March 13, 1934. J. W. BRYCE 1,950,476

CARD PERFORATING MACHINE

Filed April 15, 1929 7 Sheets-Sheet 1

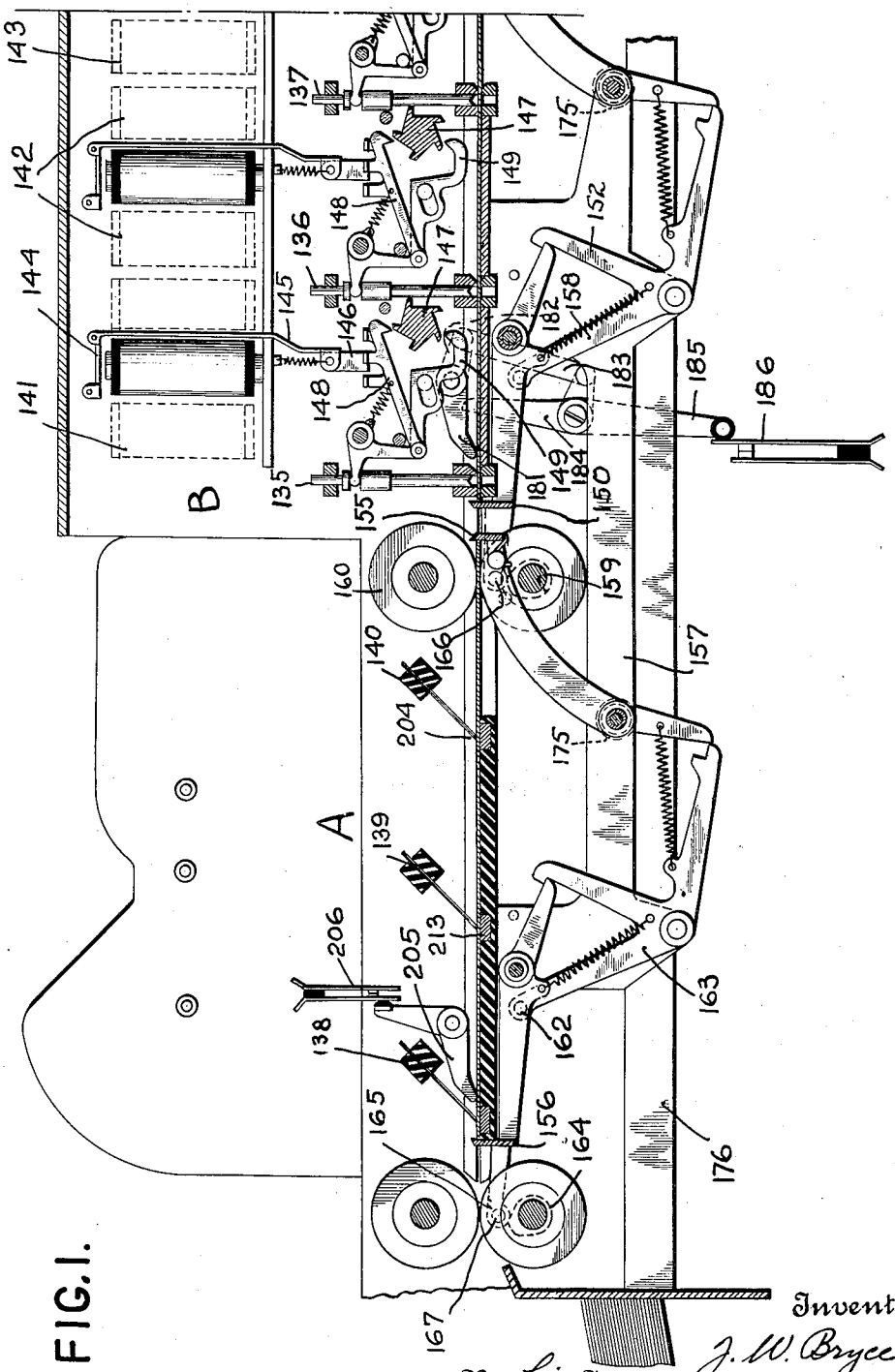


FIG. 1.

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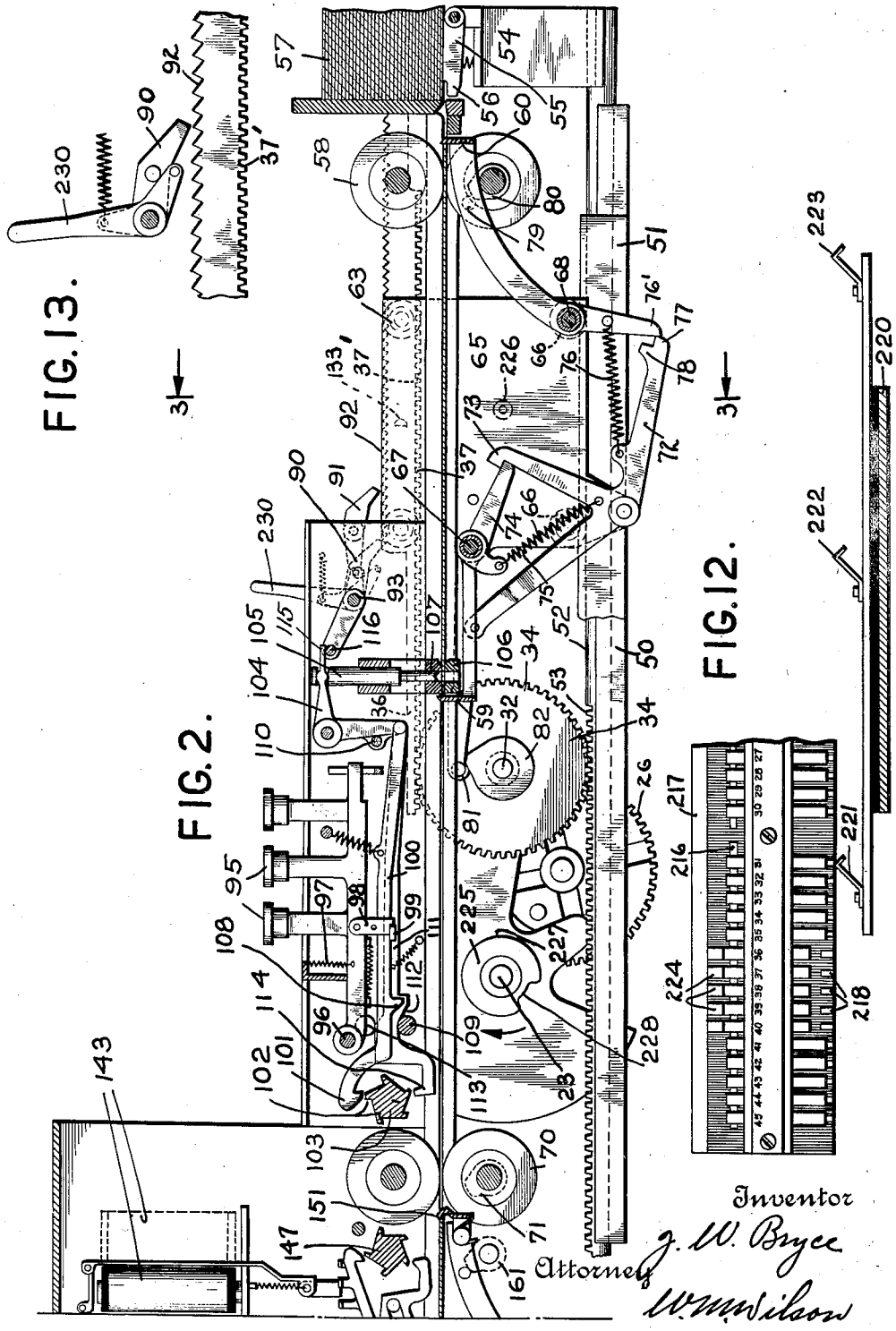


FIG. 13.

FIG. 2.

FIG. 12.

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CARD PERFORATING MACHINE

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FIG. 3.

