Fig. 2 showing a cam blocking control for one field of a card;

Fig. 8 is a view looking toward the right end

of Fig. 2 showing a cam blocking control for another field of the card;

Fig. 9 is a plan view showing pin locking slide conditioning means and controls as used in association with the sensing unit;

Fig. 10 is a view in perspective of the means employed in rendering pin locking slides ineffective if a card is not in the card chamber;

Fig. 11 is a diagrammatic view illustrating the transfer of data from a card to a business form by the use of the invention;

Fig. 12 is a view of two perforated cards showing the intra-card total taking of amounts perforated in different areas of the same card, and

Fig. 13 is a view similar to Fig. 12 illustrating successive tabulation of amounts perforated in different areas of sequentially sensed cards.

The present invention is incorporated in a standard Powers tabulating machine, fully shown and described in a patent to Lasker et al., No. 2,323,816, issued July 6, 1943, in which reference is made to Lasker Patent No. 2,044,119, dated June 16, 1936, and to both of which patents the present invention, as applied to a standard tabulator, is referable. As disclosed in Figs. 1, 2, and 3, a base portion 100 of the machine includes side frames 101 and 102, between which are disposed front card feed rolls 103, rear card eject rolls 104, and skid rolls 105. All of these rolls cooperate to pass cards one at a time from a card hopper 106 through the card chamber of a card sensing mechanism and into a card receptacle, not shown. The base also houses the main base shaft 107, one complete revolution of which, from the position shown in Fig. 5, constitutes one cycle of machine operation, and which, through the eccentrics 108 keyed thereto, vertically reciprocates the lower sensing pin box 109, or record sensing means, on the guide posts 110. The lower pin box is pivoted in the upper ends of pitmans 111 whose lower ends terminate in eccentric straps 112 which embrace the eccentrics 108. All of this mechanism, as well as some of the parts to be described, finds its counterpart in the Powers standard tabulating machine and is disclosed and described in detail in both the patents referred to. It is, therefore, not deemed necessary to give a detailed description of each part and operation, except as it effects the working of the present invention.

As the lower pin box 109 is raised, sensing pins 113 that find data perforations in a card detained in the card chamber 114 by a closed card stop 115, are locked up by the suitably timed lateral movements of paired locking slides 116, 117, to positively raise data retaining set pins or set up means 120 which are mounted in the upper stationary set pin box 118. The raised set pins 120 are latched up by latch plates 119 and upon a change of designation data certain of said pins initiate total-taking operation through actuation of cam slides 121, in the manner set forth in the patents above referred to. The upper part of the tabulating machine includes a connection box frame 122 slidable in grooved rails 123, and releasably latched in place above the upper pin box 118 by manipulation of a finger piece 124. The wiring of the connection box transfers the movement of the set pins to upper pins 126, which set printing segment controlling stops as in Patent 2,044,119, or set permutation bars as in Patent 2,323,816, to control printing accumulating and totaling.

The present invention contemplates the successive sensing in the same card, of different zones; of different fields of the same zone; and of different fields of different zones. A zone in this instance is considered as that area of a card which is bounded by two lines parallel to the long edges of the card, while a field is an area of a zone bounded by lines parallel to the short edges of the card. Consequently, the sensing pins 113 of the lower pin box 109 must be selectively locked up in different zones or fields as the card is successively sensed. As seen in Figs. 2, 5, and 9 a lower rear frame bar 127 of the sensing pin box 109 carries the spaced brackets 128 through which pass the ends of rock shafts 131, 132, and 133. Each shaft is slotted longitudinally to retain by force fit, or in any other suitable manner, a longitudinally disposed locking slide rocker blade, the rocker blades extending the length of the lower pin box 109 and being arranged as at 134, 135, and 136 in the rock shafts 131, 132, and 133, respectively.

The rocker blades and their associated mechanism constitute means for locking up pins 113 in different columns of the lower sensing pin box corresponding to data index columns in preselected zones or fields of a 90-column card. Each column of sensing pins 113 is flanked on both sides by locking slides, one of the slides 116 or 116' having locking teeth 137 for the six pins that sense the upper zone of a card, and the other slide 117 or 117' having locking teeth 138 for the six pins that sense the lower zone of a card. The pins 113 that sense the upper zone each have the usual locking extrusion 139, and the pins 113 that sense the lower zone each have the usual locking extrusion 140 beneath which are projected the locking teeth 137 and 138, respectively, to lock up the sensing pins that have found data perforations in the card, when the slides are moved toward the left (Fig. 5). The slides 116, 117, 116' and 117' are mounted at their ends between upper and lower frame bars of the sensing pin box for reciprocal movement, and as they are arranged in pairs with respect to each row of sensing pins, they can be selectively moved in cycles of tabulating operation to lock up the sensing pins that find data perforations in successively sensed zones or zonal fields of a card.

