

Dec. 5, 1961

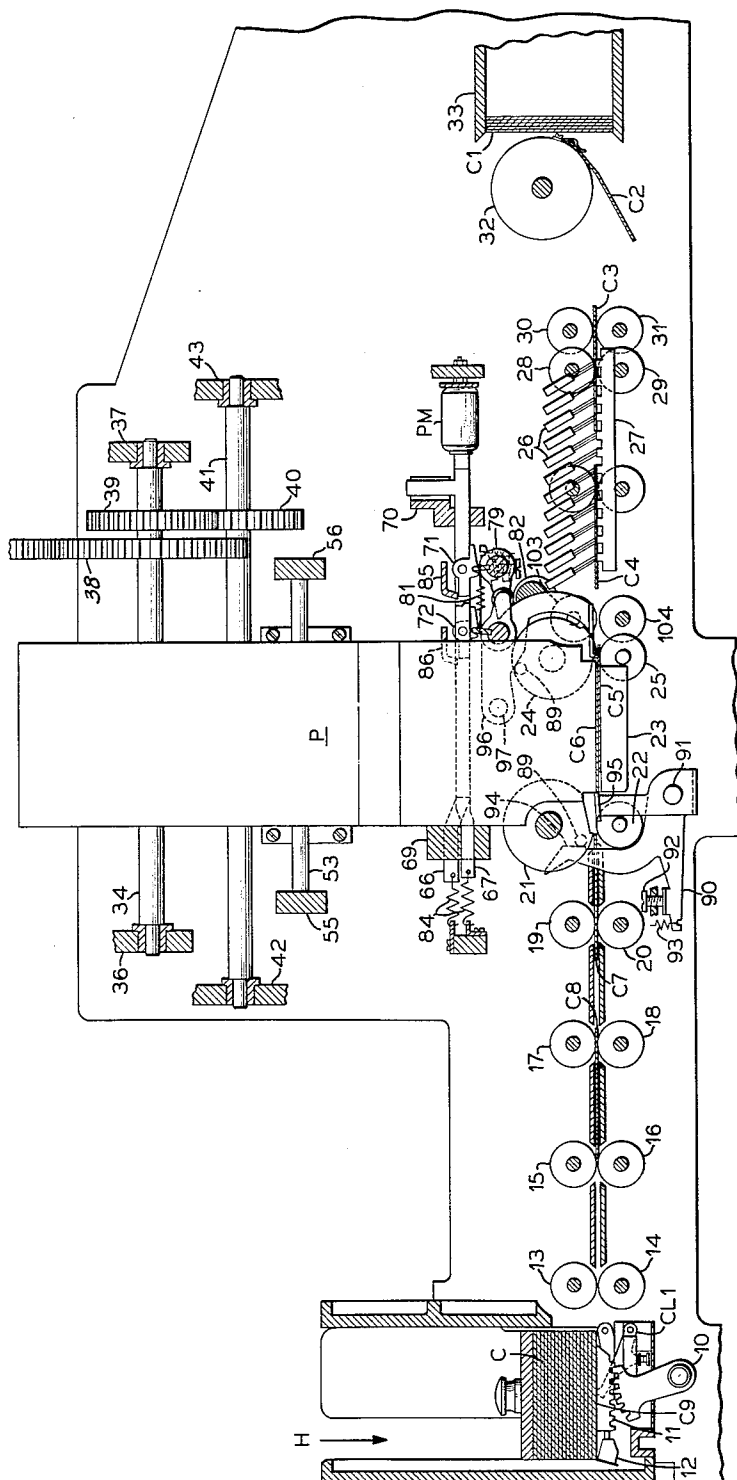
J. C. BAKER

3,011,697

RECORD PUNCHING MACHINE

Filed Nov. 21, 1957

6 Sheets-Sheet 1



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