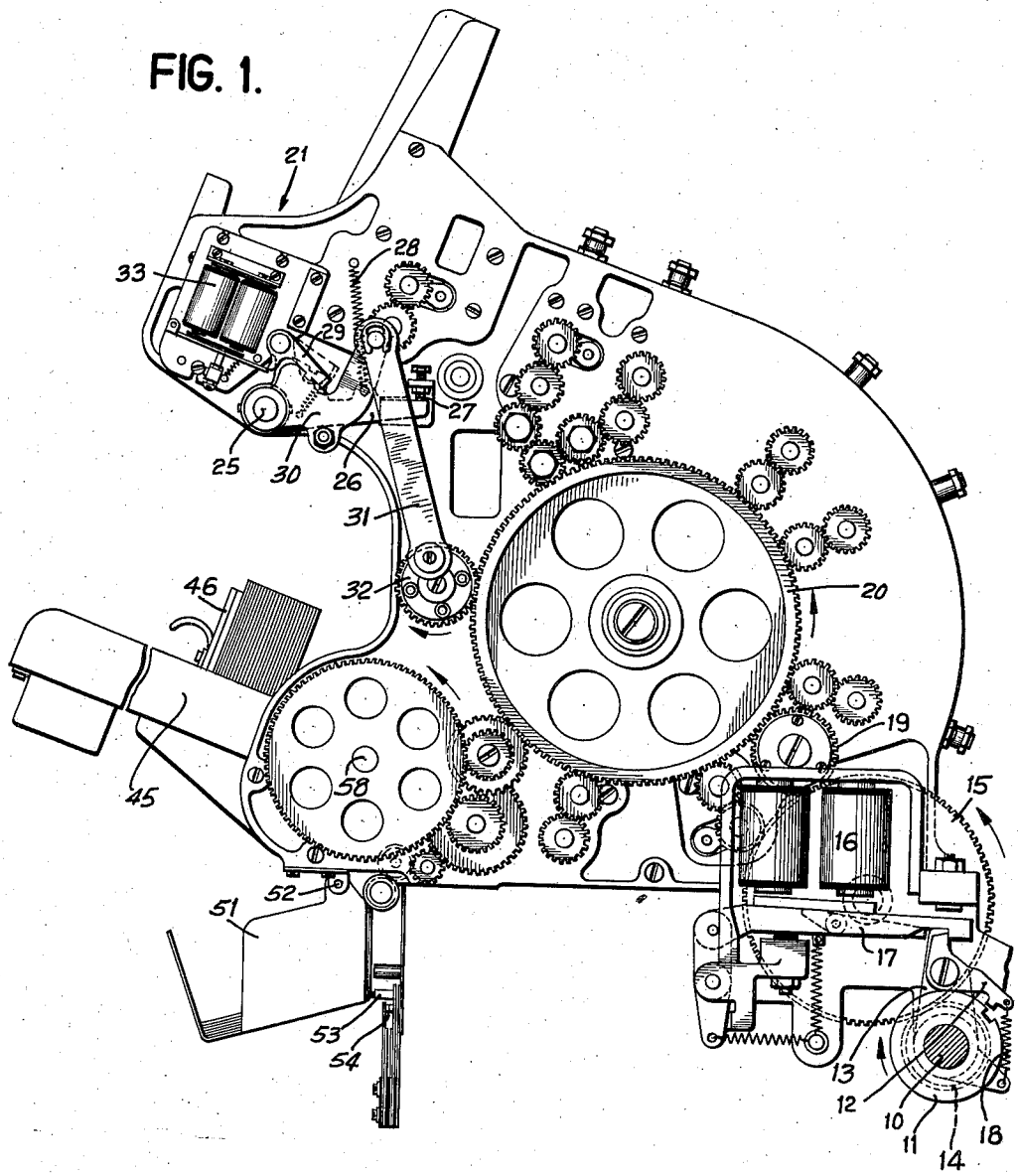
Oct. 4, 1938. A. W. MILLS ET AL 2,131,919

RECORD CONTROLLED PRINTING MACHINE

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FIG. 1.



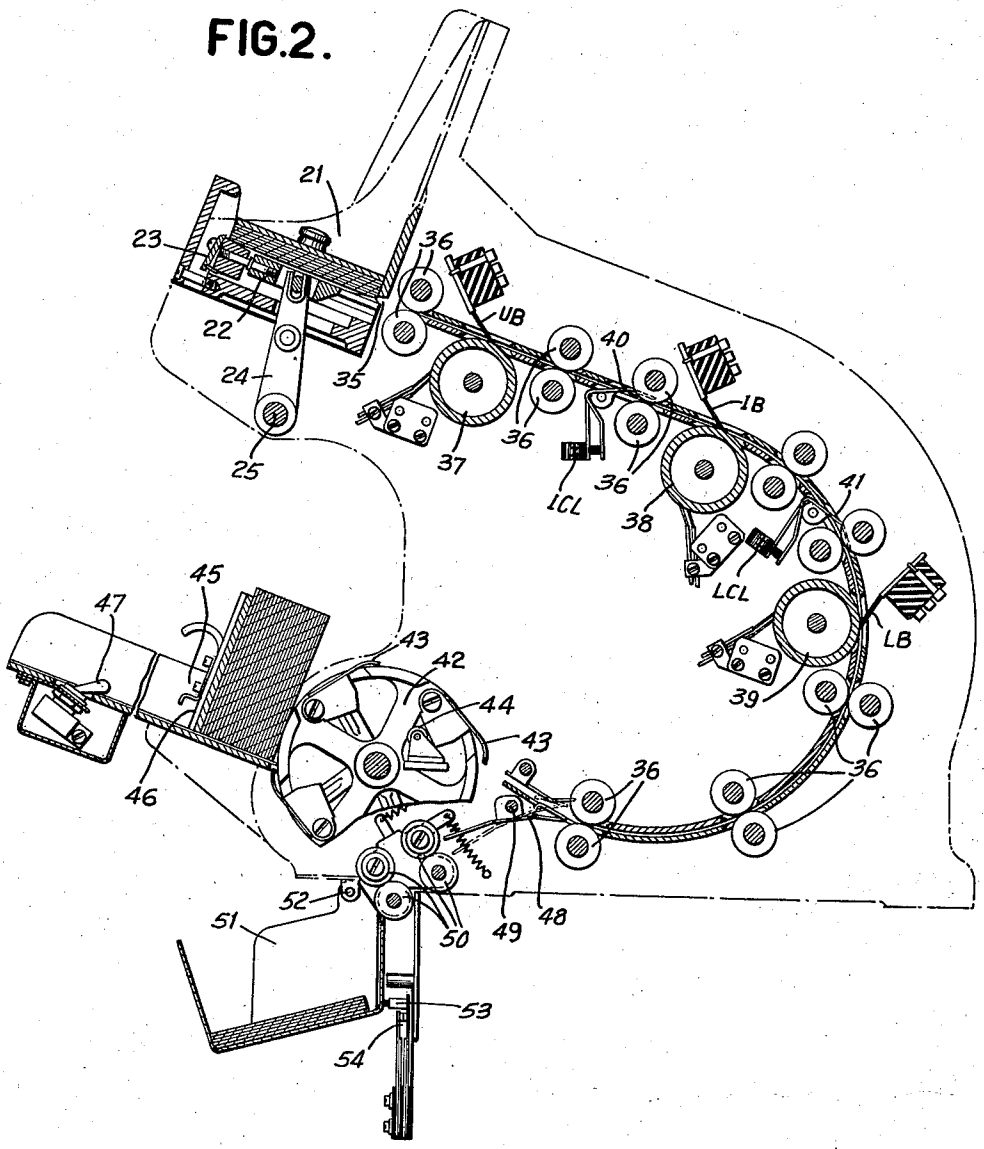
INVENTORS
ALBERT W. MILLS
FRANK J. FURMAN
BY EDWARD J. RABENDA
J. W. Lowmitzer
ATTORNEY

Oct. 4, 1938. A. W. MILLS ET AL 2,131,919

RECORD CONTROLLED PRINTING MACHINE

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FIG.2.