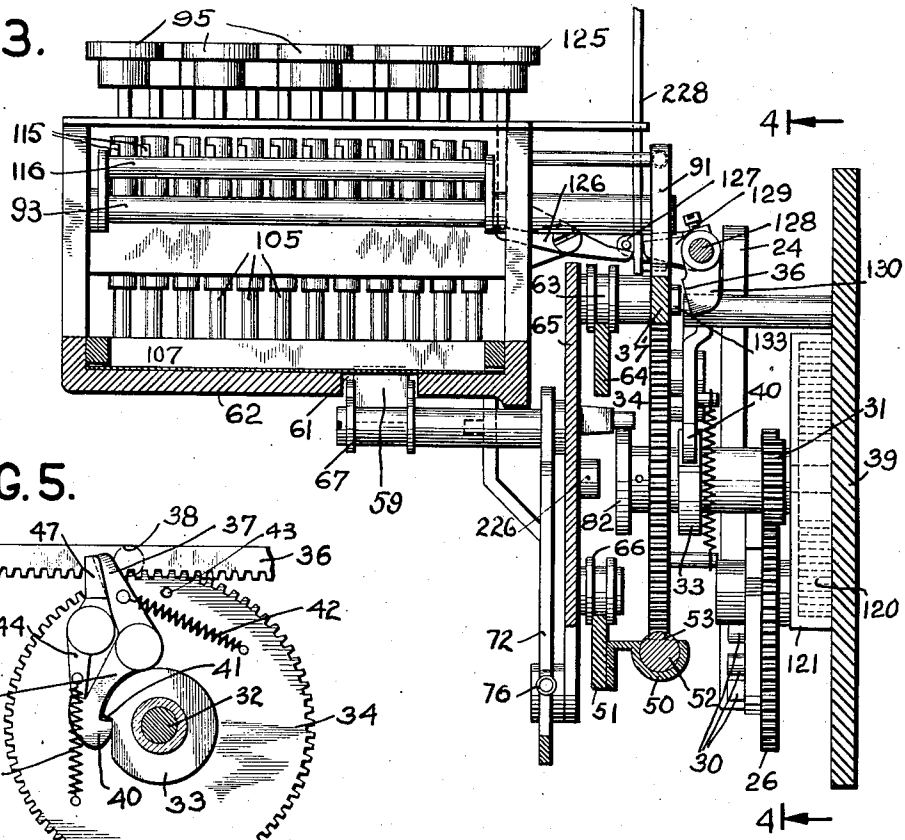


FIG. 5.

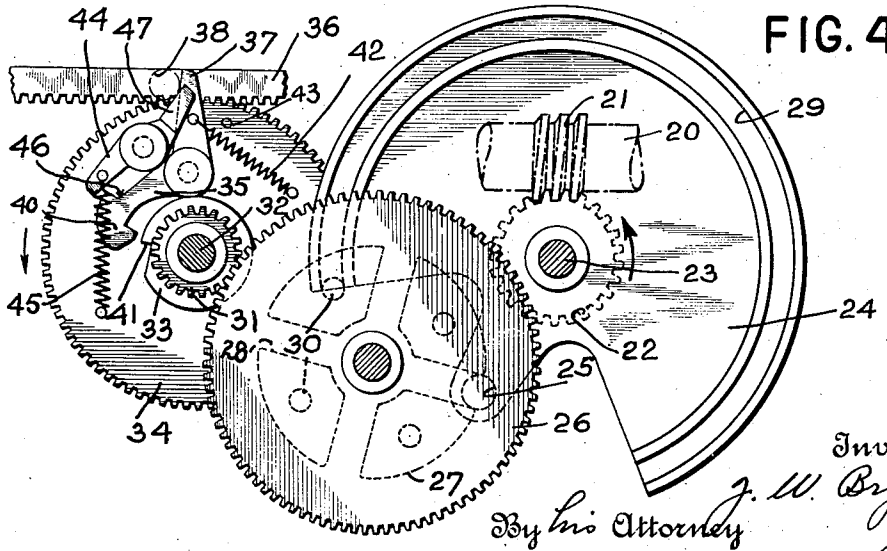


FIG. 4.

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CARD PERFORATING MACHINE

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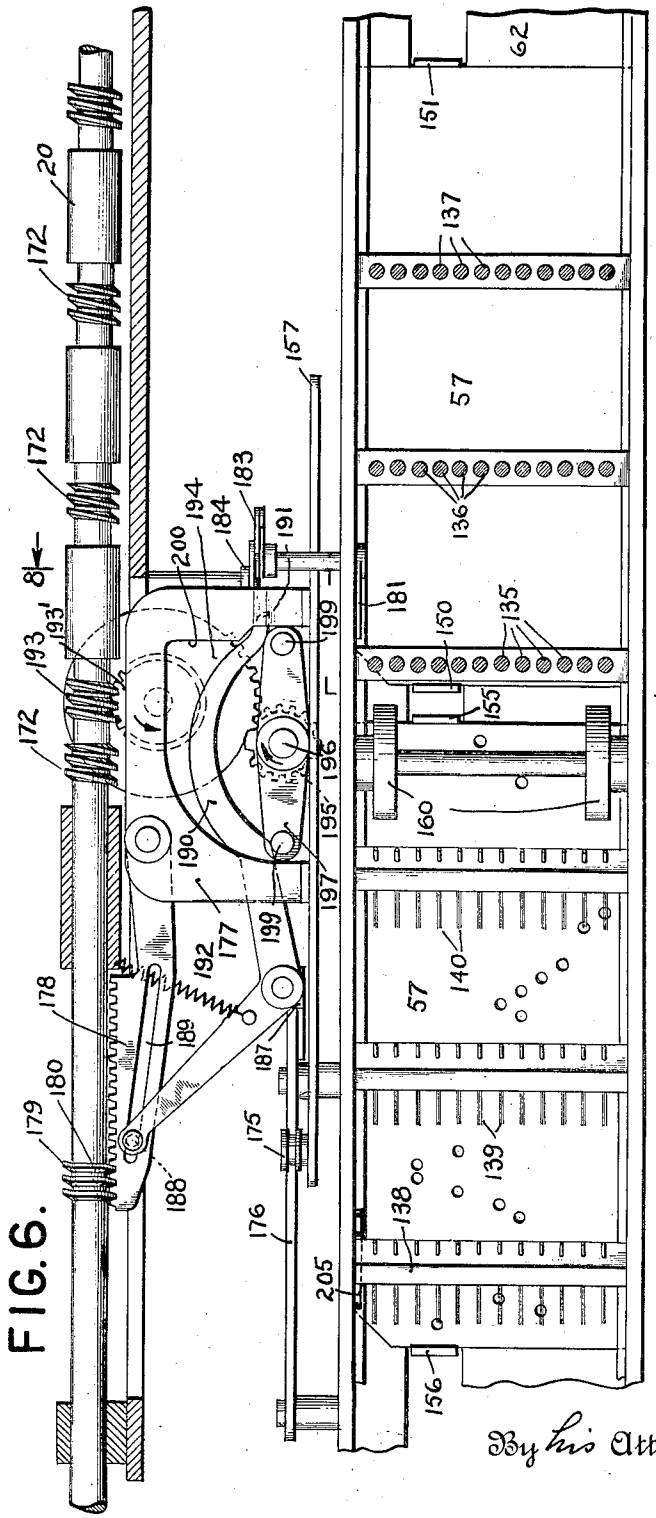


FIG. 6.

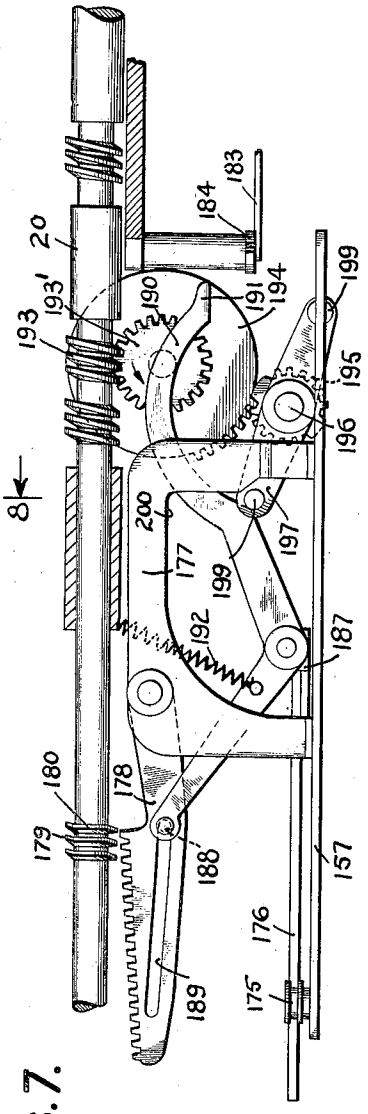


FIG. 7.

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FIG. 8.

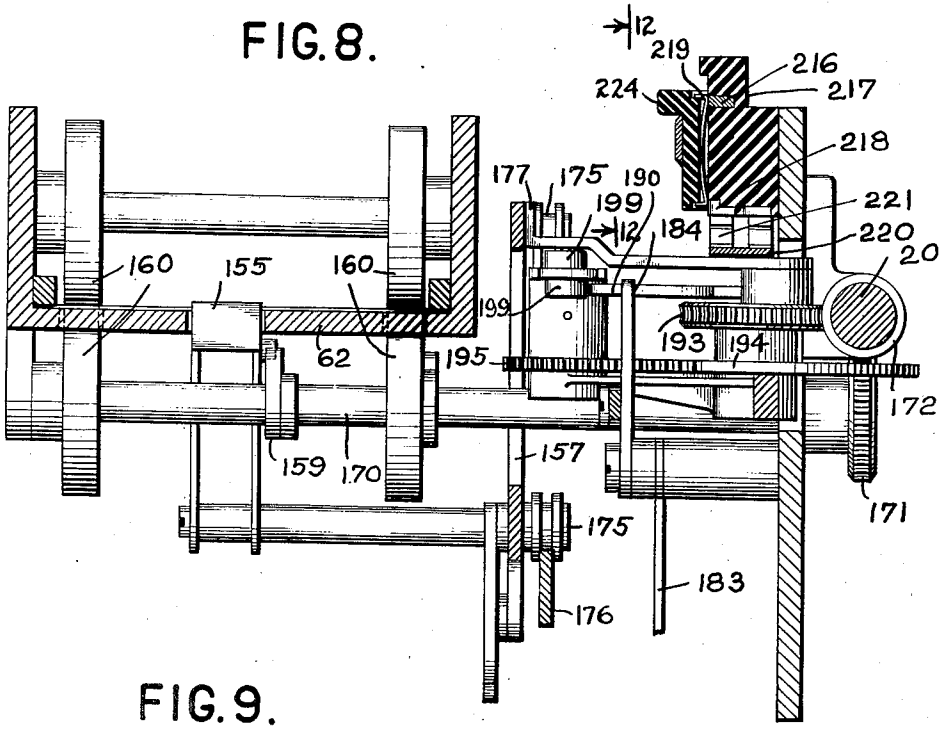


FIG. 9.