As one example of a business form to be printed from tabulated data, reference is made to the diagrammatic showing of Fig. 11 in which a bill form 142, having separable parts, carries upper and lower lines of printed data (shown in solid line) taken from upper and lower zones, respectively, of a perforated card 143, said printed matter being the same in each of the parts of the bill. The first four data columns of the card in this instance, constitute a designation data field 144, and the locking slides designated 116', 117' that control the locking up of the first four rows of pins 113 in the sensing pin box, are provided with extensions 146' and 146', respectively, which hook over the upper edge of the rocker blade 134, so that when the shaft 131 is rocked, the slides 116', 117' will lock up any sensing pins that find perforations in the designation data field of either the upper or lower zone of the card.

The shaft 131 has secured thereto a pendulous cam arm 147, whose roller 148 engages the edge of a stationary plate cam 149 which is carried by a bracket 150 attached by screws 152 to the guide posts 110. When a card is in the card chamber 114, the roller 148 is yieldably urged against the cam 149 by an arm and spring combination 153 (Fig. 8), the arm of which is secured to shaft

131. In every cycle of machine operation, the sensing pin box 109, and with it, the shafts 131, 132, and 133 reciprocate vertically, and in normal card sensing operation, the roller 148 moves along the vertical and oblique edges of the cam 149, which constitute the cam face 154, to rock the shaft 131 and blade 134 to impart alternate locking and unlocking movements to the slides 116', 117'. Consequently, in every card sensing operation, any sensing pin 113 that finds a perforation in the card corresponding to a data index position in the first four columns of the card, will be locked up by the slides, after the upper end of said sensing pin passes through the opening in the card and before it comes into contact with its corresponding set pin 120.

While the slides 116', 117' operated by rocker blade 134 control the sensing pins of the designation data field 144 in both upper and lower zones of the card in every tabulating cycle of the machine, and are not disabled in either of the upper zone or lower zone entry cycles, means are also provided for operating a group of slides 116 to lock up the sensing pins corresponding to the upper zone data field 155 of the card on the first tabulating cycle, and operating another group of slides 117 to lock up the sensing pins corresponding to the lower zone data field 156 of the card on the second or succeeding tabulating cycle. Reference will be made to upper zone locking slides 116 and lower zone locking slides 117, it being understood that these slides may lock up sensing pins in the selected field areas of upper and lower zones in successive sensings of a card.

In Fig. 11 the first line data on the card is perforated in the upper zone field 155 of the card, and the second line data in the lower zone field 156 of the card. The slides 116 (Figs. 5 and 9), that lock the pins 113 that find perforations in the field 155 of the upper zone of the card, are arranged so that their hook extensions 146 catch over the upper edge of the rocker blade 135 fixed in shaft 132. The slides 117, that lock the pins 113 that find perforations in the field 156 of the lower zone of the card, are arranged so that their hook extensions 145 catch over the upper edge of rocker blade 136 fixed in shaft 133.

The shaft 132 has fixed at its left end (Figs. 2 and 7) a pendant cam arm 158 whose roller 159 engages the inner vertical edges of a cam 160 and a cam gate 161. The latter is pivoted as at 162 to the cam 160 and is limited in its rocking movement in clockwise direction under influence of spring 163, by an ear 164 engaging the outer edge of said cam. Substantially the same construction prevails with respect to shaft 133 whose depending arm 166, shown at the right hand end of Fig. 2 (also Fig. 8) carries a roller 167 for engagement with the inner edges of a cam 168 and cam gate 169, the latter of which, under influence of spring 170, is limited by an ear in its clockwise movement on pin 171 by which it is pivoted to cam 168. It will be here noted that cam 149 has no gate, while cams 160 and 168 are each provided with a gate. As the lower sensing pin box is vertically reciprocated, the cam roller 148 will follow the oblique portion of the face of cam 149 to rock the shaft 131 and move the slides 116', 117', that are actuated by blade 134, to alternately lock and unlock the sensing pins that have found perforations in the upper and/or lower zonal fields of the card reserved for designation data. Simultaneously, the rollers 159 and 167 in reciprocating movement will follow the

oblique portions of their respective cams 160 and 168 to rock the shafts 132 and 133, respectively, if not prevented from doing so by the cam conditioning gates, as will be described.