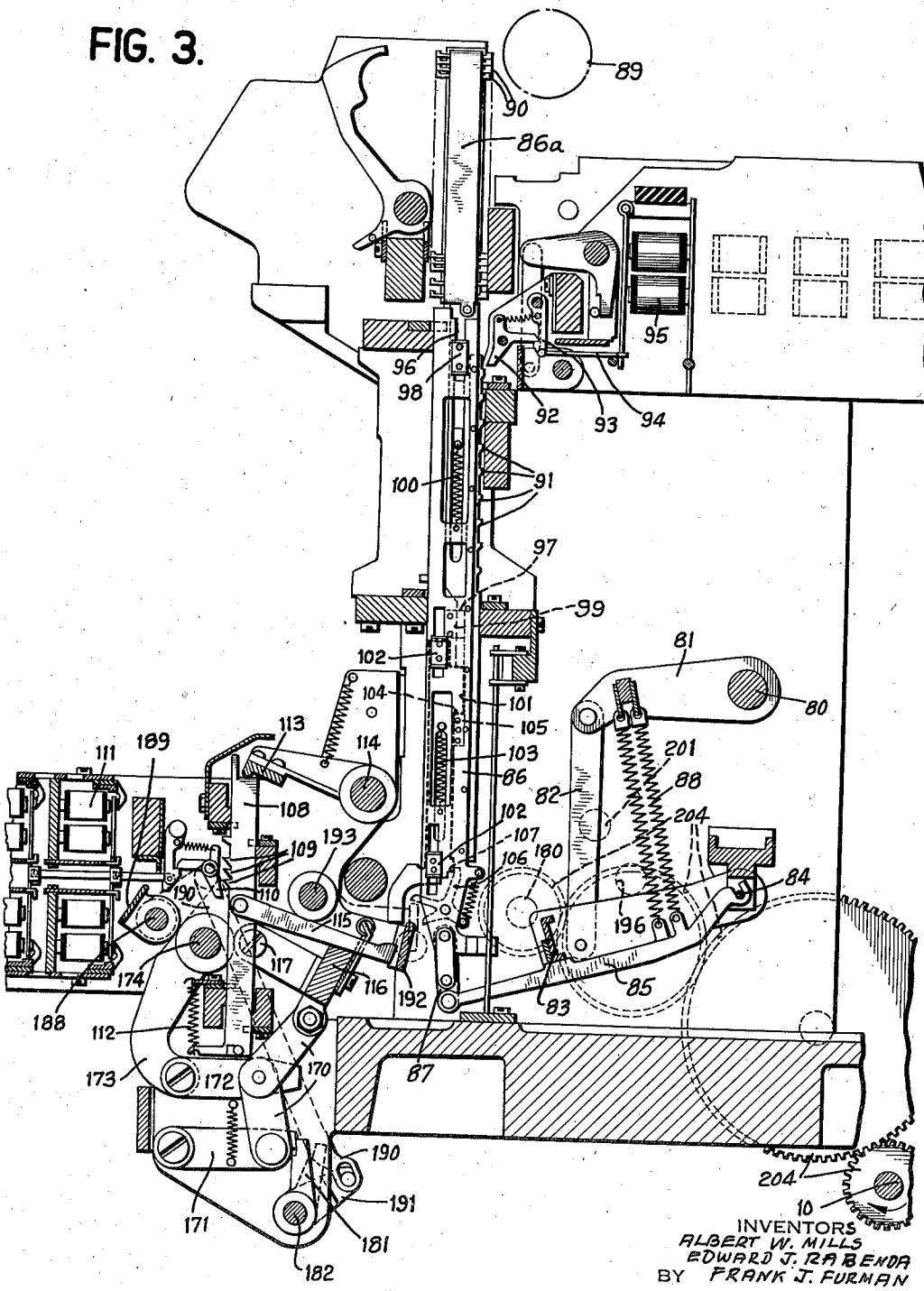
INVENTORS
ALBERT W. MILLS
FRANK J. FURMAN
BY EDWARD J. RABENDA
F. W. Lonnitzer
ATTORNEY

Oct. 4, 1938. A. W. MILLS ET AL 2,131,919

RECORD CONTROLLED PRINTING MACHINE

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FIG. 3.



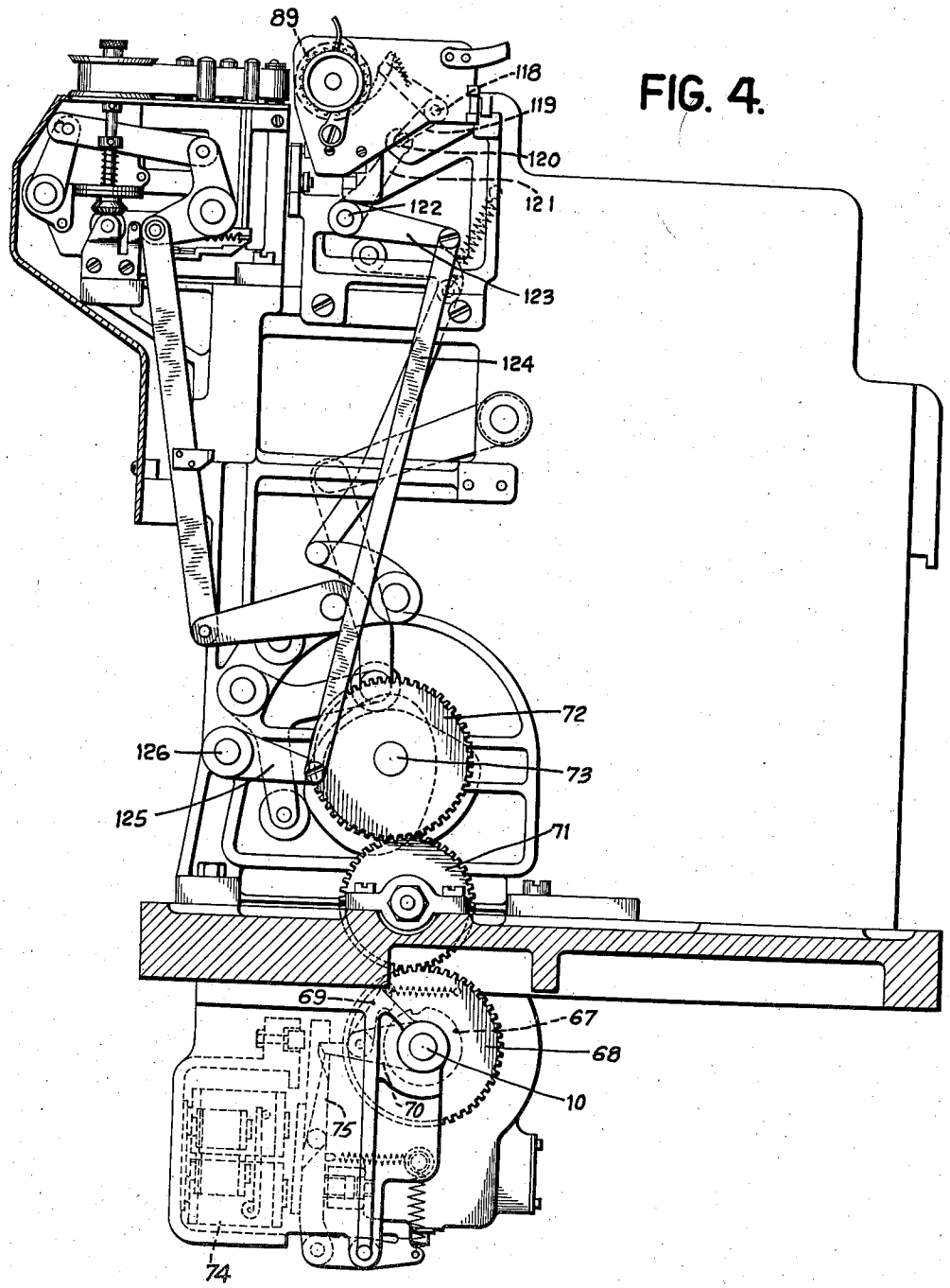
INVENTORS
ALBERT W. MILLS
EDWARD J. RABENDA
BY FRANK J. FURMAN
J. W. Lonnitze
ATTORNEY

Oct. 4, 1938. A. W. MILLS ET AL 2,131,919

RECORD CONTROLLED PRINTING MACHINE

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FIG. 4.



INVENTORS
ALBERT W. MILLS
FRANK J. FURMAN
BY EDWARD J. RABENDA
G. W. Lonnitzer
ATTORNEY

Oct. 4, 1938. A. W. MILLS ET AL 2,131,919

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FIG. 5.

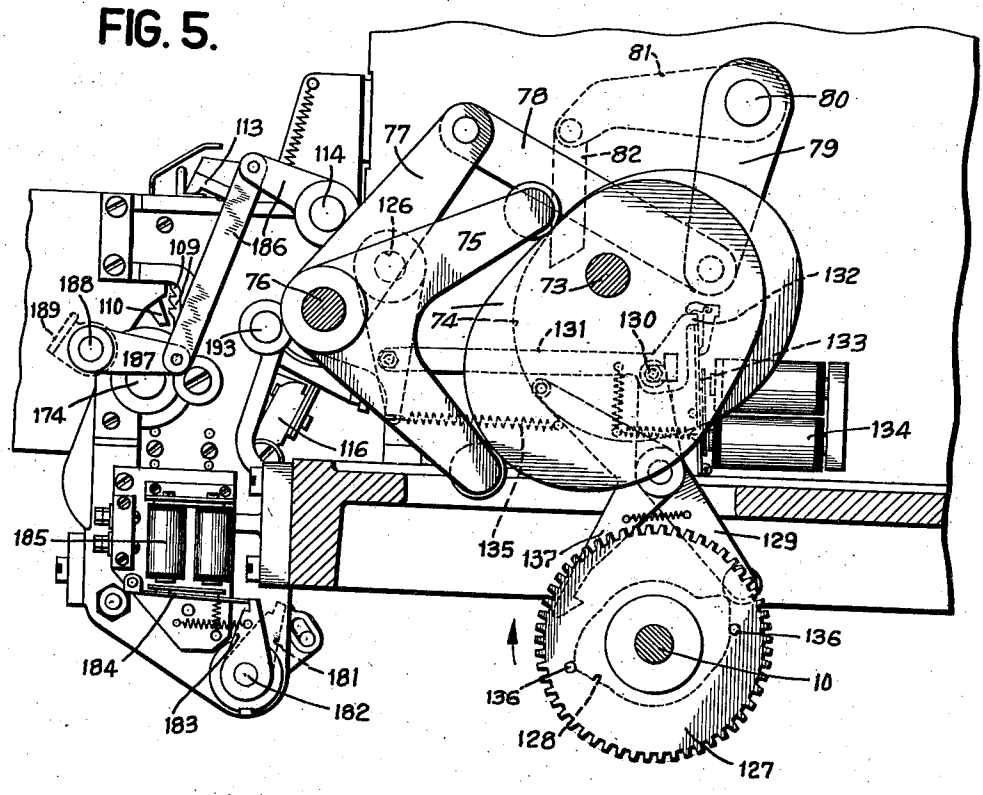
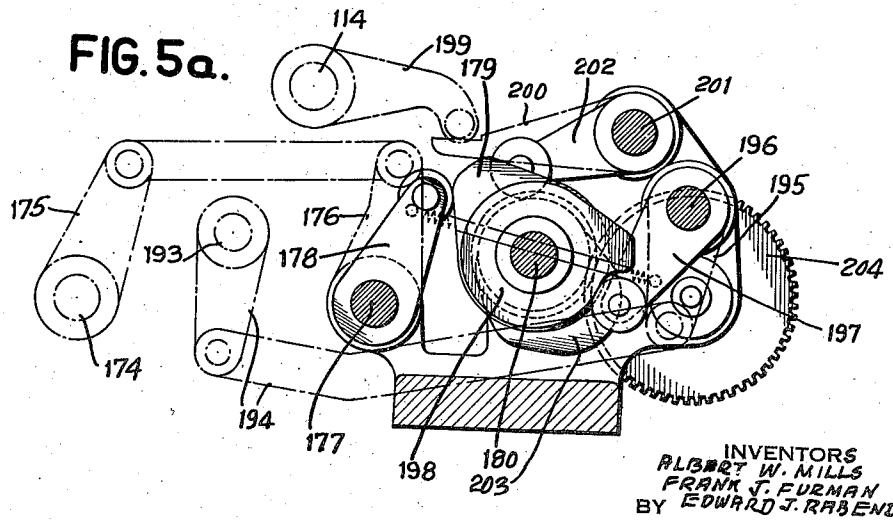


FIG. 5a.