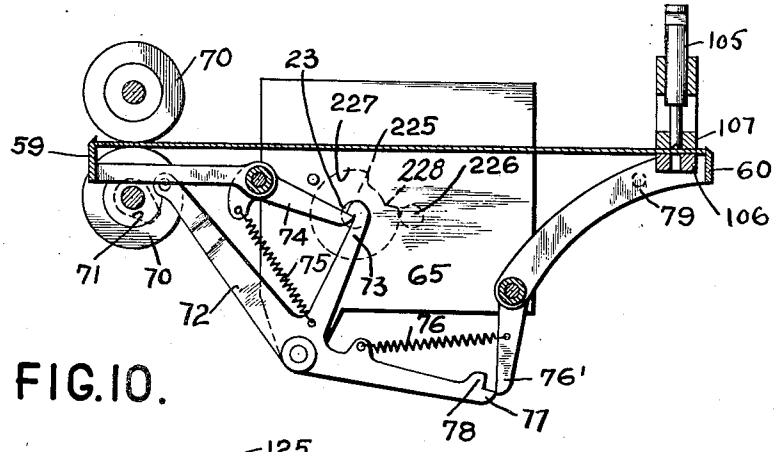
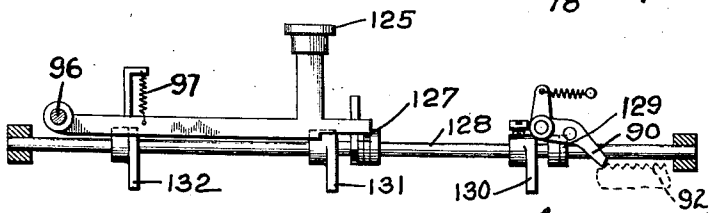


FIG. 10.



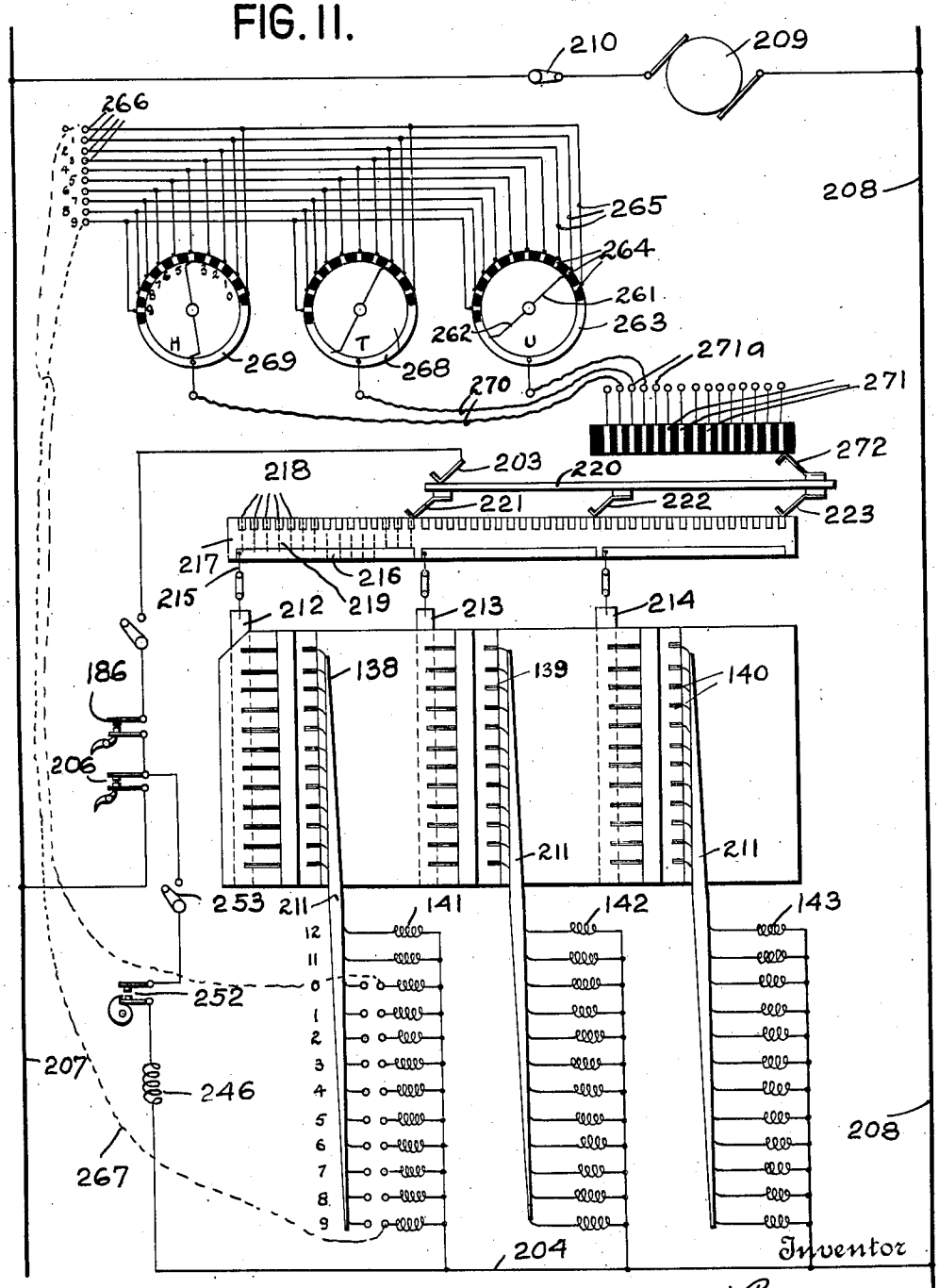
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FIG. 11.



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FIG. 16.

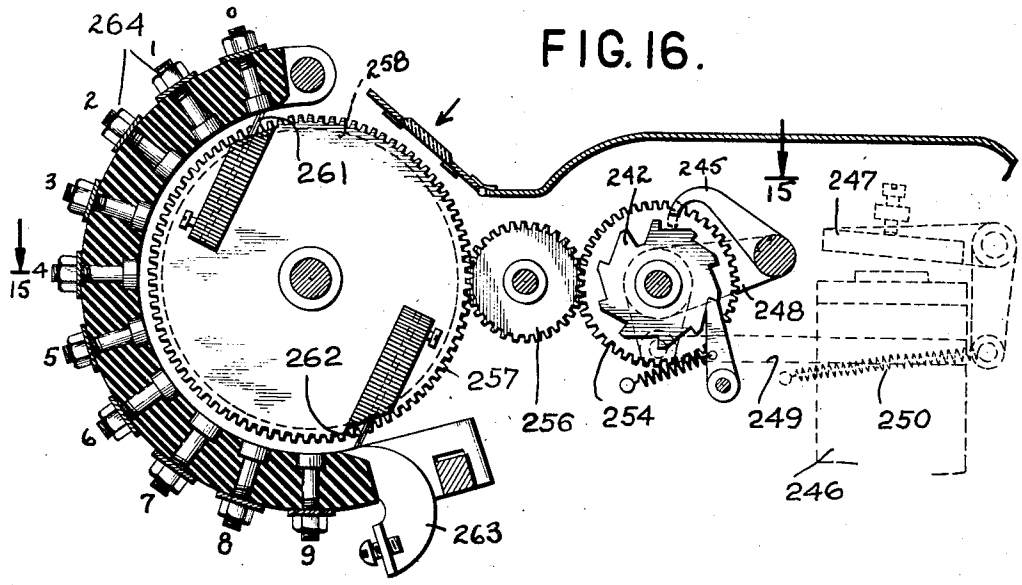


FIG. 15.