A cam conditioning gate detent shaft 173 (Fig. 8) extending through and journaled in the lower portions of cams 149, 160, and 168 is rocked by a remotely controlled rod 174 through a rock arm 175. The latter, as well as an adjacent dog 177, is loosely pivoted to shaft 173, and connected in relatively yieldable relation with said dog 177 by spring joined pins 172 and 176 on the arm and dog, respectively, and by a spring 170 to the cam gate 169. The end of the dog 177 is notched as at 178 to engage a pin 179 on the lower forked end of the gate 169, to prevent swinging movement of the latter in counter-clockwise direction. The roller 167, associated with cam 168, is thus prevented from riding on the oblique edge of said cam against the influence of its arm and spring combination 180, to rock the shaft 133. In connection with cam gate 161 (Fig. 7) a detent 181 loosely pivoted to shaft 173 has a notch 182 for engagement with a pin 183 in a forked end of the cam gate. When the detent is lowered to engage the pin, counter-clockwise pivotal movement of the gate and consequent engagement of the roller 159 with the oblique edge of cam 160 to allow shaft 132 to be rocked under the influence of its arm and spring combination 184, is prevented.

The shaft 173 has fixed thereto, in operative association with rock arm 175 and detent 181, the detent control fingers 186 and 187, respectively. With a card in the card chamber and at the beginning of the first tabulating cycle, the detent 181 is in raised position to allow gate 161 to swing (as shown in outline in Fig. 7), so that as the sensing pin box is elevated, the cam rollers 148 and 159 will ride along the oblique edges of their respective cams 149 and 160 and rock the shafts 131 and 132. As a sensing pin corresponding to a control hole in the card causes operation of the control rod 174, in a manner to be later described, said rod will depress arm 175 disengaging dog 177 from cam gate 169, and, through contact of the pin 172 on said arm 175 with finger 186 will rock the shaft 173. The rocking of shaft 173 (Fig. 7) will swing the finger 187 down to tension a spring 188 connecting studs 189 of the detent 181 and finger 187, to cause the detent to bear against the pin 183. As the sensing pin box lowers, the roller 159 will allow gate 161 to swing clockwise under influence of its spring 163, until the pin 183 rides into register with the notch 182 of the detent 181 under pressure of spring 188. The movement of the cam rollers, as set forth, has rocked the shafts 131 and 132 to move the slides 116', 117' and 116 connected to blades 134 and 135 to first locking and then unlocking position. On the next tabulating cycle of the machine, the locking slides 116 for the upper zone sensing pins will be held at ineffective position by the latch gate 161, but dog 177, being disengaged from gate 169, will allow the cam roller 167 to ride on the oblique edge of the cam 168 to rock shaft 133. The blade 136 on shaft 133 will impart locking and unlocking movement to the slides 117 that control the sensing pins corresponding to the lower zone of the card. Since the cam 149 is not provided with a gate the designation shaft 131 will be rocked causing the slides 116' and 117' to lock their pins 113 up but since there is no change in designa-

tion due to the fact that the same card is being sensed, this action will be ineffective.

The machine has been illustrated with the parts as they appear when the card chamber is empty. In order to prevent the sensing pins 113 from being locked up in the absence of a card, operation of the rock shafts 131, 132, and 133 is prevented by a rock latch 191 (Figs. 6 and 10) pivoted as at 192 in horizontal position in the lower ends of pendant links 193 and 194, the latter being fixed at its upper end to shaft 131. The link 193 is pivoted at 196 to a pin lever 197 fulcrumed as at 198 in bracket 199. The bracket 199 and a pin bracket 201 (Fig. 2) are mounted in one end of the sensing pin box 109, the bracket 201 constituting guide means for a card presence sensing pin 202 supported at its bottom on the free end of the pin lever 197. The weight of rock latch 191 and link 193 acting through lever 197 will tend to maintain the pin 202 in raised position, which keeps the nose 203 of the rock latch 191 in latching engagement with the stud 204 of a plate 205 secured to one of the tubular sections 206 of the pin box 109 that vertically reciprocates on the posts 110. The under side of latch 191 is notched to receive pins 208 and 209 which extend from pendant links 210 and 211, respectively, positioned at opposite sides of the latch 191. Link 210 is fast to shaft 133 and link 211 is fast to shaft 132. When a card occupies the card chamber, the pin 202 is held down as the lower sensing pin box 109 rises and the resultant rocking of lever 197 raises the nose 203 of latch 191 free of stud 204, so that the shafts 131, 132, and 133 may be rocked by the motion of their respective cam arms.

Other control mechanism may influence or be influenced by the operation of the detent shaft 173 and to this end the latter has secured thereto a card feed control arm 213 and a card stop control arm 214. The arm 213 (Fig. 1) through vertical and horizontal links 215 and 217, respectively, joined by a bell crank 218 having a yieldable connection 219 to said link 217, actuates the arm 221 fixed to a transverse rock shaft 222. Rocking movement of the latter swings a detent latch 223 into the notch 224 of a link 226 which joins the upper ends of vertically disposed rock arms 227 and 228. The arm 228 carries a roller 229 maintained in contact with a picker cam 230 by a picker operating spring 231, unless prevented by engagement of latch 223 with the link notch 224 when the high point of the cam is under the roller and the picker is in position to feed a card. The spring 231 is secured to rock arm 227 and, through it, actuates the shaft 233 which carries another rock arm 234 joined at its upper end by link 235 with picker 236, the latter feeding a card from the hopper 106 to the front feed rolls 103 at each reciprocation of rock arm 234.