INVENTORS
ALBERT W. MILLS
FRANK J. FURMAN
BY EDWARD J. RABENDA
A. W. Lomnitzer
ATTORNEY

Oct. 4, 1938. A. W. MILLS ET AL 2,131,919

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FIG. 6.

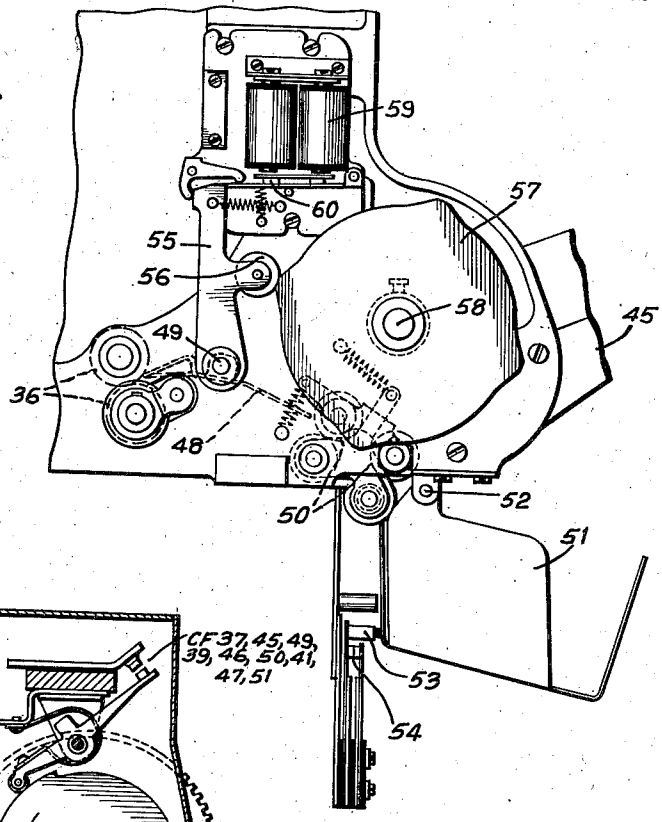
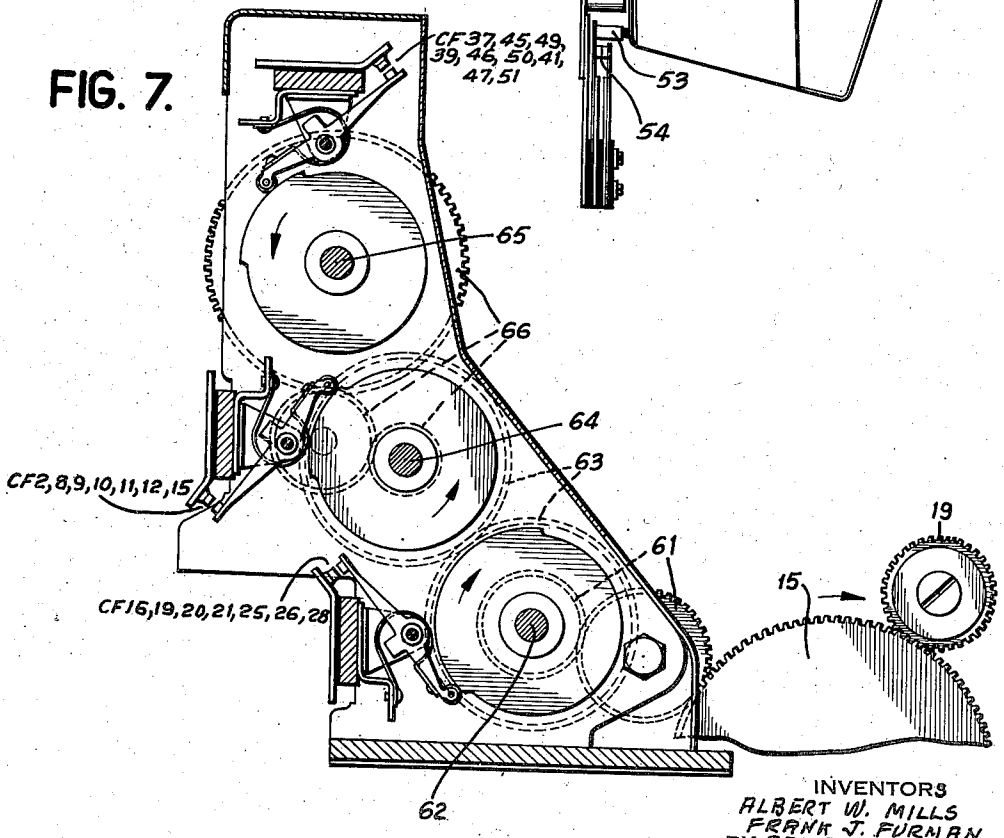


FIG. 7.



INVENTORS
ALBERT W. MILLS
FRANK J. FURNAN
BY EDWARD J. RABENDA
J. W. Lounsbury
ATTORNEY

Oct. 4, 1938. A. W. MILLS ET AL 2,131,919

RECORD CONTROLLED PRINTING MACHINE

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FIG. 8.

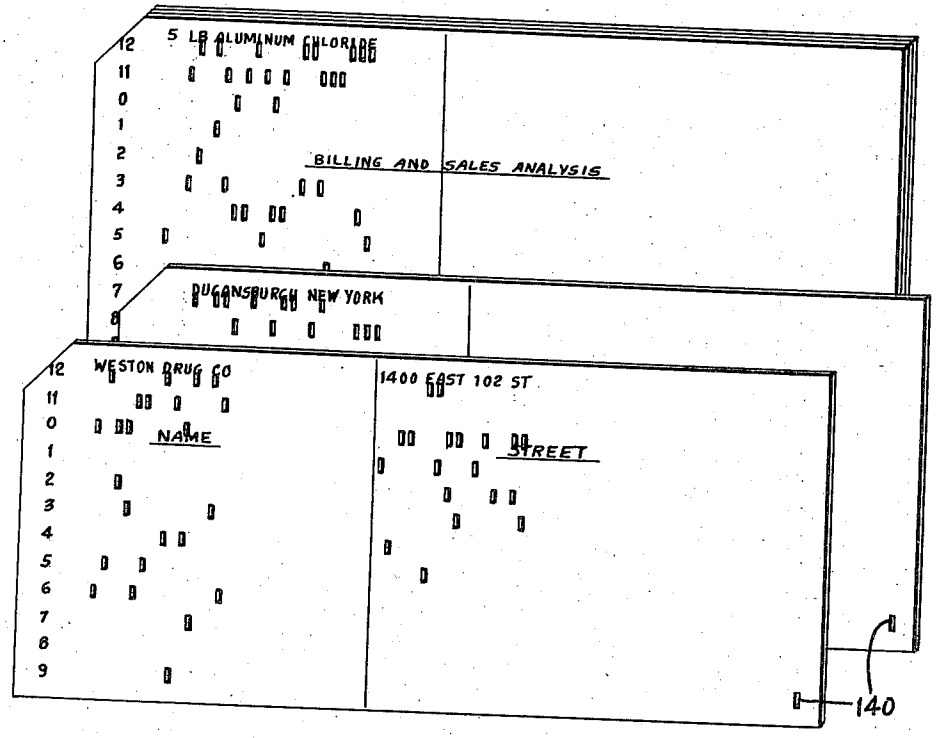
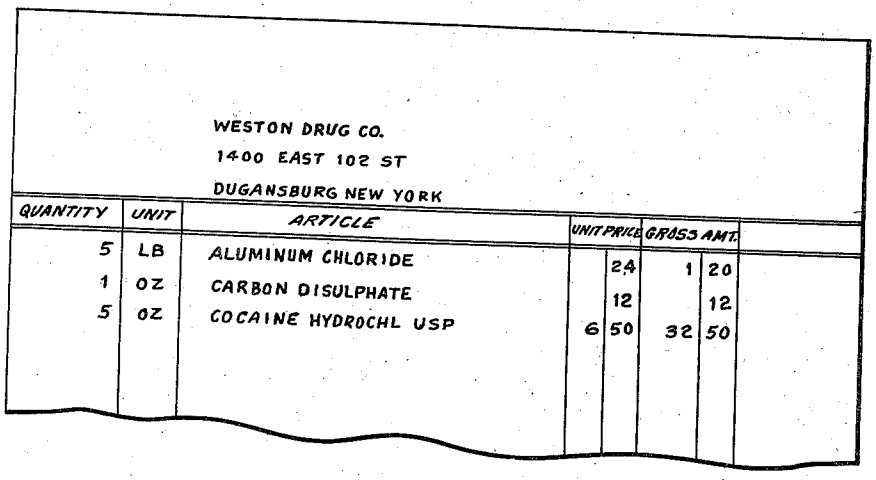


FIG. 9.