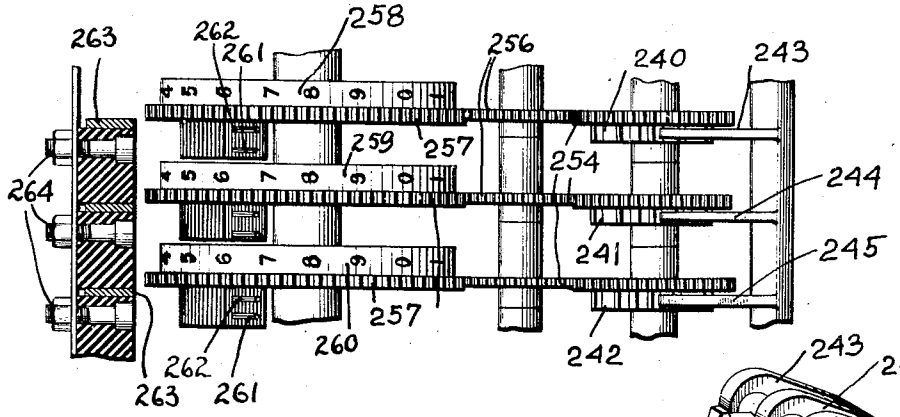
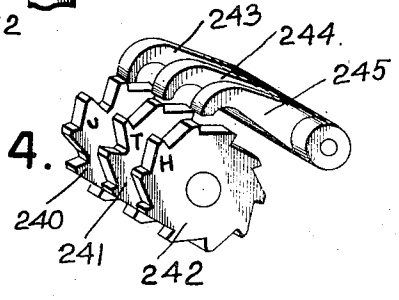


FIG. 14.



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Patented Mar. 13, 1934

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UNITED STATES PATENT OFFICE

1,950,476

CARD PERFORATING MACHINE

James W. Bryce, Bloomfield, N. J., assignor, by mesne assignments, to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application April 15, 1929, Serial No. 355,155

39 Claims. (Cl. 164—113)

This invention relates to machines for punching record cards and more particularly to the type adapted to punch a series of cards, in whole or part, in order to represent a duplicate of a pattern or master card. The purpose of machines of this type is to obviate the necessity of manually punching cards in the columns adapted to represent like data in a series of cards.

It has been proposed heretofore to provide an arrangement whereby a card may be manually inserted in the manual punching section of the machine to be completely punched to represent by perforations the data which is invariable with respect to a series of cards and the particular variable data of that card. Immediately thereafter the card is fed to the analyzing section of the machine whereby the perforations of certain of the columns of the card just punched are read. This reading is adapted to control the operation of the punches automatically to effect a repetition of certain punchings of the first card upon the following card. In this manner each card acts as pattern or master card for each succeeding card.

In the present invention one object is to provide means for feeding cards automatically in succession from a supply hopper to the manual punching section obviating the necessity of introducing the cards manually making the machine quicker in operation.

Another object of the present invention is to provide an automatic punching section having punches which are entirely distinct and separate from the punches which effect the manual punching of the card.

With respect to the automatic punching section of the machine which in the present embodiment, comprises an analyzing station and a punching station controlled thereby, it is an object to provide a plurality of rows of analyzing brushes and a corresponding row of punches the effect of which is to speed up the automatic punching operations.

To this end each analyzing station and punching station is coordinated with a certain section of the card and by providing a plurality of rows it will be observed that intermittent feeding of the card to completely punch the latter will be reduced fractionally and in accordance with the number of rows provided. In the present instance, three rows of punches and analyzing brushes are provided, the first row being correlated with columns 1–15, the second row with columns 16–30 and the third with columns 31–45 of a 45 column record card. Thus fifteen steps of movement are required to completely analyze and punch a card since each row works independently upon its correlated section of record card. Obviously the operation of the machine is speeded up by the employment of this arrangement.

It is a further object of the present invention to provide means whereby a manually punched card is not released so as to be fed to the automatic punching section until the latter is in condition to receive it. While, in general operations of the machine, the speed of automatic punching is greater than the manual punching the above provides a desirable and valuable adjunct to the machine.

It is a further object of the machine to provide means whereby cards may be fed in succession through the automatic punching section for the purpose of effecting repetition work in selected columns when manual punching is not required.

It is a further object to provide means whereby cards may be fed in the manner above described and perforated to represent serial numbers and in connection with the means provided to represent serial numbers by perforations it is a still further object to permit such perforations to be made in combination with either the invariable or variable data representing perforations or both.

In the appended drawings:

Figs. 1 and 2 taken together represent a longitudinal sectional view of the assembled punching machine.

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2.

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 3.

Fig. 5 is a view similar to Fig. 4 but shows some of the parts in different positions.

Fig. 6 is a top plan view of a part of the machine shown in Figs. 1 and 2.

Fig. 7 is a view similar to Fig. 6 but shows some of the parts in different positions.

Fig. 8 is a sectional view taken on the line 8—8 of Fig. 6.

Fig. 9 is a view in side elevation of one of the card carriages and the manner in which it is coordinated with a protective feature of the machine.

Fig. 10 is a view illustrating the carriage tabulating mechanism.

Fig. 11 is a diagram of the preferred electrical circuit connections of the punching machine.

Fig. 12 is a view in side elevation taken on the line 12—12 of Fig. 8.

Fig. 13 is a detail view of the selective means

provided to render the escapement mechanism inoperative.

Fig. 14 is a perspective view of a portion of the consecutive numbering control device.

Fig. 15 is a plan view taken on the line 15—15 of Fig. 16.

Fig. 16 is a view in side elevation of the consecutive numbering control device.

Power for driving the mechanisms of the machine is derived from a constantly rotating shaft 20 (Fig. 4) having a worm 21 in mesh with a worm gear 22 fast to a shaft 23. Secured to shaft 23 is an actuating disk 24 which has an integral extension carrying a pin 25. Secured to the face of a gear 26 are a plurality of segments 27 spaced apart to form radial slots 28 in which the pin 25 is adapted to enter as the disk 24 turns in a counterclockwise direction and thus drive the gear 26 in a clockwise direction. At other times a guide slot 29 of disk 24 is adapted to engage a pair of diametrically opposite pins 30 thus providing a Geneva lock for the gear 26. The gear 26 is in continuous mesh with a pinion 31 loose on a shaft 32 and to which is secured a notched clutch element 33. Mounted on stub shaft 32 is a gear 34 carrying a clutch pawl 35. Fig. 4 illustrates the position of the parts at the beginning of the manual card punching operations after which a rack 36 is stepped along in increments driving the gear 34 in a counterclockwise direction as viewed in Fig. 4. In this position of the parts it will be seen that the tail 37 of pawl 35 has engaged a stationary pin 38 secured to the side frame plate 39 disengaging the hooked portion 40 of pawl 35 from the notch 41 in disk 33. As the gear 34 is driven in a clockwise direction (Fig. 4) the tail 37 will leave the pin 38 permitting a spring 42 to rock the tail against a stop pin 43. Upon the completion of the intermittent stepping of gear 34 which is coincident with the termination of manual card punching operations the opposite side of the tail 37 will strike the pin 38 (see Fig. 5) rocking pawl 35 so that its hooked end 40 engages the notch 41. At this time a pawl 44 urged by spring 45 will cause its engaging end to engage a shoulder 46 of the pawl 35 firmly holding pawl 35 and clutch element 33 in a driving relationship. As the gear 31 and clutch element are driven in the manner previously described gear 34 will be driven in a counterclockwise direction thus shifting rack 36 to restore the card carriage to its normal position. At the termination of the counterclockwise movement of gear 34, a tail 47 of pawl 44 will strike pin 38 disengaging pawl 44 from the shoulder 46 of pawl 35, after which pawl 35 itself will be rocked to disengage its hooked end 40 from the notch 41 in the clutch element 33 see Fig. 4.

Summarizing, it will be clear that the end of the step by step movement of the card carriage will bring the clutch elements to a driving connection to permit the driving means to restore the card carriage and to cause the feeding of a record card from the stack in a manner now to be described.

Slidably mounted in a tube 50 (Fig. 3) attached to a fixed guide rail 51 is a rod 52 having rack teeth 53 projecting through a longitudinal slot in tube 50 said rack teeth meshing with the gear 34. The rod 52 carries a plate 54 (Fig. 2) on which is mounted a picker 55, a shoulder thereof 56 being adapted to engage the edge of lowermost card of a stack 57 when the rack 52 is at its extreme position to the right to thus feed a card to a pair of feeding rollers 58 when the rack is restored to the left by the drive gear 34. The rollers 58 may have any suitable driving connection to the shaft 20 for continuously rotating them. The rollers are separated by a distance substantially equivalent to the thickness of a card to permit the card to be driven by frictional contact but permits the card to be held between a pair of bail members 59 and 60 which constitute the card carriage and which steps the card along in accordance with manual punching operations. As best shown in Fig. 3 the members 59 and 60 project through a longitudinal slot 61 formed in a table 62 to thus step the card along the table.

Fixed to the rack 36 by studs are guide rollers 63 (Figs. 2 and 3) rolling over the upper edge of a guide plate 64. The pivot studs of the rollers 63 are connected to a plate 65 also carrying guide rollers 66 rolling over the guide plate 51 hereinbefore referred to. The card engaging yoke member 59 is pivoted to plate 65 by a pivot stud 67 while the companion yoke member 60 is pivoted to the pivot stud 68 (Fig. 2) of one of the guide rollers 66.