The card stop control arm 214 fast on shaft 173 (Figs. 1 and 8) has a yieldable pin and slot connection 237 to a vertical card stop link 238 which is connected to one leg of a bell crank 239 pivoted in the machine adjacent the card stop mechanism and carrying in the other depending leg a blocking pin 241 arranged to be moved under the outer end of card stop operating lever 242 upon rocking movement of the detent shaft 173. The card stop 115 (Fig. 3) is vertically reciprocated in well known manner by levers 242 and 243 joined by a short link 244. The lever 243 is suitably fulcrumed (as shown in connection with its counterpart 136 in Fig. 3 of Patent 2,323,816) and operated by a vertically disposed link 245 connected at its lower end to the outer end of a roller arm 246 whose roller 247 rides on the card stop cam 248 fast on the main base shaft 107. The card stop 115 is closed, except for a period of main shaft operation in a normal tabulating cycle, commencing at about 125 degrees and ending at about 210 degrees, during which open period, the sensed card is ejected from the card chamber 114 by the skid rolls and passes to the eject rolls, all of which are driven from a worm shaft indicated by numeral 103 in Fig. 4 of Patent 2,323,816.

The card chamber 114 (Fig. 5) is defined by spaced plates 249 constituting the bottom of the upper stationary set pin box 113 and through which plates pass the sensing pins 113 to raise the data retaining or set pins 120 contained in said box 118. The pins 120 are locked in their elevated positions by the latch plates 119. Reference is here made to Patent 2,323,816, and particularly to Fig. 18 thereof, for illustration and description of the upper set pin box of the present invention, in which the designation slide retract bail 251, its rock shaft 252, change of designation sensing interponent 253 and bail 254, find their counterparts in the bail 144, its shaft 146, interponents 583, 584 and bail 579, respectively, of said Patent 2,323,816. The rock shaft 252 is operated by a retract cam 256 on shaft 107, at about the end of each cycle to cause the bail 251 to momentarily retract the spring urged latch plates 119, through mechanism not shown here, but having its equivalent in the cam operated lever arm 150, push bar 148, link 149 and arm 147 illustrated in Fig. 3 of Patent 2,323,816, and fully described therein. The latch plates 119 are alternately provided with projections for locking up the set pins 120 corresponding to the upper and lower zone index positions, and the designation slides 121 are adapted to condition the machine for total taking when a change of designation data is sensed. When this change is sensed the interponent 253 is swung by slide 121 to rock a shaft, not shown here, but illustrated in Figs. 19 and 22 of Patent 2,044,119 as at 336 to cause rotation of shaft 342 whose cam 372, lever 374, link 378 and arm 381 will rock shaft 382 whose counterpart in the instant application is indicated as at 222. Rocking of shaft 222 will drop hook 223 into notch 224 and prevent card feeding operation of picker 236.

Heretofore, when data sensed in a card was to be printed, for instance, at three different places on the same line of a record sheet, it was necessary to have at least three Bowden wires in the connection box for each data designation set pin, or to use connectors of the type shown in Patent 2,160,113, whose arrangement within the connection box frame was difficult due to the large number of Bowden wires involved, and made replacement of broken wires exceedingly difficult. To obviate the use of connectors and to group and hold Bowden wires in the connection box, so that the same wires will transfer the data set up in pins 120 from both zones of the card as they are successively sensed, a slotted plate 257 (Figs. 1, 3, and 4) closing the bottom of the connection box frame 122 provides a guiding support for the depending shouldered ends 258 of six upper zone grouping bars 259 and six lower zone grouping bars 260. The twelve lower ends of these coacting bars are disposed in columnar arrangement to coincide with each column of set pins 120 representing upper and lower zone data index positions. The bars 259 and 260 are diag-

onally offset lengthwise in mid-section as at 261 and cross each other obliquely, to bring the upper ends of the corresponding bars of each zone together so that each pair, representing the same data index position in each zone, protrudes through and is guided in a suitable slot 262 in plate 263. Thus, extending through plate 263 are forty-five columns of six pairs of bars each, the upper ends 264 of each pair being united by an extrusion 265 on one bar engaging a hole 266 in the companion bar, and each pair consisting of an upper zone bar 259 and a lower zone bar 260. Reference to Fig. 1 will show, therefore, that the two zone, twelve position length of a column at the top of the upper set pin box 118 is condensed by the bars 259, 260 into a column of one zone, six position length in the plate 263. In effect, the number of index positions as depicted by the set pins is reduced by half, as represented by the groups of Bowden wires operated by the grouping bars.