WESTON DRUG CO.
1400 EAST 102 ST
DUGANSBURG NEW YORK

QUANTITY	UNIT	ARTICLE	UNIT PRICE	GROSS AMT.
5	LB	ALUMINUM CHLORIDE	24	1 20
1	OZ	CARBON DISULPHATE	12	12
5	OZ	COCAINE HYDROCHL USP	6 50	32 50

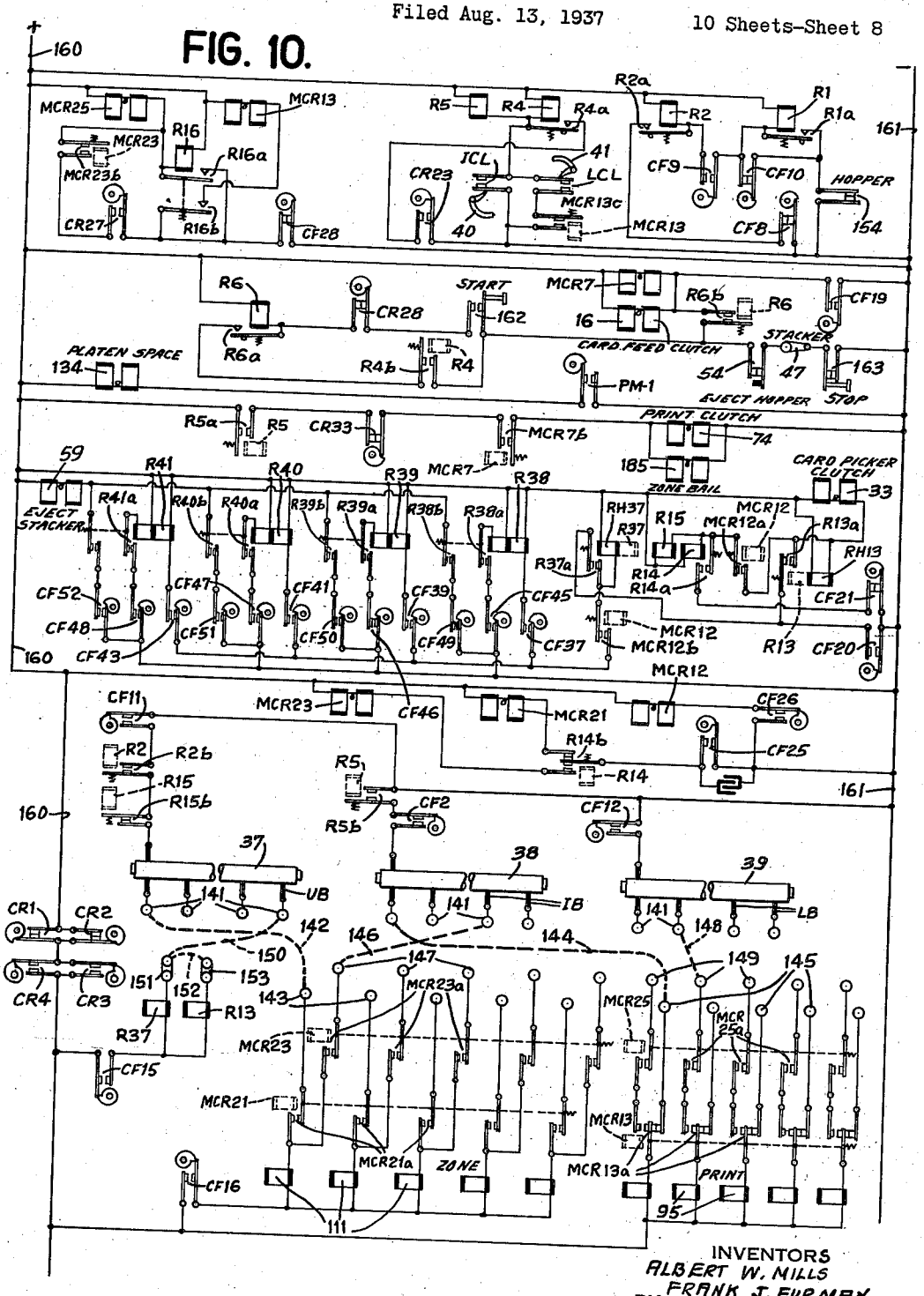
INVENTORS
ALBERT W. MILLS
FRANK J. FURNAN
BY EDWARD J. RABENDA
J. W. Lonnitzer
ATTORNEY

Oct. 4, 1938. A. W. MILLS ET AL 2,131,919

RECORD CONTROLLED PRINTING MACHINE

Filed Aug. 13, 1937 10 Sheets-Sheet 8

FIG. 10.



INVENTORS
ALBERT W. MILLS
FRANK J. FURMAN
EDWARD J. RABENDA
BY J. W. Lowmiller
ATTORNEY

Oct. 4, 1938. A. W. MILLS ET AL 2,131,919

RECORD CONTROLLED PRINTING MACHINE

Filed Aug. 13, 1937 10 Sheets-Sheet 9

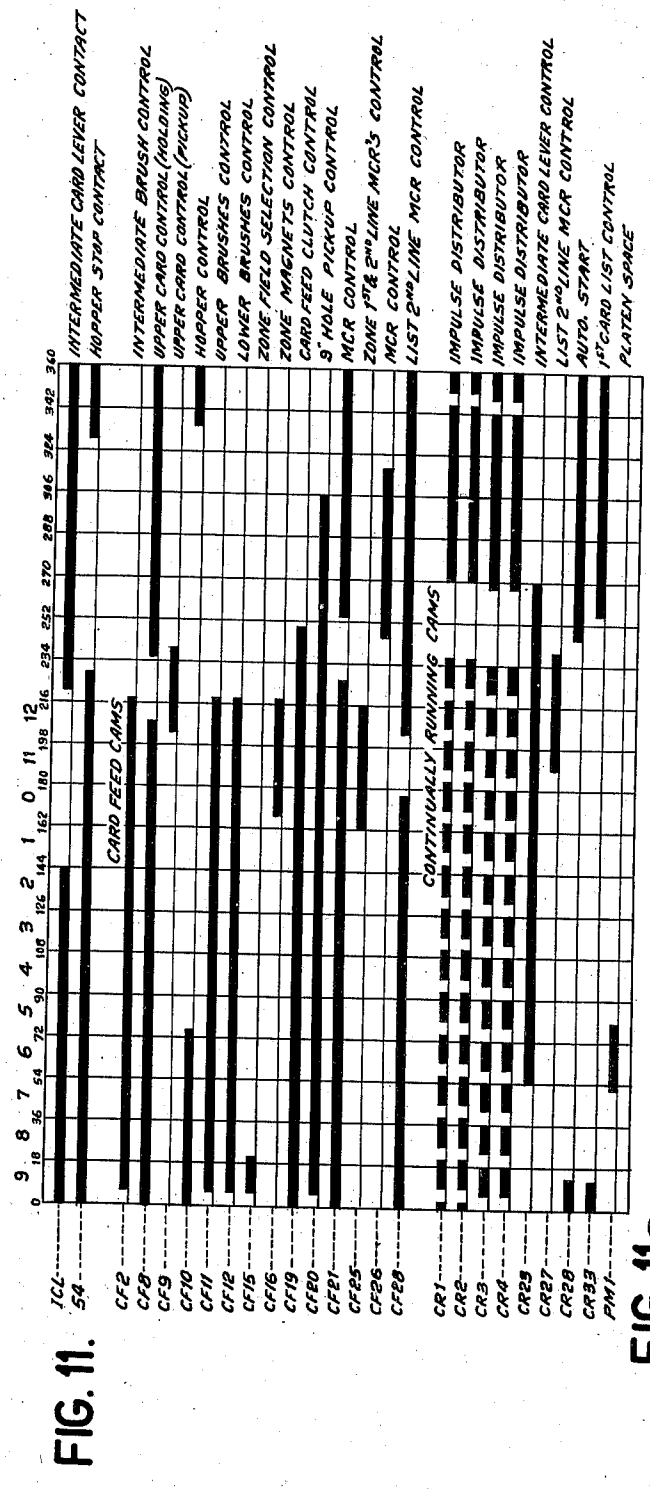


FIG. 11.

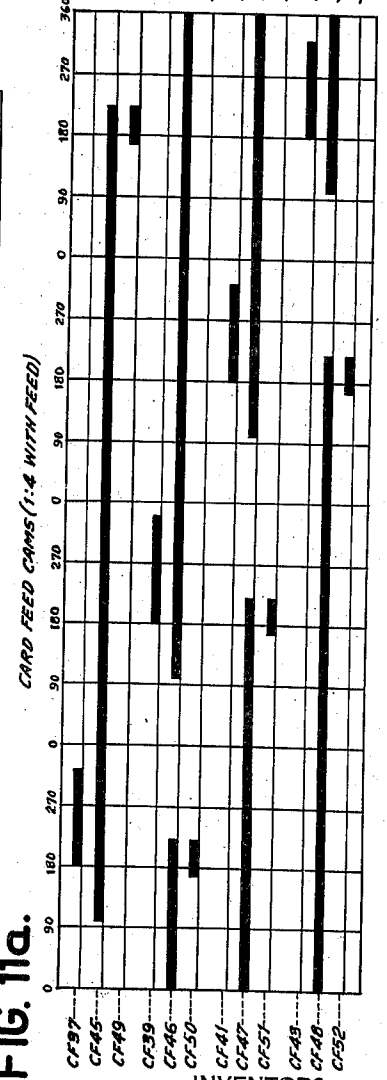


FIG. 11a.