At the completion of the manual punching operation the carriage will have assumed the position shown in Fig. 9, the card having been fed between pairs of feeding rollers 70 which are ineffective to feed the card by frictional contact therewith since the card is firmly held between the members 59 and 60. When the card is in the position shown in Fig. 9 a cam 71 rotatable with lower roller 70 engages a pin carried by a triple armed member 72 pivoted on plate 65. This rocking movement disengages hooked end 73 of one of the arms of member 72 from a tail 74 of yoke member 59 permitting a spring 75 to rock the same and free it from the front edge of the card. The rollers 70 thereupon automatically feed the card to the automatic gang punching section. The member 60 is urged by a connected spring 76 so that it is held in engaging relationship with the card by the coaction of a tail 76' with the extreme end 77 of one of the arms of member 72. When the triple armed member 72 is rocked as aforesaid, the spring 76 will be free to rock bail 60 out of card engaging position until it is stopped by the engagement of the tail 76' with a stop shoulder 78 of member 72. When members 59 and 60 are both in their lowermost position to release the card the card carriage is automatically shifted to the right to approach the position shown in Fig. 2. As it assumes this position a pin 79 carried by one of the yoke arms of member 60 will be engaged by the high point of a cam 80 rotatable with the lower feeding roller 58. At the same time a pin 81 (Fig. 2) carried by an integral extension of member 59 will be engaged by the high point of a cam 82 rotatable with gear 34. The triple armed member 72 rocked by the restoration of tail piece 74 will then hold members 59 and 60 in latched position. It will be understood that the picker and shuttle carriage have reverse reciprocating movements so that when the picker is feeding a card from the stack 57 the carriage is moving reversely to receive the card feed. The rollers 58 feed the card over the table whereupon the clips 59 and 60 close upon the card to hold it firmly therebetween.

Intermittent movements of the carriage are coincident with manual punching operations and are effected by the usual escapement mechanism and in the preferred embodiment comprises a pair of escapement dogs 90 and 91 (Fig. 2) which coact with ratchet teeth 92 of the rack 37'. These

escapement dogs are alternately operated by a rock shaft 93 as an incident to each punching operation.

Any suitable mechanism may be provided whereby certain card columns may be manually punched to take care of the variable data to be represented in the cards. The form preferably employed comprises that shown in the application of A. W. Mills, Serial No. 40,714, filed July 1, 1925 (now Patent No. 1,845,001) to which reference may be had for complete details. However sufficient description will be given to understand the operation of this part of the machine and its coordination with the automatic gang punching unit. The punch keys are represented by numeral 95 (Fig. 2) and are pivoted upon a rod 96 and are each depressed against the action of a restoring spring 97 so that a dog 98 carried by the related key co-operates with a lug 99 of a secondary actuator 100. This brings the toothed portion 101 in position to be engaged by one of the teeth 102 of a fluted bar 103. The latter has a connection to any of the constantly rotating parts of the machine so that as it rotates in a counterclockwise direction it will draw the secondary actuator to the left and through a bell crank member 104 force the corresponding punch 105 through the card to be punched. The punch, of course, passes through perforations formed in a die plate 106 and a stripper plate 107 spaced apart to permit the passage of a card therebetween.

As the secondary actuator 100 is shifted to the left a cam edge 108 will engage a stationary rod 109 camming the actuator upwardly and the lug 99 will be drawn out of cooperation with the notch in the dog 98, positively withdrawing the secondary actuator out of cooperation with the main actuator, and this disengagement will be effective irrespective of any maintained depression of the key 95.

Pivotally mounted for engagement and actuation by any one of the bell cranks 104 is a restoring rod 110 so that operation of a punch will displace the rod 110 to the left and will cause a corresponding shifting movement of a restoring member 111 so that by cam edges 112 engaging the rods 109 and 113 will cause the hook or tip 114 of the restoring member to be displaced to such position as to be engaged by an oncoming tooth 102 of the main actuator 103, lagging behind the engagement of the main and secondary actuations at a time in operation equivalent to a half tooth cycle. After engagement has taken place rotation of the main actuators thrusts the restoring member to the right, restoring rod 110 and thus positively actuating the operated bell crank to positively restore the punch or punches that have been displaced. At the end of this restoring movement it is understood that the restoring member is positively disengaged from the main actuator by cam devices 112, 109 and 113. Each of the bell cranks 104 is provided with an extension 115 engaging over a rod 116 of an escapement paw operating bail attached to rod 93, so that alternating operations of pawls 91 will permit the usual escapement of the card carriage. The carriage is impelled by the usual coil spring 120 (Fig. 3) wound in a drum 121, one end of the coil spring having a connection to the shaft 32.

At the usual starting of manually punching a number of cards it is necessary, of course, to provide for the positioning of the first card in the card carriage. Upon the passage of the last card through the manual punching devices the carriage will be restored to normal ready to receive a card but in the absence of a card in the hopper the carriage will be empty at the start of a new set of punching operations. Initial feeding of a card can be provided for by operating any punch key intermittently but to obviate such an undesirable and tedious operation a special key has been provided to permit the carriage to jump in steps, instead of a long jump under action of spring 120.

The special space key 125 (Figs. 3 and 10) is similar to a punch key and operates a bell crank 126 (Fig. 3) in engagement with a lever 127 secured to a rock shaft 128. The shaft 128 (Fig. 10) carries a lever 129 in engagement with the escapement pawl 90 to disengage the pawls from the escapement rack 92. Secured to rock shaft 128 are a plurality of stop levers 130, 131 and 132 (Figs. 3 and 10). The initial depression of key 125 will rock lever 129 to render the escapement device ineffective permitting the carriage to jump under the action of spring 120 until the pivot stud 133 of one of the rollers 63 strikes the lever 130 which has been brought into the path of the stud by the depression of the key 125 after the escapement device has been rendered ineffective. As the key is returned to normal one of the pawls of the escapement device will engage the ratchet teeth 92 prior to the disengagement of lever 130 and stud 133. In a similar manner levers 131 and 132 permit the carriage to escape in accordance with successive manipulations of space key 125. When the carriage assumes a position corresponding to punching of the last card column, the relative positions of the clutch devices will be as shown in Fig. 5, permitting the next intermittent movement of the driving element to shift the card carriage reversely to receive the first card fed from the hopper by picker member 55.

After the manual punching of certain card columns the card is presented to the automatic gang punching unit to provide for gang punching the remaining card columns reserved for representing in variable data. The first card presented to the manual punching mechanism is manually perforated in its entirety in order that with respect to the invariable data it may in effect be a master or pattern card for the next card introduced to the gang punching mechanism.

Outlining the gang punching parts of the machine, in general, it will be observed that it comprises two sections, an analyzing section A (Figs. 1 and 2) controlling the punching section B. As shown, the punching section comprises three sets of equally spaced punches 135, 136 and 137 correlated with the related sets of analyzing brushes 138, 139 and 140 similarly spaced. When a card is in its initial position to be punched the sets of punches are correlated with certain card columns. For 45 column Hollerith cards, the starting position of a card will have columns 1, 16 and 31 correlated with the sets of punches. The second step of the card will effect the registration of columns 2, 17 and 32 with the sets of punches, and so on, so that but fifteen steps of movement of the card are required to completely punch the card. Since the analyzing brushes are similarly spaced the required feed of the card to analyze a pattern card is precisely the same. Each card presented to the analyzing section acts as a master card for the succeeding card and in the embodiment shown the cards are fed in unison so that the presentation of a perforation to an analyzing brush will cause the actuation of the corresponding brush

to produce a duplicate perforation in a corresponding column in a succeeding card.

Considering the gang punching section of the machine, the details of construction and operation of the punches are similar to the manual operated punches with the exception that the punches are controlled by a series of magnets, one for each analyzing brush of each set. Since there are twelve index points for each column, a similar number of brushes and punches are provided. The sets of magnets 141, 142 and 143 of twelve each are associated with the related sets of punches 135, 136 and 137 respectively. When any magnet is energized its related armature 144 (Fig. 1) is attracted resulting in a depression of the actuator member 145 carrying a pawl 146 similar to pawl 98 of the manually operated punching device. The other parts are similar and comprise a primary actuator 147, a secondary actuator 148, and a restoring member 149 all operating in the manner previously described.

To carry the card to be punched under the punches a card carriage comprising carriage clips 150 and 151 is provided, both associated with a latching member 152. It will be observed that these parts are similar to the parts previously described in connection with the manual punching device, the exception to be noted being that the clip 151 is yieldingly mounted to yield and snap behind a card when the latter is fed by rollers 70. This construction is desirable as the carriage may not be in its normal starting position prior to the feeding of the card from the manual punching section.