The plate 263 is supported in any suitable manner in the connection box frame and in turn supports, on posts 267, spaced intermediate and upper guide plates 268 and 269, respectively. Plates 268 and 269 are drilled to provide vertically aligned holes, which holes 271, in the upper plate 269, guide the casings of Bowden wires 272 whose lower ends are threaded into the tapped holes 273 in plate 268. The spacing of these guide plates provides means for holding the lower ends of the Bowden wires straight for an amount that will prevent too sharp a bend therein above the upper guide plate 269. The rigidity of the lower end of the Bowden wires held in plates 268 and 269 will provide for a gradual bend in the casings above the plate 269, so that friction of the core and danger to fracture of the casing is reduced to a minimum. The Bowden wires 272 are arranged in this instance in groups of three, in vertical alignment with each pair of bar-ends 264, so that no matter which bar 259 or 260 of a united pair is moved upwardly by the action of upper or lower zone set pins, the three corresponding Bowden wire cores 274, whose headed lower ends rest on the upper ends of the bars, will be actuated and will raise the upper pins 126 which are supported in the top of the connection box in the top plates 276 to control the printing and associated mechanisms as fully set forth in the patents referred to.

One pair of bars corresponding to a control hole 277, shown in the upper zone of the card in this instance, operates a control pin 278 (Figs. 1, 3, and 4), guided in suitable openings in the plates 268 and 269, to rock a control shaft 279 journaled in brackets 280 mounted at opposite ends of the plate 269. The shaft 279 has fixed thereto a control pin arm 281 and a control rod arm 282, so that an upward movement of control pin 278 will rock the shaft 279 to depress control rod 174 against the yieldable resistance offered by rock arm 175.

As illustrated, the lower ends of two of the Bowden wires, of each three wire group rest on the upper ends of the upper zone grouping bars, 259, while the lower end of one of the Bowden wires of each group rests on the upper ends of the lower zone grouping bars 260, as shown diagrammatically in Fig. 11. If the extrusion 265 is not used to join the grouping bars they will operate independently and the upper zone grouping bars will each actuate two Bowden wires and the lower zone grouping bars will each actuate one Bowden wire, with the result that data in the upper zone of the card can be printed in two different places on one line of the record sheet and data in the lower zone can be printed at one place on another line of the record sheet.

A cycle of operation of the machine in printing data on the business forms illustrated in Fig. 11, is defined by one rotation of the main shaft 107 from the position shown in Figs. 1 and 5. When the upper zone of the card is sensed, the control pin is set, and on the next cycle card feed is prevented and the card stop held closed. When the lower zone of the card is sensed in this next cycle, the control pin is retracted when the locked-up set pins corresponding to the data of the upper zone are unlatched by the upward movement of the new group of set pins that correspond to the data of the lower zone. When the control pin 278 drops, rod 174 will rise, shaft 173 will be rocked to its counterclockwise limit and detent latch 223 will be disengaged from link 226. At the same time detent 181 will be disengaged from cam gate 161 by the finger 187 and these movements will have been completed at about 20 degrees of main shaft rotation in the following or new card sensing cycle. A new card is then fed into the card chamber against the card stop, which has closed after permitting ejection of the previous card. The sensing pin box 109, in its upward movement beginning at 180 degrees, causes the sensing pins 113 that have found perforations in the data designation field and upper zone of the card to be locked up at about 274 degrees by the slides 116', 117' and 116. The slides are operated by the blades 134 and 135 under the rocking influence of their respective cam arms 147 and 158.

The locked-up pins engage and start to raise the upper set pins 120 at about 294 degrees to condition the printing means so that the data perforated in the upper zone will be printed on the first line of the form. The control pin 278 will be actuated by the sensing of hole 277 to cause the rock shaft 173, through rod 174, arm 175,, and finger 185, to swing the detent 181 into engagement with the stud 183 of cam gate 161. Simultaneously, the dog 177 is swung out of engagement with pin 179 of cam gate 169. This dog has prevented swinging movement of cam gate 169 and consequent locking up of any of the sensing pins thtat found data perforations in the lower zone of the card on the first sensing cycle. The control rod 174 is held depressed by its control pin 278 and associated locked-up set pin 120 until the set pins are released in the usual manner on the next succeeding tabulating cycle, at about 335 degrees. At this time if the set-up of pins 120 changes, due to a change in designation data, the cam slides 121 will be moved as different pins are set up and such movement will operate the bail 254 through the interponents 253 to condition the machine for total taking. Depression of rod 174 rocks shaft 173 which pulls link 216 to cause the picker detent latch 223, to engage the notch of the picker link 226 and also pulls link 238 operating the bell crank 239 to throw the blocking pin 241 of the latter beneath the card stop lever 242 to prevent opening of the card stop. Thus, feed of a new card is prevented and the sensed card is held in the chamber for another cycle.