INVENTORS
ALBERT W. MILLS
FRANK J. FURMAN
BY EDWARD J. RABENDA
F. W. Lowenhagen
ATTORNEY

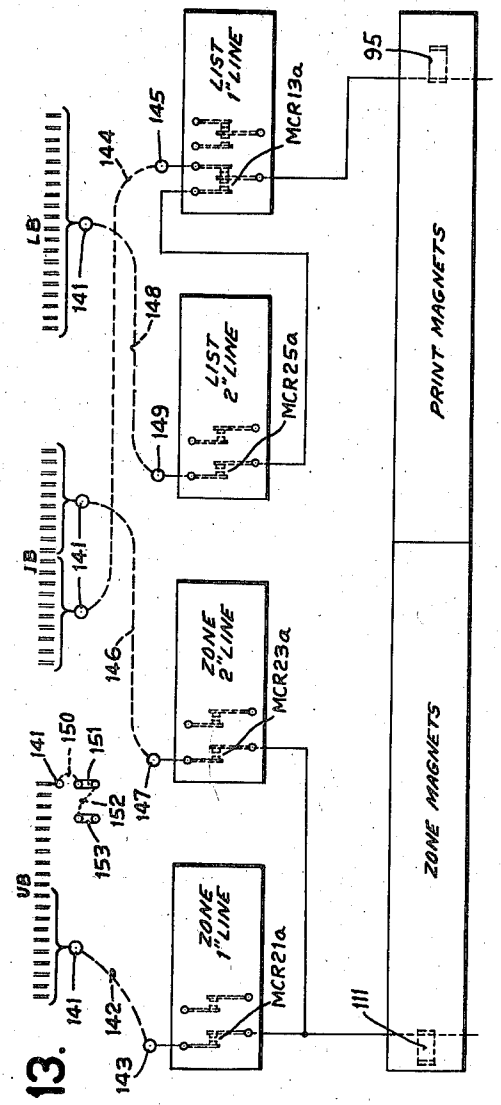
RECORD CONTROLLED PRINTING MACHINE

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FIG. 12.

PICK 1"CARD	1"CARD PASSES UB	1"CARD PASSES LB	1"CARD DEFLECTED	1"CARD TO EJECT		2"CARD DEFLECTED	2"CARD TO EJECT
		PICK 2"CARD	2"CARD PASSES UB	2"CARD PASSES LB		3"CARD PASSES UB	3"CARD PASSES LB
	PICKER DECLUTCHED		PICKER DECLUTCHED			PICK 4"CARD	4"CARD PASSES UB	4"CARD PASSES LB
	ZONE NAME	LIST NAME	PICK 3"CARD	ZONE 1"DETAIL		PICK 5"CARD	LIST 1"DETAIL	5"CARD PASSES UB
		ZONE STREET	LIST STREET			ZONE 2"DETAIL	LIST 2"DETAIL	
		ZONE STATE	LIST STATE				ZONE 3"DETAIL	

FIG. 13.



INVENTORS
ALBERT W. MILLS
FRANK J. FURMAN
BY EDWARD J. RABENDA
F. W. Lounsbury
ATTORNEY

Patented Oct. 4, 1938 2,131,919

UNITED STATES PATENT OFFICE

2,131,919

RECORD CONTROLLED PRINTING MACHINE

Albert W. Mills, Endicott, Edward J. Rabenda, Binghamton, and Frank J. Furman, Vestal, N. Y., assignors to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application August 13, 1937, Serial No. 158,938

9 Claims. (Cl. 101—93)

This invention relates to printing machines and more particularly to printing machines of the type controlled by perforated record cards.

The principal object of the invention is to provide a printing machine for preparing statements or invoices in which the name and the address of the addressee are printed at the head of the statement or invoice and various detail items are listed in the body of the invoice.

A further object of the invention is to provide an improved card feeding mechanism for handling groups of cards, each group including at its head, name and address cards followed by detail cards and in which provision is made for automatically separating the name and address cards from the detail cards after they have passed by the analyzing stations of the card handling section.

A further object of the invention is to provide an improved card feeding mechanism wherein record cards are advanced one by one in succession to pass a plurality of sensing stations and in which provision is made to cause name and address cards to completely traverse all the sensing stations before the following card is fed and to permit detail cards to follow one another past the sensing stations in closer proximity so that as one detail card is passing one of the stations, the following detail card is at the same time passing the adjacent station.

A more specific object of the invention is to provide a novel card ejecting mechanism controlled by special perforations on the name and address cards and operative to deflect such cards from the normal discharge hopper to a special hopper so that after all cards have been run through the machine, one hopper will contain all the detail cards and the other will contain the name and address cards.

A further specific object is to provide a pivotally mounted discharge hopper to receive the name and address cards, so arranged that the weight of the cards in the hopper, when the same is approximately filled, will cause rocking of the hopper to operate a pair of contacts to terminate a further operation of the machine.

A further object of the invention is to provide improved mechanism for causing two different items of information recorded on a single record card to be printed on two successive lines of a statement or invoice.

Further objects of the instant invention reside in any novel feature of construction or operation or novel combination of parts present in the embodiment of the invention described and shown in the accompanying drawings whether within or without the scope of the appended claims and irrespective of other specific statements as to the scope of the invention contained herein.

In the drawings:

Fig. 1 is an outside view of the card feeding and handling mechanism of the machine.

Fig. 2 is a section taken centrally through the card feeding and handling mechanism.

Fig. 3 is a central section of the printing mechanism of the machine.

Fig. 4 is an outside view of the printing mechanism.

Fig. 5 is a detail of the operating mechanism for the printing type bars.

Fig. 5*a* is a detail of the cams for operating the zoning mechanism.

Fig. 6 is a detail of the control mechanism for the name and address card eject hopper.

Fig. 7 is a detail of the contact cams driven from the card feeding mechanism.

Fig. 8 is a diagram showing a typical group of cards.

Fig. 9 is a sample of an invoice prepared under control of the group of cards of Fig. 8.

Fig. 10 is a wiring diagram of the electric circuits of the machine.

Fig. 11 is a timing diagram of certain of the cam controlled contact devices.

Fig. 11*a* is a similar timing diagram of differently timed cam controlled contact devices.

Fig. 12 is a diagram illustrating the sequence of operations involved in handling a group of record cards.

Fig. 13 is a diagram showing the manner of interconnecting the various units in carrying out the operations of the machine.

Before explaining the manner in which the machine operates in its entirety, the various mechanical units will be separately described, after which a typical problem will be considered and the various steps involved in preparing a statement will be explained to set forth the coordination of the separate units.

Card feeding mechanism

Referring to Fig. 1, the main drive shaft of the machine is shown at 10 and this may be driven and maintained in constant operation through any suitable connection to a driving motor or other source of energy. Secured to shaft 10 is a clutch driving disk 11 cooperating with a dog 12 mounted upon an arm 13 to which is fixedly connected a gear 14 to drive the card feeding and analyzing mechanism through an idler gear 15. The engagement of these clutch elements is con-

trolled by a magnet 16 and armature latch 17. The armature latch 17 normally holds dog 12 out of engagement with the driving disk 11 and in the position shown in Fig. 1. Magnet 16, upon energization, rocks armature latch 17, releasing dog 12 so that its spring 18 may bring it into engagement with driving disk 11. Upon deenergization of magnet 16, armature 17 will be moved by its spring into the path of a projecting toe of dog 12 to throw the dog out of engagement with disk 11. Arm 13 will be similarly engaged by armature 17 to prevent further movement of gear 14 in a clockwise direction.

The idler gear 15, through a further intermediate gear 19, drives a large gear 20 from which the feed rollers, picker mechanism, and stacker are driven, as will be explained.

Referring to Fig. 2, the record cards are fed singly from the supply magazine 21 by the usual card picker mechanism comprising a slidably mounted plate 22 carrying a picker knife 23 for cooperation with the record cards. The plate 22 has a pin and slot connection with an arm 24 secured to a rod 25 which has secured at its end (see Fig. 1) an arm 26 which is normally urged in a counterclockwise direction against a stop 27 by a spring 28. Arm 26 has pivoted thereto a dog 29 arranged for engagement in a suitable notch in an arm 30 which is freely pivoted on rod 25. Arm 30 has connected thereto one end of a link 31 whose opposite end is eccentrically connected to a gear 32 driven by the large gear 20. The arm 30 is thus invariably oscillated once for each cycle of the machine.

If, during the counterclockwise or return stroke of arm 30, magnet 33 is energized, the free end of its armature will lie in the path of the short arm of dog 29 so that when the dog reaches its home position it will be rocked to the dotted line position shown and, if magnet 33 is held energized, arm 26 will not follow arm 30 on its next operating stroke. Consequently, the picker mechanism will not advance a record card during the next operation of arm 30. Gear 32 is arranged to make one revolution for each card cycle of the machine and as long as dog 29 remains in engagement with arm 30, a card will be fed for each cycle. When magnet 33 is energized, it will cause the picker mechanism to skip a cycle so that the machine will go through an operation without advancing another card. The manner in which magnet 33 is controlled will be explained in connection with the circuit diagram.

The picker knife 23 advances the record cards singly from the bottom of the stack through throat 35 (Fig. 2) to the first of a series of pairs of rollers 36 which convey the card in an arcuate path between suitable guide plates. The pairs of rollers 36 are driven through the gearing indicated in Fig. 1 from the large gear 20. Disposed in the path of the record cards are three analyzing stations at the first of which upper brushes UB, cooperating with a contact roller 37, sense the perforations; then, intermediate brushes IB, cooperating with contact roller 38, sense the perforations, and, finally, the third set of lower brushes LB, cooperating with contact roller 39, read the card a third time. The brushes are so spaced that when brushes LB sense a particular index point position of a record card, the brushes IB sense the corresponding index point positions of the next following card and brushes UB sense the same position of the second following card.

Intermediate the brushes UB and IB is a card lever 40 which, as a record card approaches the brushes IB, will close intermediate card lever contacts ICL. Similarly disposed in advance of the brushes LB is a pivoted card lever 41 which, under the influence of a record card, will cause closure of lower card lever contacts LCL as the card approaches the lower brushes LB.