For the purpose of carrying the record card through the analyzing section an additional set of clips 155 and 156 are provided and are just forward of the clips 150 and 151. The two carriages are mounted upon a carrying plate 157 which is given an intermittent movement carrying the cards in unison through the punching and analyzing mechanisms. When the clips are in their forward positions, coincident with the last step of movement of the cards, they are unlatched by cam devices operating in a manner previously described and with respect to clips 150 and 151 is effected by the coaction of the arm 158 with a cam 159 rotatable with the lower one of a pair of feeding rollers 160. When the clips release the card, the rollers 160 feed the card from the punching to the analyzing section. The clips 150 and 151 are restored to their normal relatched position when they are brought to their normal starting position by cams 159 and 161. The card held by the clips 155 and 156 is released when a pin 162 carried by an arm of latch member 163 engages a cam 164 rotatable with one of a pair of feeding rollers 165, which latter then feeds the card just analyzed to a receiving hopper. The clip 155 is restored to its normal position when a pin 166 engages the cam 159 and clip 156 is restored when a pin 167 carried by the extension thereof engages the cam 164. Clip 155 is yieldingly mounted to permit a card to be fed between clips 156 and 155 if the latter is restored upwardly before a card reaches and engages clip 156.

Fig. 8 incidentally, illustrates the preferred manner of driving the various feeding rollers. In connection with the pairs of feeding rollers 160 it will be seen that the shaft 170 driving the lower rollers 160 has secured thereto a worm gear 171 in mesh with a worm 172 secured to the drive shaft 20. The rollers 165 are preferably driven at a higher speed of rotation than the rollers 160 to quickly eject the card when released by the clips 155 and 156. Subsequent to this the card carriage is restored, the rollers 160 feeding the card thereto so that substantially at the time the card is beneath the analyzing brushes the clips 155 and 156 will be restored to engage and hold the card.

The plate 157 is guided for a longitudinal movement by rollers 175 (Figs. 6 and 8) rolling over fixed rails 176. Secured to the plate 157 is a bracket member 177 on which is pivotally mounted a rack plate 178 having worm teeth adapted to engage the special worm teeth 179 of worm shaft 20. When the worm teeth of plate 178 engage the worm teeth 179 the card carriage will be shifted slightly until the flattened portion 180 of the worm teeth break the driving engagement. The card carriage will thereupon be stationary to permit punching of the card until the circular worm teeth 179 reengage the worm teeth of the plate 178 to effect a subsequent intermittent movement of the card carriage. The driving connection for driving the carriage is effected whenever a card is presented to the gang punching station and is preferably controlled by the following means.

Located above the card table and projecting downward so as to contact a card is a card lever 181 (Figs. 1 and 6) connected by a link 182 to a second bell crank lever 183 having a stop extension 184 and a contact controlling portion 185 adapted to close contacts 186 when a card engages the lever 181 and rocks the same. A bell crank lever pivoted to a bracket 187 attached to guide rail 176 has a pin 188 at the extremity of one arm thereof engaging a slot 189 formed in rack plate 178. The other arm of the bell crank has a curved portion 190 and a tip 191.

The bell crank is free to be rocked about its pivot by a spring 192 when the stop portion 184 of lever 183 is brought out of the path of the tip 191 as an incident to the presence of a card in the punching station, permitting the spring to rock the plate 178 upwardly into a driving engagement with the worm 179, 180. If a card fails to feed to the punching station the stop 184 will be in the path of tip 191 preventing a driving engagement between the card carriage and the driving parts of the machine. In mesh with a worm 193 is a worm gear 193' to which is attached a mutilated gear 194 the teeth of which mesh with one of two sets of teeth of a mutilated pinion 195 pinned to a shaft 196. The design of the parts is such that each revolution of gear 194 will effect a complete rotation of pinion 195. Secured to shaft 196 is a double lever 197 having at its extreme ends a pair of studs 199 each of which passes through the lever 197 so that one part of the stud 199 is in the plane of the curved extension 190 while the other part of the same stud is in the plane of the bracket plate 177 and adapted to engage an edge 200 of a notch therein to return the card carriage to its normal position.

When the teeth of the mutilated gear 194 (Fig. 7) engage the teeth of the mutilated pinion 195 they will turn the arm 197 from a horizontal position, one end of stud 199 engaging the curved extension 190 rocking the bell crank and withdrawing the rack 178 out of driving engagement with the worm teeth 179, 180 at the end of the feeding movement of the carriage. Thereafter the other end of the stud 199 will engage the edge 200 to quickly shift the carriage reversely, one end of the stud 199 contacting with the underside of the curved extension 190. As the stud 199 leaves the tip 191 the spring 192 will be effective

to cause a subsequent engagement of worm 179, 180 and rack 178 if the arm 184 is out of stopping position as determined by the presence of a card in the punching section (see Fig. 6). If a card should not be fed to the punching station the arm 184 will stop the movement of the bell crank to prevent a driving engagement to feed the card carriage.

A supplemental card lever 205 (Fig. 1) associated with the analyzing section of the machine is adapted to close contacts 206 when a card is in this section. Referring to the circuit diagram it will be observed that current for the electrical instrumentalities is supplied by line wires 207, 208 to energize the driving motor 209 when a switch 210 is closed. Considering for the purpose of explanation a single punching and analyzing station, current is supplied to the magnets 141, 142 and 143 for example, by a wire 204, each set of magnets being serially connected to their related sets of brushes 138 by a cable wire 211. The brushes 138, 139 and 140 bear against their related contact bars 212, 213 and 214. Associated with each set of brushes and magnets are cut-out devices which prevent the actuation of a punch in any column representing by perforations therein the variable data or that manually punched, otherwise each card would be punched like the preceding. The preferred means is described as follows:

The bar 212, for example, is connected by a wire 215 to a contact plate 216 of a stationary commutator bar 217. Each of the commutator bars 218 is selectively connected to the plate 216 by adjustable spring contact plates 219. Supported by the card carriage is a plate 220 carrying a plurality of brushes 221, 222 and 223 and against which bears a brush 203 in any position of the plate 220. Column cut-out is effected by manipulation of bars 224 (Fig. 8) which shifts the related plate 219 and disconnects the bar 216 from the related segment 218 when pushed upwardly as viewed in Fig. 8.

By selectively manipulating the bars 224 appropriated to the different card columns, certain of the columns related to the variable data may be cut out of circuit connection with the related punch magnet even though a perforation should be present in the column or columns cut out. In practice the first card is punched completely, that is to represent the variable data of that particular card and the invariable data, the latter for example representing dates, districts, states, etc., which is to be the same for all cards.

The card columns relating to the invariable data are selected in order that the next and succeeding cards may be punched to represent the same data indicated on the first card. The variable data to be punched usually comprises more columns than the invariable data so that the time required for manual punching is ordinarily greater than the time required for automatic punching of the invariable columns so that the carriage associated with the automatic punching will usually be in its retracted position prior to the time the next card to be automatically punched is released after having been manually punched in certain columns. Since the automatic punching is far quicker than manual punching the number of columns that are required to be automatically punched may greatly exceed the number of columns to be manually punched. It is desirable to employ "skip bars" in order that during manual punching operations the card carriage may automatically skip the columns to be subsequently automatically punched. Thus it may be possible for the operator, under certain conditions, to release a manually punched card before card carriage 150—151 is in retracted position. Such a possibility may be eliminated by attention of the operator to the position of carriage 150—151 who under the circumstances holds up the punching of the last column but to take care of such a condition automatically the following mechanism is employed.

Secured to the shaft 23 is a disk 225 (Figs. 2 and 9) in the plane of a pin 226 secured to the carriage 65. The disk 225 may be defined by a concentric part 227 and a notch 228. It will be remembered that shaft 23 is driven by the worm shaft 20 and referring to Fig. 7 it will be observed that the mutilated gear 194 is also driven by the worm shaft 20. Recalling that the teeth of mutilated gear 194 are the means for restoring clip carriage 150—151 it will be observed that a certain relationship exists between the teeth of gear 194 and the notch 228 of disk 225.

The notch 228 is so positioned that the pin 226 may enter the same only when the teeth of gear 194 are restoring carriage 150—151 and 155—156 and since at this time the card has been released from the punching station, carriage 59—60 may take the last step of movement so that cam 71 (Fig. 9) is in the range of the pin carried by one arm of member 72 to release the card which has just been punched manually which thereafter is fed to the automatic punching station by rollers 70. The concentric part 227 of disk 225 contacts with pin 226 to prevent release of the manually punched card during the time the card carriages 150—151 and 155—156 are stepped during the automatic punching operation during which time, of course, the manually punched card should not be fed thereto.

It is desirable at times to permit cards to be automatically and successively fed through the machine in order that a series of them may be punched similarly and without being perforated by the manually operated punches. As a simple and effective means for controlling the machine to adapt it for this type of operation a lever 230 (Fig. 13) is provided and when shifted and locked in its position of adjustment will retain pawls 90—91 removed from cooperation with the escapement teeth 92. The carriage 59—60 is permitted to assume its extreme position at the left under control of the escapement spring by successive depressions of the space key 125. When in this position the carriage will automatically be retracted by the clutch mechanism to receive the first card fed from the stack. This card may contain the perforations it is desired to duplicate or it may then be manually punched in the manner previously described. Since lever 230 is adjusted to render the escapement mechanism ineffective the carriage 59—60 will be shifted to the left by the escapement spring 120.