In this second sensing or tabulating cycle, as the pin box rises, the slides 116', 117' and 117 that lock up the sensing pins that find openings in the data designation field and in the lower zone of the card, are operated by the blades 134

and 136 under the rocking influence of their respective cam arms 147 and 166. The control rod being depressed, has caused latching of cam gate 161 so that the cam arm 158 cannot rock the blade 135 and the pins that sense openings in the upper zone of the card will not be locked up by the slides 116. In the two tabulating cycles the data of the successively sensed upper and lower zones of the card or record is printed at three different places on the two lines of the business form, and the numerical amounts having been entered in three different accumulators, will permit the printing of a total at three places upon a change of data designation, as fully explained in the patents referred to. The total taking operation, carried out between two successive tabulating cycles, requires two additional cycles, so that a change of designation data in each individual card of a group, or in selected cards of a group will initiate total taking without interfering with the cycle sequence of the machine.

To recapitulate, the operation of the machine is such that a card passes into the sensing chamber and is sensed in the designation data field 144 of both upper and lower zones and at the same time either the upper zone data field 155 or the lower zone data field 156 only is sensed. In the present instance it is the upper zone. If the card does not have a control hole 277 it will pass out of the sensing chamber after the sensing of the upper zone data field and a new card will be fed thereto. However, when a control hole 277 is sensed the control pin 278 will be raised and held up by its associated locked up set pin 120 to cause rocking of shaft 173 thereby in turn disabling the slides 116 and operating the slides 117 to cause sensing of the other zone, in this instance the lower zone, on the next cycle of the machine. The rocking of the shaft 173 in this manner likewise prevents operation of the card picker and release of the card stop to hold the card in the chamber for a second cycle. The slides 116' and 117' lock the designation data pins up for the second cycle but since the same card is in the sensing chamber they are ineffective. When the set pins of the previous or upper zone reading are released together with the control pin, which occurs after the operation of slide 117, the shaft 173 is rocked back to normal to again cause sensing of only the first zone of the card on the next and succeeding cycles until such time as another control hole is sensed.

The timing of the Powers tabulating machine is fully set forth in the aforementioned Lasker patents. Briefly, when a card is in the sensing chamber, during the rise of the reciprocating pin carrier and after the sensing pins that find perforations in the card have passed therethrough, the locking slides shift into position to lock up those pins that passed through the perforations. Upon the continued rise of the carrier the locked up pins push up corresponding set pins. The corresponding set pins are then latched up by the latch plates and remain in latched condition until the following cycle. Upon the rise of the reciprocating carrier during the second cycle when a new card is in the sensing chamber with different data designations therein, the newly locked up sensing pins will cause different set pins to rise. The rise of these new pins will momentarily cam the latch plates to the right to release the set pins locked up on the first cycle and the return of the latch plates will then latch up the newly raised set pins.

With the foregoing in mind, it will be obvious that during the first cycle when the sensing pins sense the data designations of the upper zone together with the control hole the slide 117 will lock up all such pins. The corresponding set pins 120 will then be latched up and the set pin corresponding to the control hole will raise the control pin 278 and hold it up until that time in the next cycle when the set pins are released. Thus, through the linkage described, the rock shaft 173 will be rocked against the yieldable resistance offered by the rock arm 175 and maintained in rocked position until such time in the next cycle when newly locked up sensing pins through the rising set pins cam the latch plates 119 to the right permitting the rock shaft 173 to return to normal. This occurs during the second cycle and after the slides 116 have locked up the sensing pins that found perforations in the lower zone of the card.

The slides 116, 117 can be arranged with respect to each column of sensing pins, so that the extent and location of the data fields of the card may be varied to suit the requirements which the machine is to meet, thus providing a flexibility in manufacture that is attained without material alteration of the general organization of the mechanism.

While three slide-controlling rocker blades are illustrated herein, it is obvious that others could be added, along with their controlling cams and mechanisms, to afford successive sensing of more than two zonal areas of the card if desired.