As the cards continue in their travel after having passed the last brush station, they are advanced to the stacker drum 42 upon which are pivoted spring-pressed clips 43 which cooperate with a fixed cam roller 44, so positioned that as the clips pass a point tangent to the end of the circular card path they open to permit the leading edge of the card to enter between the periphery of the drum and the clips which thereafter close upon the card and draw it into the discharge stacker 45.

Drum 42 is geared to rotate once every four card cycles. In the discharge hopper the cards are stripped from the clips in the usual manner and as the cards accumulate therein the pusher plate 46 is urged toward the left. When the magazine is filled to capacity, the plate 46 engages the handle 47 of a snap-switch which controls a pair of contacts to stop the operation of the machine.

Disposed in the path of the record cards is a deflector plate 48 secured to a rod 49 and normally lying in the position shown in Fig. 2. When plate 48 is rocked to its dotted line position, as indicated, the cards, instead of proceeding to the stacker drum clips, will be deflected by plate 48 into engagement with pairs of rollers 50 driven through suitable gearing from gear 20 and the card will be advanced to a tray 51. Tray 51 is pivotally suspended from pins 52 and balanced so that it bears against a pin 53 (see Fig. 6) carried by the blade of a pair of contacts 54. The tension of the contact spring is such that when the tray is nearly full, the weight of the cards will bear against pin 53 sufficiently to cause opening of contacts 54 whose function is to cause the machine to stop.

The mechanism for causing plate 48 to rock from its full line position to its dotted line position is shown in Fig. 6 wherein shaft 49 has secured thereto an arm 55 having a roller 56 in cooperation with a cam 57 mounted on the stacker drum shaft 58 which, as explained, makes one revolution for each four successive card cycles.

A magnet 59, when energized, will attract its armature 60 at a time when cam 57 is holding arm 55 in the position shown to relieve the pressure against the free end of armature 60. Thereafter, as the cam 57 rotates, arm 55 will be permitted to follow the contour of the cam and rock clockwise, carrying with it the deflector plate 48. At the end of the cycle the succeeding rise on the cam will restore arm 55 to its latched position.

Referring to Fig. 7, the gear 15, through gearing designated 61, drives a shaft 62 which, in turn, through gears 63, drives a further shaft 64, the ratio being such that shafts 62 and 64 make one revolution for each card cycle. On these shafts are carried various cams which operate their respective contacts during card feeding operations of the machine. These cam controlled contacts are designated in the circuit diagram with the prefix CF and their timing is shown in the timing diagram, Fig. 11.

Above shaft 64 is a further shaft 65 driven from shaft 64 through reduction gearing desig-

nated 66. On this shaft are also contact controlling cams prefixed CF, but these cams are driven at a ratio of 1:4 with respect to the card feed cycle; that is, they make one revolution during four revolutions of the card feeding mechanism. The timing of these contacts is shown in the circuit diagram, Fig. 11a.

Printing mechanism

Referring to Fig. 4, the main drive shaft 10 of the machine carries a notched disk 67 adjacent to gear 68, which disk is adapted to be engaged by a dog 69 pivotally mounted upon an arm 70, which arm is integral with the gear 68. Through an intermediate gear 71 meshing with a gear 72, the printing drive shaft 73 is driven. Driving connection is established upon energization of print clutch magnet 74 which rocks its armature 75 counterclockwise to release dog 69 for engagement with the constantly running notched disk 67. Secured to the shaft 73 (Fig. 5) is a pair of complementary cams 74 which is adapted to oscillate a bifurcated follower arm 75 secured to a rod 76 upon which is also attached an arm 77 which has link connection 78 to an arm 79 secured upon a shaft 80. In Fig. 3, shaft 80 carries arms 81 which have depending link connection 82 with a bail 83 pivoted at 84. Also pivoted at 84 are type carrier actuating arms 85 which are connected at their free ends to the lower extremity of type carriers 86 through link connections 87. Arms 85 are urged in a clockwise direction by springs 88 which are connected at their upper ends to a cross bar extending between arms 81. Thus, as the arms 81 and bail 83 are rocked in a clockwise direction through the action of cams 74, the springs 88 will rock the arms 85 in the same direction and will cause elevation of the type carriers 86 which are suitably mounted for vertical movement.

The type carriers are provided with type elements for printing the letters of the alphabet as well as the digits and is substantially that shown in the Patent No. 2,016,682, granted to A. W. Mills, October 8, 1935, so that a brief description herein will suffice to explain its manner of operation. It includes the usual platen 89 past which the type carriers 86 are reciprocated. The head 86a of each type carrier 86 has type elements 90 adapted to print the numerals 1 to 9 and the letters A to Z. The type elements are arranged in nine groups in the following order: 9, I, R, Z; 8, H, Q, Y; 7, G, P, X; 6, F, O, W; 5, E, N, V; 4, D, M, U; 3, C, L, T; 2, B, K, S; 1, A, J. Near the bottom of the type head are two zero type elements. The numerical type elements 90 correspond to the usual numerical type elements of a conventional Hollerith type bar, but are spaced far enough apart to make room for three alphabet type elements between successive numeral type elements which are selected for a printing operation in the same manner as in conventional Hollerith tabulating machines, for instance, as in Patent No. 1,822,594, under control of a perforation in one of the index point positions 1 to 9 of a record column. The alphabetic type elements are selected under control of combinations of perforations, each of which may comprise a perforation in one of the index point positions 0, 11, and 12, with another in one of the remaining nine index point positions.

The selection of the alphabetic type elements 90 is effected by arresting each carrier 86 in the appropriate position corresponding to the value of the perforation in index point positions 1 to 9 of the record card and by further movement of the type head 86a relative to its carrier one, two, or three steps, according to whether the other perforation of the combination necessary for a selection is in the 12, 11, or 0 position. The mechanism which effects relative movement between each carrier 86 and its type head 86a may be termed the zoning mechanism. Each carrier is provided with a series of stops 91 which represent the corresponding index point positions 0 to 9 on the record card. As the carrier is moved upwardly, the stops 91 move in succession to pass a stopping pawl 92. The latter is held in the position of Fig. 3 by a latch 93 which has connection 94 with the armature of the usual printing magnet 95. When a carrier is used to print numerals only, it will, of course, be controlled by a single perforation in one of the index point positions 0 to 9, inclusive. In such case, each type head and its carrier 86 is maintained in the relationship shown in Fig. 3 and as the card is analyzed, a circuit is completed through a perforation in the card which will energize the magnet 95 in the well known manner and will effect a release of pawl 92, causing it to engage the stop 91 corresponding in value to the location of the single perforation in the record card column. This operation results in bringing the corresponding numeral type element to the printing line.

The carrier 86 is provided with a slot 96 and a guide 97 which are adapted to receive a slotted block 98 and the lower end 99 respectively of the type head 86a, the block sliding within the slot 96 and the lower end 99 sliding in the guide 97.

A spring 100, whose lower end is anchored to the carrier 86, is provided at its upper end with a hooked member which engages the lower edge of an opening in the shank of the type head, the spring 100 tending to resiliently hold the head in cooperation with the carrier 86. Mounted upon the lower portion of each carrier 86 is a slide 101 provided with grooved blocks 102 which cooperate with suitable slots in the carrier 86. A spring 103, anchored at its lower end to the carrier and at its upper end to the slide 101, tends to move the slide downwardly to bring a shoulder 104 in the slide into engagement with a block 105 riveted to the carrier 86. With the parts assembled as in Fig. 3, the spring 103 urges the type head 86a in the same direction so that the lower end 99 thereof engages the slide 101. It is plain that, if the slide 101 is moved upwardly relative to the carrier 86, the type head 86a will move likewise. A spring-pressed latch 106 pivoted at the lower end of the carrier 86 is adapted to cooperate with three shoulder stops 107 formed in the lower end of slide 101. When the slide is moved upwardly one or more steps with respect to the carrier, the latch 106 will cooperate with one of the stops 107 to hold the parts in their displaced relationship.

Associated with each alphabetic type bar assembly is a vertically slidable comb 108 which is adapted to be moved downwardly and then upwardly during each cycle of the machine. Each comb has a series of three stops or lugs 109 which, on the upward movement of the comb, pass a stopping pawl 110 in synchronism with the passage of the zone perforations 0, 11, and 12 by the upper analyzing brushes of the machine. Each

pawl 110 is controlled by a zone magnet 111, the energization of which operates its armature to release pawl 110, allowing the latter to be moved by its spring into engagement with one of the stops 109. By this action, further upward movement of the comb 108 is prevented for the time being. The combs 108 are moved upwardly by means of springs 112 and moved downwardly by a bail 113 secured to a shaft 114. The bail engages the upper ends of the combs and moves the latter downwardly whenever the shaft 114 is rocked at the proper time.

The comb 108 has pivoted thereto an arm 115 whose free end lies in the path of movement of the associated slider 101 and whose lower edge rests upon a bail 116 which is pivoted at 117. Under control of the zone perforations the pivot point of arm 115 may take one of three positions below that of Fig. 3. In this figure, the parts are shown with the comb in the position it assumes when no zone holes are present in the card, that is, when numerals only are to be printed. When the carrier 86 is in its lowermost position, the bail 116 is rocked in a counterclockwise direction to move the arm 115 in a similar direction into engagement with the lower extremity of slide 101. It will be apparent that the distance which the free end of arm 115 is moved upwardly under control of the bail 116 depends upon the location of the pivot point of arm 115 at such time. Thus, if the pivot point is located as shown in Fig. 3, the free end of arm 115 will be moved upwardly to a position where it barely touches slide 101. A zone perforation in the zero index point position will result in the movement of the free end of arm 115 three steps upwardly from the position of Fig. 3. A perforation in the 11 position will cause it to move two steps while a perforation in the 12 position will cause it to move only one step above the position in Fig. 3. These steps of movement are, of course, transmitted to the slide 101 and it, in turn, will be moved upwardly 1, 2, or 3 steps in accordance with the setting of the related comb 108, the latch 106 carried by the carrier 86 serving to hold the slide in its displaced position with respect to the carrier.