On account of the coordination between the carriages of the manual and automatic punching sections the card will be released from the former section and fed to the latter. When the first card finally reaches the analyzing section it will control the punches of the automatic section to thereby duplicate the punching of the successively fed card. This action is repeated so that a series of cards may be punched in duplicate and without any attention of the operator since the cards are successively and automatically fed from the card hopper.

It is sometimes desirable to automatically

punch cards to indicate serial numbers either with or without the manual or automatic punching of numbers. A mechanism provided for this purpose is shown in Figs. 14, 15 and 16 wherein it will be observed that the control device comprises a series of wheels 240, 241, 242 of successive denominational orders and which are adjusted differentially by a series of pawls 243, 244, 245 of successive length. The pawl 245 for example, when reciprocated rotates the units wheel 242 a unit and when a complete revolution has been effected the pawl drops in a deep notch which permits the adjacent pawl 244 to step the next higher order wheel a notch. Such numbering wheels and transfer devices are well known in the art and need not be explained in further detail.

The preferred means for reciprocating the bail comprises a magnet 246 which attracts its armature 247 when it is energized thus rocking the pawl carrying member 248 through a link 249, restoration of the parts being effected by a return spring 250. As shown in the circuit diagram magnet 246 is in serial connection with cam contacts 252 a switch 253 and card lever contacts 206. It will be observed that in the connections shown the magnet will be energized each punching operation of the machine if switch 253 is closed, since cam controlled contacts 252 are closed at each punching machine operation. The energization, however, is also dependent upon the closure of contacts 206 which depend upon their closure upon the presence of a card in the analyzing section.

Rotatable with the several wheels 240, 241 and 242 is a series of gear wheels 254 adapted through idler pinions 256 to set gear wheels 257 to each of which is secured a series of indicator wheels 258, 259 and 260 to visibly indicate the relative positions of notched wheels 240, 241 and 242.

The gear wheel 258 for example carries a pair of brushes 261, and 262 which are electrically connected by a suitable wire. The brush 262 is adapted to engage a conducting segment 263 (Fig. 11) while the brush 261 successively contacts a plurality of segments 264, the particular one in contact depending upon the standing of the units counter wheel 240. Each of the segments 264 have wire connections 265 to plugs 266 which may be plugged up to the related magnets 141, for example, by plug connections 267. A similar commutator device is provided for the tens and hundreds counter wheel so that the segments that are connected to the various magnets depend upon the standing of the respective counter wheels. Further, it will be observed that the conducting segments 263, 268 and 269 are connected by plug connections 270 to certain ones of a series of stationary segments 271. A contact plate 272 movable with the card carriage is adapted to successively contact said segments as the carriage is intermittently stepped.

If, for example, it is desired to punch serial numbers in certain columns the series of punch magnets 141, 142 and 143 will be selected by plug connections 267 with respect to the section in which the columns are. If the columns selected are between 1–15 inclusive, magnets 141 are plugged to the numbering devices—between 16–30 inclusive, magnets 142 are selected and for columns 31–45 in the last section magnets 143 are utilized. The plug connection 271*a* is made in accordance with the desired columns of the section selected.

When contact plate 272 contacts the segments 271 shown plugged to the commutator device, a closed circuit connection will be made to certain magnets of set 141. For example, if the reading of the commutator device is "421" as shown in Fig. 11 and the connections made as shown, contact plates 219 of the columns contacted by the brushes 221 (Fig. 11) simultaneously with the brush 272 and segments 271, are first adjusted to ineffective position.

When contact plate 272 contacts the first segment 271 a connection is made from line wire 207, card lever contacts 206, 186, brush 203, plate 220, brush 272, the segment 271 leading to the "1" segment 264 which has a plug connection to the "1" magnet 141 through wire 204 to the line side 208. Energization of the magnet mentioned will actuate the punch at the "1" position of the column under the series of punches 135. Upon the next step of the carriage the "2" punch magnet 141 will be energized, then the "4" punch magnet 141 so that the three columns selected will be perforated to represent "421". The feature of punching to represent serial numbers is shown and claimed in the copending application Serial No. 638,477 filed October 19, 1932.

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 card punching machine, comprising in combination with a plurality of rows of punches spaced apart for perforating index points of a work sheet, an analyzing mechanism adapted to concurrently analyze a plurality of columns of perforations of a pattern sheet to control the correlated punches, and means for shifting the work sheet whereby each row of punches perforates a plurality of columns in accordance with the corresponding columns of the perforations in the pattern sheet.

2. In a duplicating machine, means for operating a plurality of rows of punches to perforate a work card in accordance with a pattern card, means for feeding a work card and pattern card in succession, a pattern card controlled punch controlling means, and means whereby said rows of punches under control of the controlling means completely punch the work card in all columns during a feeding movement less than the length of the card.

3. In a duplicating machine, an analyzing mechanism adapted to simultaneously analyze several columns of index points of a pattern sheet, a plurality of columns of punches, means whereby said analyzing mechanism controls a plurality of columns of said punches to duplicate the perforations in a plurality of columns of said pattern sheet upon said work sheet, and means whereby a column of punches effects punching in a plurality of columns of the work sheet.

4. In a duplicating machine, an analyzing mechanism adapted to simultaneously analyze several columns of index points of a pattern sheet, a plurality of columns of punches and means whereby said analyzing mechanism controls said punches to duplicate the perforations on said pattern sheet upon said work sheet, and

means for moving said pattern and work sheets together during the punching operation.

5. In a duplicating machine, means for concurrently analyzing in each position of a pattern sheet a plurality of columns of index points of the pattern sheet, a plurality of rows of punches, means controlled by the analyzing means for controlling the rows of punches to perforate a plurality of columns of a work sheet for each of its successive positions, and means for concurrently feeding said pattern and work sheets whereby a single row of punches may perforate the work sheet in the same number of columns as are analyzed by the correlated analyzing means.

6. In a duplicating machine, a plurality of rows of punching devices each row arranged for operating upon the same positions on a work sheet as are operated upon by the other rows of punches, a corresponding number of rows of controlling devices for controlling the simultaneous operation of a plurality of rows of work sheet punching devices in accordance with a pattern sheet, and means effective subsequent to each punching operation being performed on a plurality of rows of the same work sheet for moving said work sheet and pattern sheet together, the same distance whereby said work sheet is punched in positions corresponding to the pattern card.

7. In a duplicating machine, an analyzing mechanism comprising a plurality of rows of sensing devices spaced apart, each row coordinated with a plurality of spaced columns of perforations of a pattern sheet, means comprising a corresponding number of rows of punches coordinated with a plurality of columns of index points of a work sheet, means whereby the sensing device of each row controls the punching devices of a corresponding row, and means for shifting the work sheet and punches relative to each other whereby the selected punches of a row perforate a plurality of columns of the work sheet.

8. In a duplicating machine, in combination, a card punching mechanism, including a plurality of rows of punches, controlling means therefor controlled by a pattern card, means for simultaneously feeding a work card and a pattern card in step by step relationship to derive the data from columns of the pattern card and to punch the data in corresponding columns upon the card to be punched, and means whereby said punches under control of the controlling means completely duplicate on a work card the perforations on a pattern card in a step-by-step movement equivalent to less than the length of the work card.

9. In a duplicating machine, key controlled punches adapted to manually punch a work sheet, means operable as an incident to completion of the manual punching operation for automatically feeding the sheet out of operative relation with the manually controlled punches to the duplicating section of the machine and means for automatically carrying said manually punched sheet through the duplicating section of the machine to be duplicately perforated in accordance with a pattern sheet.

10. In a duplicating machine, key controlled punches adapted to manually punch a work sheet, separately controlled punches comprising the duplicating section of the machine, means operable as an incident to completion of the manual punching operation for automatically feeding the sheet to the duplicating section of the machine and work sheet feeding means of the duplication section whereby the manually punched sheet is completely perforated in the duplicating section in accordance with a pattern sheet by effecting an intermittent feeding movement which is less than the length of the work sheet in the feeding direction.

11. In a duplicating machine, means comprising keys for manually punching a work sheet, means for feeding said work sheet to the duplicating section of the machine upon completion of the manual punching operation, said duplicating section comprising a plurality of columns of elements for simultaneously analyzing a plurality of columns of index points of a pattern sheet, each column comprising a set of different index points and automatically punching the corresponding columns of index points of a sheet previously punched by the key controlled punches.

12. In a duplicating machine, key controlled punches for manually perforating a work sheet, means for feeding said work sheet to the duplicating section of the machine upon completion of the manual perforating operation, said duplicating section comprising a plurality of rows of analyzing devices coordinated with a pattern sheet and a corresponding number of rows of punching devices, and means for moving said pattern sheet and work sheet in succession whereby said work sheet is automatically perforated in one or more selected columns in accordance with the pattern controlling sheet.