It is evident that a business form having, say, three detachable parts could be duplicate printed in each part with four different lines from two different cards each having two zonal fields. This would be accomplished to include a total if desired by a change of designation data in alternate cards. In Fig. 12 the data perforated in the upper and lower zones of card designated 1510 is printed in a plurality of places on the business form 142 and as card 1511 bears a change in designation data the total of the upper and lower zone data of card 1510 is printed on the form in its proper place. Each card of a group as shown in Fig. 12, carries data in two different zones and intra-card totaling occurs upon change of designation data. In Fig. 13 two cards carry four sets of data in four zones, which data may be accumulated and may be totaled if desired by a card bearing change of designation data. The data from the upper zones may be entered once on the form and the data from the lower zones entered twice on the form or vice versa, if the extrusion 265 is omitted, depending upon how the ends of the Bowden wires are arranged with respect to the upper ends of the grouping bars.

While I have shown and described what I consider to be a desirable and novel embodiment of the invention, it is obvious that changes in form could be made without departing from the spirit of the invention and I, therefore, do not wish to be limited to the precise form herein shown and described, nor to anything less than the whole of the invention as hereinbefore set forth, and hereinafter claimed.

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

1. In a machine of the class described, sensing means including a sensing pin carrier, means for reciprocating the carrier, and spring pressed pins in the carrier for sensing data designations in a record; slides in the carrier cooperating with different groups of pins and movable with the carrier and transversely thereof to lock in fixed

relation to said carrier those pins of each group that sense data designations in the record, rock members engaged by said slides, cam means with which the rock members coact to operate said sides as the carrier reciprocates, the rock member relating to one of said groups being normally inoperative, and means operated by the sensing means when a control designation in the record is sensed for rendering said inoperative rock member operative and another inoperative upon a succeeding reciprocation of the carrier.

2. In a machine of the character described, a record chamber, means for feeding a record to and from the chamber, a stop for preventing the record from leaving the chamber, means for opening and closing the stop, a sensing pin carrier, means for reciprocating said pin carrier, means for sensing data designations in a record including rows of spring pressed pins in said pin carrier, slides in the carrier movable to lock in fixed relation to said carrier those pins of each row that sense data designations in the record, a plurality of means associated with the pin carrier and operable in different reciprocations thereof to move slides corresponding to different pins of a row to pin locking position, means for controlling the operation of said last means for disabling one slide moving means and enabling another slide moving means upon a successive reciprocation of said pin carrier, means operated by the sensing means when a control designation in the record is sensed for rendering said last means operative, and means operated by said slide disabling and enabling means for preventing the stop from opening upon said successive reciprocation of said carrier.

3. In a machine of the character described, a record chamber, means for feeding records to the chamber in succession, a sensing pin carrier, means for reciprocating said pin carrier, means for sensing data designations in a record including spring pressed pins in said carrier, slides in the carrier movable to lock in fixed relation to said carrier, those pins of predetermined groups that sense data designations in the record, a plurality of means associated with the pin carrier and operable in different reciprocations thereof to move slides corresponding to pins of said predetermined groups to pin locking position, means for controlling the operation of said last means for disabling one slide moving means and enabling another slide moving means upon a successive reciprocation of said pin-carrier, means operated by the sensing means when a control designation is sensed for rendering said last means operative, and means operated by said slide disabling and enabling means for disabling the record feeding means upon said successive reciprocation of said pin carrier.

4. In a machine of the character described, a sensing pin carrier, means for reciprocating the carrier, means for sensing data designations in a record including rows of spring pressed pins in the carrier, a pair of slides for each row of pins, each slide of a pair being adapted for locking engagement with a different group of pins in each row, a plurality of means for moving the slides on successive reciprocations of the carrier to lock in fixed relation to said carrier those pins of the different groups of each row that sense data designations in the record and means operated by said sensing means when a control designation in the record is sensed for disabling the slide moving means relating to one of said groups and enabling another slide moving means relating to another group upon a successive reciprocation of said pin carrier.

5. In a machine of the character described, means for sensing data designations in a record including a carrier, rows of spring pressed pins in the carrier, means for reciprocating the carrier to cause the pins to sense a record, a plurality of slides in said carrier for locking engagement with different groups of each row of pins, means normally rockable to move certain of the slides on successive reciprocations of the carrier to lock in fixed relation to the carrier those pins of the one group that sense data designations in the record, means for disabling said normally rockable means on any successive reciprocation and including means rockable to move certain other slides to lock in fixed relation to the carrier those pins of a different group that sense data designation in the record, means for controlling the operation of both of said rockable means, means operated by the sensing means when a control designation in the record is sensed for rendering effective said controlling means, a no-card detecting means in the carrier, and means operated by said detecting means for preventing rocking operation of any slide moving means when a record is not in position to be sensed.