It will be understood from the foregoing description and the more detailed explanation found in Patent No. 2,016,682, that in the case where a perforation occurs in one of the 1 to 9 index point positions only, the mechanism controlled by the zone magnets 111 will not be effective to shift slide 101 relative to carrier 86 and the type bar assembly will be arrested differentially, purely by the operation of print magnet 95, as in former Hollerith tabulating machines.

Bail 116 is actuated through the medium of a toggle mechanism comprising links 170 one of which is pivoted to the bail 116 and the other is pivoted to an arm 171. The point of connection of the links carries an arm 172 which is also pivoted to an arm 173 secured to a shaft 174. Referring to Fig. 5a, shaft 174 also carries an arm 175 which has link connection with an arm 176 secured to a rod 177. A follower arm 178 on rod 177 is actuated by a cam 179 on shaft 180.

Referring to Fig. 3, an arm 181 carried by a rod 182 is adapted to be rocked from its dotted to its full line position prior to the straightening of the toggle links 170 so that when shaft 174 is rocked in a counterclockwise direction under control of its cam 179, the arm 171 will be restrained against movement and the straightening of the toggle will move the bail 116 upwardly. In Fig. 5, rod 182 carries an arm 183 whose upper end is adapted to be engaged by the free end of an armature 184 of magnet 185. Energization of magnet 185 will permit arm 183 to rock in a counterclockwise direction under the influence of its spring and thereby carry with it rod 182 and the arm 181.

Referring to Fig. 5, the shaft 114 has arm and link connection 186 with an arm 187 on a shaft 188 which carries a bail 189 (see also Fig. 3); through this connection rocking of shaft 114 to restore the combs 108 will also cause clockwise rocking of bail 189 to restore the latches of pawls 110. Shaft 188 has arm and link connection 190 with an arm 191 on rod 182 to cause relatching of arm 183 against the free end of armature 184.

As the type carrier 86 descends from printing position with the slider 101 held in displaced position by latch 106, it is necessary to first restore the slider to its lowermost position before effecting a new zone setting thereon. To this end a bail 192 is provided which is moved to the dotted line position of Fig. 3 before the carrier reaches the lower extremity of its movement. In such position the bail 192 is in the path of an extending arm of latch 106 and as the carrier continues its descent the extension will engage bail 192 and cause clockwise rocking of latch 106 to release slide 101. Following this action, the bail 192 is lowered and the slide 101 is in readiness to receive a new setting under control of arm 115.

In Fig. 5a, bail 192 is carried by a shaft 193 which through arm and link connection 194 is connected to an arm 195 secured upon shaft 196 which shaft also carries a follower arm 197 cooperating with a cam 198 on shaft 180. Shaft 114 of bail 113 also carries an arm 199 whose free end has a roller in cooperation with an arm 200 secured upon a shaft 201. Shaft 201 also carries a follower arm 202 in engagement with a cam 203 mounted on shaft 180. The shaft 180 is driven from the main shaft 10 of the machine through gearing designated 204 in Fig. 3.

Mounted on the main drive shaft 10 or geared thereto are various cam operated contacts whose timing is indicated in Fig. 11 and which are designated with the prefix CR, indicating that these are contacts operated by constantly running cams making one revolution for each cycle of the machine. A cam operated contact prefixed PM is carried by the print shaft 76 and operated only when the shaft 73 is in operation.

Paper line spacing

Referring to Fig. 4, the statement or invoice is carried by the platen 89 supported by the paper carriage frame in the usual manner. Spacing of the platen is effected by the usual pawl and ratchet operated from shaft 118 journaled in the paper carriage. Fixed to shaft 118 is an arm 119 carrying a rod 120 cooperating with a bifurcated lever 121 mounted on stud 122. To this stud is secured an arm 123 connecting through link 124 with an arm 125 on shaft 126.

In Fig. 5, the constantly running gear 127 on shaft 10 has affixed thereto a double cam 128 engaging a lever 129 urged by a spring into contact with the cam. An upwardly extending arm of lever 129 carries a stud 130 which moves in an L-slot of link 131. A nose 132 of link 131 rests upon armature 133 of a magnet 134. The magnet 134, energized at a time when the follower roller of lever 129 is on the lower portion of cam 128 and stud 130 is to the right in the L-slot will permit link 131 to be drawn down into operating relationship with the stud so that

as lever 129 is rocked counterclockwise, shaft 126 will be actuated to cause spacing of platen 89. A spring 135 restores shaft 126 and connected links. Following each paper spacing operation, a pin 136 in the gear 127 coacts with bell crank 137 to positively raise link 131 out of active engagement with the stud in the L-slot and latch it on armature 133. The double rise on cam 128 permits a second paper spacing operation of the above described instrumentalities. Thus, if during the same cycle magnet 134 is energized a second time, an additional paper spacing operation will be effected. The manner in which the magnet 134 is controlled will be explained in connection with the circuit diagram.

Referring now to Fig. 8, there is shown a typical group of cards which is to control the preparation of the statement shown in Fig. 9. At the head of the group is a so-called "name and address" card in which perforations, representing the name, are made in the left portion of the card, and perforations representing the street address, are made in the right hand portion. The card is identified as an address card by a perforation designated 140 made in the "9" index point position of the last or eightieth column of the card. The second card is known as a "city and state" card and contains perforations in its left hand portion representing city and state. This card also contains the identifying perforation 140.

As will be explained hereinafter, the sensing of this special perforation will cause these cards to be passed to the special eject hopper after they have been sensed by the analyzing brushes. Following the two heading cards is a group of detail cards, each of which contains perforations representing information relating to various items to be billed.

In Fig. 9 is shown the manner in which the group of cards is to control printing on the invoice with the left hand portion of the first record card controlling printing on the first line, the right hand portion controlling printing on the second line, and the second card controlling printing on the third line, after which a spacing operation is brought about to skip over the pre-printed column headings. Each of the detail cards, in turn, will control printing on successive lines, there being one line for each card.

Circuit diagram

The complete operation of the machine will now be explained with particular reference to the problem indicated in Figs. 8 and 9 and also with reference to the diagrams shown in Fig. 10.

Before initiating operation of the machine, it is necessary to effect certain preliminary plug connections. These are represented diagrammatically in Fig. 13 where a single plug connection is indicated to represent the plugging of an entire field or group of card columns. The plug sockets 141 related to the upper analyzing brushes UB which traverse the left hand portion of the card are connected through suitable plug connection 142 to plug sockets 143. The brush sockets 141 of the intermediate brushes IB which sense the left hand portion of the cards are connected through plug connection 144 to plug sockets 145 and the sockets 141 of brushes IB which traverse the right hand portion of the card are connected through plug connection 146 to plug sockets 147. The plug sockets 141 of the brushes LB are connected through plug connections 148 to plug sockets 149. The various sockets 143, 145, 147, and 149 are wired to contact devices whose function and manner of operation will be set forth hereinafter. A further plug connection 150 is made from the upper brush 141 traversing the last card column to a socket 151 and from here a further connection 152 is made to a socket 153.

With these preliminary plug connections established and the main line switch closed so that there is current on the left side of line 160 and on the right side of line 161 and a group of cards, such as that shown in Fig. 8, placed in the feed hopper in the machine, the apparatus is in readiness to commence operation, which is initiated by operation of the start key which closes contacts 162 and establishes a circuit traceable from right side of line 161, through stop key contacts 163, eject hopper contacts 54, start key contacts 162, cam contacts CR28 (which time the completion of the circuit), relay magnet R6, to line 160. Relay R6 closes its contacts R6*a* and R6*b*, the latter completing a circuit through the card feed clutch magnet 16 whereupon the card feed mechanism is released for a cycle of operations.

During this first card feed cycle, the first card of the group is advanced to the feed rollers which convey it to the brushes UB. In starting the machine, it is necessary to repeatedly depress the start key or, as an alternative, hold the start key depressed for several cycles until the leading card has reached the intermediate brushes IB. During the second card feed cycle, the first card passes brushes UB and as it approaches brushes IB it operates the intermediate card lever 40 to close contacts ICL which establish a circuit from line 161 through contacts ICL, relays R4 and R5, to line 160. Relay R4 closes its contacts R4*a* to provide a holding circuit through cam contacts CR23 which overlap the period that the card lever contacts are opened so that as long as cards continue to feed in succession, relays R4 and R5 will remain energized. Contacts R4*b* of relay R4 will accordingly be closed to short-circuit the start key contacts 162 and maintain relay R6 energized, which in turn will keep the card feed clutch magnet 16 in operation.

In parallel with the card feed clutch magnet 16 is relay magnet MCR7 which is accordingly energized concurrently therewith. Cam contacts CF19 close as soon as the card feed mechanism begins to operate and keep the relay magnet MCR7 and clutch magnet 16 energized for the greater part of the cycle as may be seen by reference to the timing diagram, Fig. 11.

Before the start key is operated a circuit is traceable from line 161, contacts 154, normally closed contacts CF10, relay R1 to line 160, causing closure of contacts R1*a* and providing a holding circuit which will be maintained until the usual hopper contacts 154 open due to exhaustion of cards from the supply hopper. During the first cycle contacts CF9 close and energize relay R2 through a circuit from line 161, contacts 154, R1*a*, CF9, relay R2 to line 160. Contacts R2*a* establish a holding circuit through contacts CF8 which will keep the relay energized until the first card has passed the brushes UB in the following cycle.

As the leading edge of the first card commences to pass brushes UB during the second cycle, the "9" perforation 140 in the last card column will complete a circuit traceable from line 161, contacts CF11, R2*b* (now closed), R15*b*, roller 37, "9" hole, brush UB, socket 141, connection 150,

socket 151, relay R37, contacts CF15, impulse distributors CR1 to CR4, to line 160. A parallel circuit from socket 151 connection 152 and socket 153 will at the same time energize relay R13.