13. In a duplicating machine, key controlled punches adapted to manually punch a work sheet, means operable as an incident to completion of the manual punching operation for automatically feeding the sheet to the duplicating section of the machine said duplicating section comprising a plurality of rows of punches controlled by a pattern sheet and adapted to perforate a plurality of columns simultaneously during the intermittent movement of said work sheet.

14. In a duplicating machine, key controlled punches adapted to manually punch a work sheet, means operable as an incident to completion of the manual punching operation for automatically feeding the sheet out of operative relation to the manually controlled punches to the duplicating section of the machine, said duplicating section comprising means for automatically effecting a step-by-step movement of said work sheet and a pattern sheet whereby punches automatically controlled by said pattern sheet effect a duplicate perforation of said work sheet.

15. A punching machine comprising in combination, manually controlled punching means for perforating a record card, means for automatically feeding the card out of operative relation with the manually controlled punching means to a controlling position whereby the perforations of the record card emerging from said punching means automatically controls the punching of corresponding perforations upon a succeeding record card, and means whereby record cards are automatically fed in succession to said manually controlled punching means.

16. A punching machine comprising in combination, manually controlled punching means for perforating a record card, means for automatically feeding the card completely out of operative relation with the manually controlled punching means whereby the perforations of the record card emerging from said punching means automatically control the punching of corresponding perforations upon a succeeding record card, and

means whereby a blank record card is automatically fed to the manually controlled punching means as an incident to the completion of manually punching a record card.

17. A punching machine comprising in combination, manually controlled punching means comprising a row of punches for perforating a record card, supplemental punches automatically selected for operation in accordance with the perforations of a pattern record card and means automatically operable as an incident to the completion of the manual punching operations for feeding the card punched to the supplemental punches.

18. A punching machine comprising in combination, manually controlled punching means comprising a row of punches for perforating a record card, a supplemental set of punches controlled in accordance with the perforations of a pattern card adapted to perforate the record card in columns not punched manually, and means for feeding record cards in succession from a supply hopper to said manually controlled punching means and thereafter to said automatic punching means automatically and as an incident to the completion of the manual punching operations.

19. A punching machine comprising in combination, manually controlled punching means comprising a row of punches for perforating a record card, a supplemental set of punches controlled in accordance with a master card adapted to automatically punch the card in columns not manually punched, and means whereby the manually punched record card is fed to the automatically controlled punches as an incident to the completion of the manual punching operation.

20. In a duplicating machine, in combination, means comprising punches for manually operating upon a sheet, means comprising supplemental punches operable as an incident to the completion of the manual sheet operation for automatically operating upon the sheet, and means whereby said automatic operating punching means is controlled in accordance with a pattern sheet.

21. In a duplicating machine, in combination, means comprising punches for manually operating upon a sheet, means comprising supplemental punches operable as an incident to the completion of the manual sheet operation for automatically operating upon the sheet, and means whereby said automatic operating means is controlled in accordance with a pattern sheet, and means for feeding said pattern sheet concurrently with said first named sheet to control operation in different fields thereof from corresponding fields on the pattern sheet.

22. In a duplicating machine, in combination, means comprising punches for manually operating upon a sheet, means comprising supplemental punches operable as an incident to the completion of the manual sheet operation for automatically operating upon the sheet, and means whereby said automatic operating means is controlled in accordance with a pattern sheet, and means for feeding said pattern sheet concurrently with said first named sheet to control operation in different fields thereof from corresponding fields on the pattern sheet and means for selectively suppressing the control of said pattern sheet in any desired fields.

23. A card punching mechanism comprising in combination, means comprising punches for manually punching a record card in certain columns step by step, a supplemental set of punches adapted to be controlled by a pattern card comprising a card previously received from the manual punching section, and means for feeding a manually punched card to the suppelmental punches upon completion of the manual punching operations whereby the punched card is automatically punched in certain other card columns.

24. A card punching mechanism comprising in combination, means comprising punches for manually punching a record card in certain columns step by step, a supplemental set of punches adapted to be controlled by a pattern card and means for feeding a manually punched card to the supplemental punches upon completion of the manual punching operations whereby the punched card is automatically punched in certain other card columns in accordance with the pattern card and means for selectively suppressing the control of said pattern card in card columns manually punched.

25. In a punching machine, a plurality of sets of punches, one adapted to be controlled manually and the other automatically in accordance with the perforations of a pattern card, and means whereby a manually punched card is automatically fed to the automatically operated punches upon completion of the manual punching operation.

26. In a punching machine, a plurality of sets of punches, one adapted to be controlled manually and the other automatically in accordance with the perforations of a pattern card, and means whereby a manually punched card is automatically fed to the automatically operated punches upon completion of the manual punching operation, and means for preventing feeding of a manually punched card to the automatically controlled punches until the automatic punching operation of a previously fed card has terminated.

27. In a punching machine, card punching mechanism, controlling means therefor controlled by a pattern card, means for simultaneously moving the pattern card and a card being punched step by step and from column to column of both cards, and means for feeding cards automatically and in succession from a supply hopper to the punching mechanism and controlling means whereby the previously punched card is automatically shifted to a position to be the controlling instrumentality or pattern card for the card next to be punched.

28. In a punching machine, card punching mechanism, controlling means therefor controlled by a pattern card, means for simultaneously moving the pattern card and a card being punched step by step and from column to column of both cards, and means for feeding cards automatically and in succession from a supply hopper to the punching mechanism and controlling means whereby the previously punched card is the controlling instrumentality or pattern card for the card next to be punched and a supplemental set of punches adapted to be manually operated to supplementally punch a card received from said hopper and prior to being fed to the automatically controlled punches.

29. In a punching machine, in combination, card punching mechanism, controlling means therefor controlled by a pattern card, means for simultaneously moving the pattern card and a card being punched step by step and from column to column of both cards, and means for

feeding cards automatically and in succession from a supply hopper to the punching mechanism and controlling means whereby the previously punched card is the controlling instrumentality or pattern card for the card next to be punched, and a supplemental set of punches adapted to be manually operated to perforate the first blank card fed from the hopper to act as the first pattern card.

30. A duplicating machine comprising means for operating a plurality of punches for punching a plurality of spaced columns of a work record for each of a series of successive positions thereof, punch controlling means controlled by a pattern record, and means for successively feeding said work record whereby said work record may be completely punched, in all columns to duplicate the pattern card in a feeding movement less than the length of the work record.

31. A duplicating machine comprising a plurality of rows of punches for simultaneously punching a plurality of spaced record card columns, for each of a series of successive positions of the record card, punch controlling means controlled by a pattern record, and means for automatically feeding said record card whereby a single column of punches effects successive punching in a plurality of record columns.

32. In a punching machine, a plurality of rows of punches adapted to punch in a plurality of columns spaced apart by intervening columns of a record card, controlling means for controlling the operation of the punches from corresponding columns of a pattern card, and means for successively shifting the record card whereby a row of punches effects punching in a plurality of columns of the record card.

33. In a punching machine, a plurality of rows of punches adapted to punch in a plurality of columns of a work record spaced apart by intervening columns, controlling means for controlling the operation of the punches from corresponding columns of a pattern card, and means whereby each row of punches effects successive punching in a plurality of columns of the work record to duplicate the pattern card.

34. In a duplicating machine, in combination, a plurality of manually operated punches for punching a record card, automatically operated punches, means for feeding said record upon completion of the manual punching out of operative relation with said manually operated punches to the automatically operated punches, and means whereby the last named punches are automatically operated in accordance with a pattern record comprising a record previously punched by the manually controlled punches and automatically fed out of operative relation therewith by said feeding means.

35. In a duplicating machine, in combination, a plurality of manually operated punches for punching a record card, a duplicating section of the machine including punches automatically operated in accordance with a pattern record to effect duplicate punching on one record while another is being manually punched, and means for automatically transposing the records from the manually operated punches to the duplicating section whereby portions of a record completely punched acts as a pattern card for the succeeding record automatically fed from the manually operated punches.

36. In a combined punching and duplicating machine, a duplicating section including punches automatically operated in accordance with a pattern card, punches manually operated and independently of the automatically operated punches, and card feeding means for positioning the punched card whereby the perforations of each card automatically punched acts as a pattern card for a succeeding card upon completion of its manual punching.

37. In a combined punching and duplicating machine, manually controlled punches for punching a record of a series to represent both repetition punching and variable data, other punches automatically operated for duplicating only repetition punching, controlling means for the automatically operated punches and automatically operable means for automatically transporting each record from the manually controlled punches to the controlling means for the automatically operated punches whereby it controls the automatically operated punches to act as a pattern record for the succeeding record.

38. In a duplicating machine, a set of punches automatically operated in accordance with each of a series of records, punch controlling means, and automatically operable means for automatically shifting a record after it is punched by said punches to said controlling means whereby each punched record of a series automatically acts as a pattern card for a succeeding record.

39. In a duplicating machine, a set of punches automatically operated in accordance with each of a series of successively fed records, means for analyzing each of said records singly, and automatic means for successively feeding each of the records through said analyzing means after a punching operation in a record to control the punches whereby each record analyzed causes automatic operation of the punches to effect duplicate punching on a succeeding record beneath the punches.

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