6. In a record controlled machine, the combination with spaced sets of movable members, one of which corresponds to the data index positions of different zones of a record; of a connection box comprising a frame removably positioned between said sets for transferring motion from the first to the second set and including grouping means and motion transmitting means mounted within said frame, said grouping means comprising coextensive bar members arranged for registry at one end individually with each of the members of said first set and arranged at the opposite end in paired relation to present contiguous areas corresponding in arrangement to the data index positions of one zone of the record, means for securing said paired bar members together, and said motion transmitting means including members a plurality of which at one end engage each of said areas and at the opposite end individually register with the members of said second set whereby said connection box may transmit data indications from either zone of a record to a plurality of movable members in the machine.

7. In a record controlled machine, in combination, a sensing pin carrier, means for reciprocating the carrier, means for sensing data designations in a record including rows of spring pressed pins in the carrier, a pair of slides for each row of pins, each slide of a pair being adapted for locking engagement with a different group of pins in each row, cam means for moving the slides on successive reciprocations of the carrier to lock in fixed relation to said carrier those pins of the different groups of each row that sense data designations in the record, means for controlling said cam means to disable certain of said slide moving means and to enable other of said slide moving means upon a successive reciprocation of said carrier, and means operated by the sensing means when a control designation in the record is sensed for rendering said last named means operative.

8. In a record controlled machine, in combination, a movable pin carrier, spring pressed pins in the carrier for sensing data designations in a record, locking slides in the carrier corresponding to different groups of pins, means for

selectively moving the slides to lock in fixed relation to said carrier those pins of each group that sense data designations in the record, means for controlling said slide moving means to disable certain slide moving means and enable other slide moving means upon a successive sensing movement of said carrier, and means operated by the sensing means when a control designation in the record is sensed for rendering said last named means operative.

9. In a record controlled machine, the combination with spaced sets of movable members, one of which corresponds to the data index position of a record and the other of which corresponds to the data receiving elements of the machine; of means for transferring motion from the first set of movable members to the second set of movable members including a frame positioned between said sets of members, a plurality of spaced plates in the frame and including upper and lower plates, grouping means comprising coextensive bar members movably mounted in the lower of said plates and arranged at one end to be engaged individually by members of said first set and secured together at the opposite end in paired relation to present contiguous areas corresponding in arrangement to half the number of data index positions presented by said first set of members, and motion transmitting means including individually encased wires positioned at one end in the upper of said plates for group engagement with each of said areas in numbers exceeding the data index positions represented by said first set of members, and arranged at the opposite end for individual registry with the members of said second set.

10. In a record controlled machine having record data set-up means, the combination with a reciprocal sensing means including a pin carrier, and spring pressed sensing pins in the carrier for engaging a record to sense data designations in upper and lower zones thereof, of upper and lower zone slides in the carrier for holding sensing pins of the corresponding zones in data sensing position, cams for effecting movement of the slides during reciprocation of said sensing means to cause entry in said set-up means of the data sensed from either zone of the same record, the cams for one of said zones being normally effective to cause entry and the cams for the other of said zones being normally ineffective to cause entry, means for selectively conditioning said cams to render ineffective said normally effective cams and render effective said normally ineffective cams, and means operated by the sensing means when a control designation in the record is sensed for actuating said conditioning means.

11. In a machine of the class described, sensing means including a sensing pin carrier, means for reciprocating the carrier and spring pressed pins in the carrier for sensing data designations in different zones of a record; slides in the carrier corresponding to pins of said different zones and movable to lock in fixed relation to said carrier those pins of each zone that sense data designations in the record, means operable on each reciprocation of the carrier for moving slides corresponding to pins of both zones, means normally operative on reciprocation of said carrier for moving slides corresponding to pins of one zone, normally inoperative means operative on reciprocation of said carrier for moving slides corresponding to pins of another zone, means for disabling said normally operative means and enabling said normally inoperative means on a successive reciprocation, means for controlling the operation of said last named means, and means operated by the sensing means when a control designation in the record is sensed for rendering effective said controlling means.

12. In a machine of the class described, a sensing pin carrier, means for reciprocating said carrier, rows of spring pressed pins in said carrier for sensing data designations in a record, slides in the carrier each movable to lock those pins in each row that find data designations in an upper or a lower zone of the record immovably with respect to said pin carrier, means associated with said pin carrier for moving the slides to pin locking position, a plurality of means for actuating the slide moving means upon reciprocation of said pin carrier, means for rendering the actuating means relating to one zone inoperative and those relating to the other zone operative upon a successive reciprocation of said pin carrier, and means operated by the sensing means when a control designation in the record is sensed for controlling the operation of said last means.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,044,121	Lasker	June 16, 1936
2,107,184	Lasker	Feb. 1, 1938
2,290,827	Thomas	July 21, 1942
2,324,433	Thomas et al	July 13, 1943

FOREIGN PATENTS

Number	Country	Date
473,757	Great Britain	Oct. 18, 1937
475,037	Great Britain	Nov. 8, 1937