Relay R37 controls a delayed operation mechanism to eject the first card when it reaches the stacker mechanism. This will be explained later. Relay R13 closes its contacts R13a to complete a circuit from line 161, contacts CF20, contacts R13a, relay coil RH13 and magnet 33 in parallel to line 160. Coil RH13 has its core common with coil R13 and acts as a holding circuit for the contacts R13a, keeping them shifted after coil R13 is deenergized. Relays of this type are well known and reference to Patent No. 2,987,343, issued to G. Lowkrantz, will show their mechanical arrangement.

Energization of magnet 33 will declutch the picker knife so that during the next cycle as the first card is passing the brushes IB there will be no card passing the upper brushes UB.

During the second cycle as the first card is passing the upper brushes UB, contacts CF25 close as the zone positions 0, 11, and 12 are sensed, completing a circuit from line 161, contacts CF25, upper contacts R14b, relay magnet MCR21 to line 160. Relay MCR21 closes its sets of contacts MCR21a so that as the zone holes are sensed circuits may be completed to control setting of the zone selecting combs in the printing mechanism. A representative zone selecting circuit may be traced as follows: from line 161, contacts CF11, R12b (now closed), R15b, roller 37, zone hole brush UB, socket 141, connection 142, socket 143, contacts MCR21a, zone magnet 111, contacts CF16, contacts CR1 to CR4 to line 160. In this manner the zoning of the type bars for the first card is effected.

After the zone hole positions have passed brushes UB, cam contacts CF26 close to energize relay magnet MCR12 and the consequent closure of contacts MCR12a will complete a circuit, provided a "9" hole has previously been sensed, which is traceable from line 161, contacts CF20, R13a, MCR12a, relays R14 and R15 in parallel to line 160. Relay 14 closes its contacts R14a to provide a holding circuit through contacts CF21 which will maintain relays R14 and R15 energized while the first card is passing the brushes IB.

The first card has now passed the brushes UB and the "name" has been zoned. As this card passes to the brushes IB, card lever 40 closes contacts ICL and causes energization of relays R4 and R5. Relay R4 closes its contacts R4a to provide a holding circuit through contacts ICL and CR23 in parallel. This circuit will be held until the card has passed the brushes IB and will then break if the next card does not follow immediately behind.

With contacts R5b closed, due to energization of coil R5, circuits to the type bar magnets 95 will be completed from line 161, contacts R5b, CF2, roller 38, digit holes in the card, brushes IB, socket 141, connection 144, socket 145, normally closed contacts MCR13a, print magnets 95, contacts CR1 to CR4 to line 160. In this manner the "name" from the first card is listed.

While the zone positions are passing brushes IB contacts CF25 close to energize relay MCR23 through the now closed lower contacts R14b and contacts MCR23a will consequently be closed during this period so that zone selecting circuits will be completed from line 161, contacts R5b, CF2, roller 38, street zone holes, brushes IB, sockets 141, connections 146, sockets 147, contacts MCR23a, zone magnets 111, contacts CF16, CR1 to CR4 to line 160. Thus, during the same cycle that the "name" is listed, the "street" is zoned. At this time, a pair of contacts MCR23b are closed and a circuit will be completed from line 161, contacts CF28, CR27, contacts MCR23b, relays MCR25 and R16 in parallel to line 160. Relay R16 closes its contacts R16b to energize a relay MCR13 and contacts R16a provide a holding circuit from line 161, contacts CF28, contacts 16a, relays R16 and MCR25 in parallel to line 160. Relay MCR13 is held energized through contacts R16b. These holding circuits are maintained throughout the sensing portion of the fourth cycle when the first card is passing the brushes LB. At such time circuits are completed from line 161, contacts CF12, roller 39, "street" perforations, brushes LB, sockets 141, connections 148, sockets 149, contacts MCR25a, left hand contacts MCR13a to magnets 95, thus effecting listing of the "street" data.

While the "street" is being listed, the second card is passing the brushes UB and as before the presence of a "9" hole causes energization of relays R13 and R37 resulting in declutching the picker knife again and the sequence of operations described is repeated with the "state" zoned at the upper brushes and listed at the intermediate brushes. Since there is only one section of the second card to be printed from, there is no zoning of this card at brushes IB and no listing from brushes LB. During the passage of the card by the brushes LB, the platen is spaced and the preprinted heading of the detail items is thus skipped.

As the first card is passing the lower brushes LB there is no card at the brushes IB and consequently contacts ICL are open. However, contacts LCL are closed and with contacts MCR13a closed during this period, contacts ICL are shunted and relays R4 and R5 energized through the second path.

When the first detail card arrives at brushes UB there will be no "9" hole present and so for this and subsequent detail cards, relays R13 and R37 will not be energized and the picker will advance the following cards in succession so that as one detail card is passing the brushes IB the next is passing brushes UB. Each card in turn is zoned at the upper brushes and listed at the intermediate brushes as already explained, and will pass the lower brushes without completing circuits therethrough. The various operations and their sequence are indicated in Fig. 12.

The manner in which the address cards are ejected from the main file will now be explained. As pointed out above, the sensing of a "9" hole by the upper brushes UB will cause energization of relay R37. This will close its contacts R37a and energize the holding coil RH37 from line 161, contacts CF20, R37a, coil RH37 to line 160. CF20 will hold this circuit until near the end of the cycle and before it opens contacts CF26 close to energize magnet MCR12 causing closure of its contacts MCR12b. During the time contacts CF26 are closed, one of the contacts CF37, CF39, CF41 or CF43 will close. The contacts as explained operate at a 1 to 4 ratio with the card feed cycles and are timed so they close in succession, one each cycle so that at any time of closure of contacts CF26, one of these four contacts will also close. Assuming that contacts CF37 close, there will then be a circuit traceable,

provided a "9" hole has caused energization of relay R37, as follows: from line 161, contacts CF20, R37a, MCR12b, CF37, double wound relay R38 to line 160. Relay R38 will close its contacts R38a establishing a holding circuit from line 161, contacts CF45, R38a, holding coil of relay R38 to line 160. This circuit is maintained for over two and a half cycles at which time the leading edge of the card will be at the last pair of feed rollers 36 (Fig. 2). At such time, cam contacts CF49 close completing a circuit from line 161, contacts R38b, eject magnet 59 to line 160. This causes rocking of the deflector plate 48 to direct the card into the eject stacker 51.

There are four sets of circuit delaying relays R38, R39, R40, and R41, each with related holding contacts CF45, CF46, CF47, and CF48 and related tripping contacts CF49, CF50, CF51, and CF52 so that a "9" hole sensed by the brushes UB during any card cycle will cause tripping of the eject stacker deflector plate three cycles later to separate such card from the detail cards.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to a single modification, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention therefore to be limited only as indicated by the scope of the following claims.

What is claimed is as follows:

1. In a machine of the class described, three record analyzing stations, means for feeding a record card past said stations in succession, said card having alphabetic data represented thereon in the form of combinational perforations, printing mechanism for printing upon a bill, means jointly controlled by the first two stations for causing said printing mechanism to print alphabetic data derived from one part of the card and means jointly controlled by the second and third stations for causing said printing mechanism to print alphabetic data derived from another part of the card.

2. In a machine of the class described, three record analyzing stations, means for feeding a record card past said stations in succession, said card having alphabetic data represented thereon by combinational zone holes and digit holes, printing mechanism including zone control devices and digit control devices, means controlled by the first and second stations for controlling said zone control devices and said digit control devices to cause printing of alphabetic data from one section of the card and means controlled by the second and third stations for controlling said zone control devices and said digit control devices to cause printing of alphabetic data from another section of the card.

3. The invention set forth in claim 2 in which the operations are synchronized to cause the second analyzing station to control the zone control devices from one section of the card and concurrently therewith control the digit control devices from another section of the card.

4. In a machine of the class described, three record analyzing stations, means for feeding a perforated record having combinational hole perforations representing alphabetic data, past said stations in succession, printing mechanism for printing upon successive lines of a bill, means controlled jointly by the first two stations for causing said printing mechanism to print alphabetic data upon one line of the bill, data derived from one section of the record card, and means controlled jointly by the last two stations for causing said printing mechanism to print upon another line of the bill alphabetic data derived from another section of the record card.

5. In a machine of the class described, record card analyzing means including three sensing stations, means for feeding a group of record cards comprising detail cards and address cards, each perforated to represent alphabetic data, past said stations, alphabet printing mechanism, means responsive to a special designation on each address card for causing each of said stations to control the operation of said printing mechanism, means for causing only two of said stations to control said printing mechanism for detail cards and means responsive to said special address card designation for causing separation of said address cards from said group of cards after they have been fed past said stations.

6. In a printing machine, a first analyzing station, a second analyzing station, and a third analyzing station, said first and second stations forming a control means for causing alphabet printing, said second and third stations forming a further control means for causing further alphabet printing, printing mechanism, means normally operative for associating said printing mechanism with only one of said control means, and record controlled means for causing the association of said printing mechanism with both of said control means.

7. The invention set forth in claim 6 in which means is provided for causing said printing mechanism to be concurrently controlled by a part of each of said two control means.

8. In a printing machine, a trio of record analyzing stations, means for feeding a record card past said stations in succession, printing mechanism controlled by each of said stations as the card is advanced past the same, a pair of receiving stations for the card, means controlled by the first station for determining to which receiving station the card is to be advanced and means controlled by said determining means for selecting one of said receiving stations to receive the card.

9. The invention set forth in claim 8 in which means is provided and controlled by said determining means for delaying the selection of the receiving station until the card has traversed all of the analyzing stations.

ALBERT W. MILLS.
EDWARD J. RABENDA.
FRANK J. FURMAN.