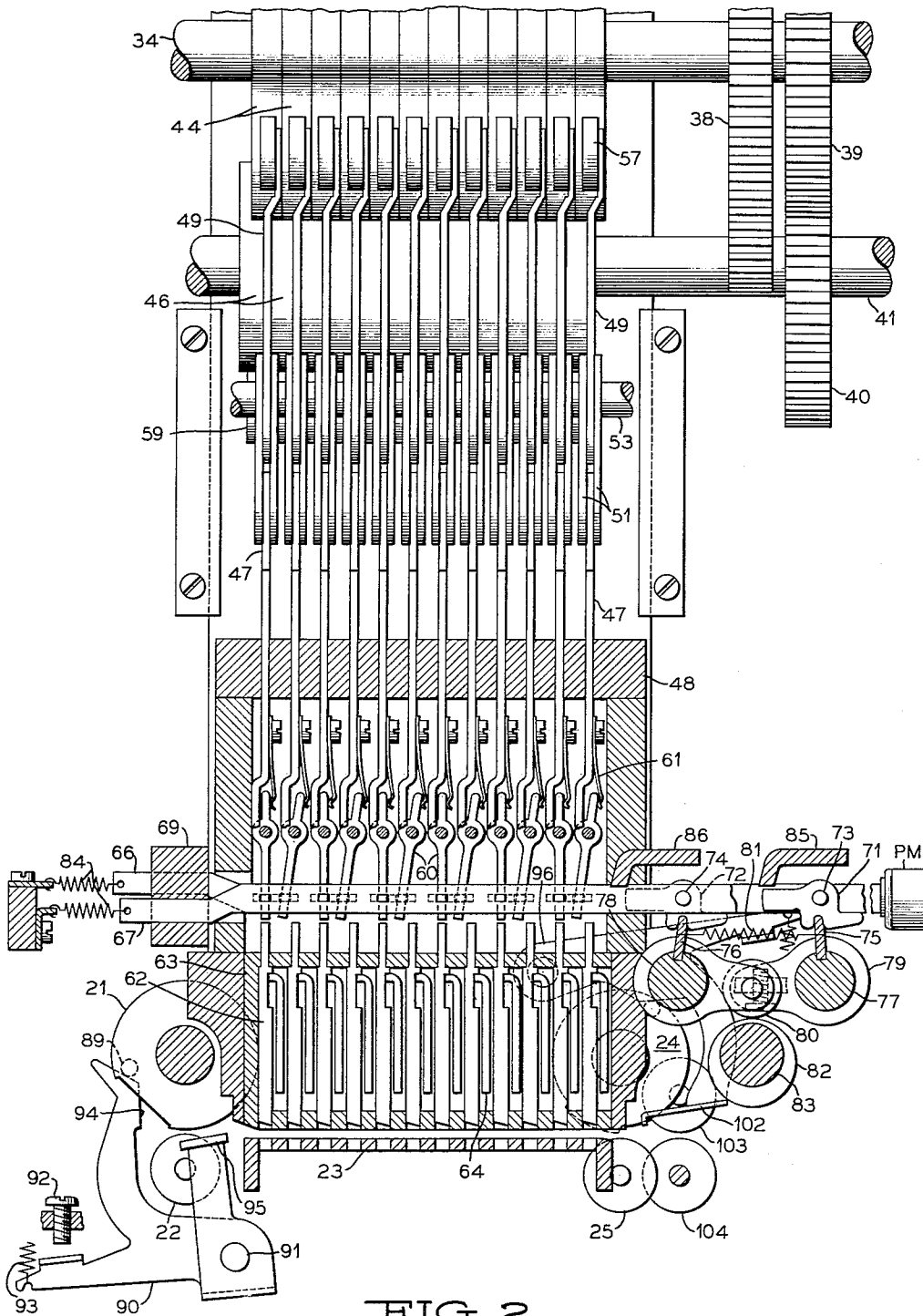
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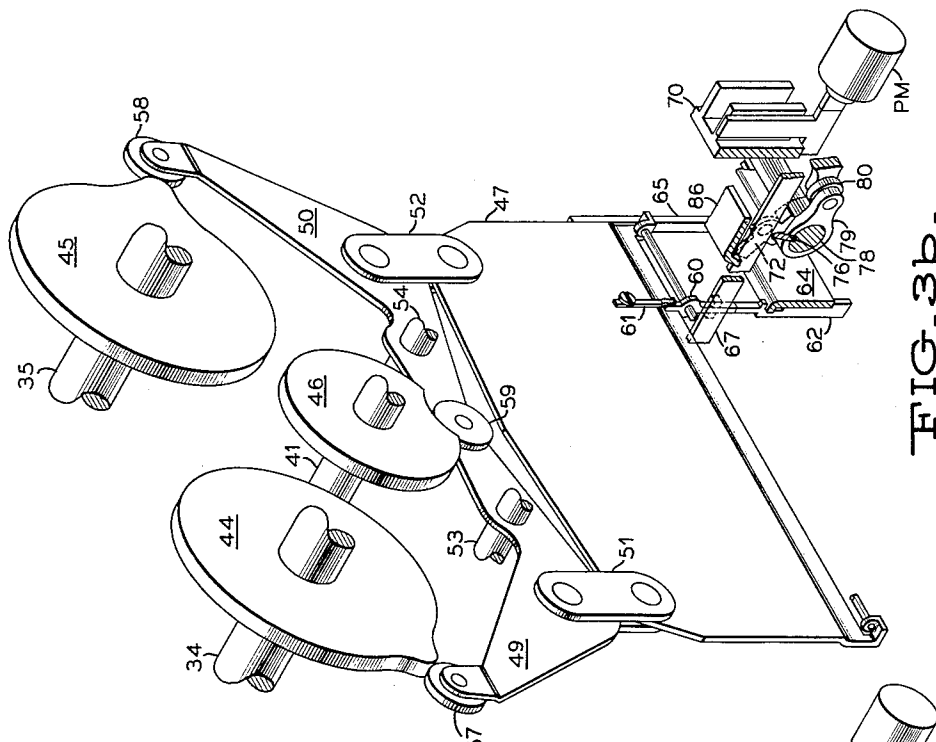


FIG. 3b.

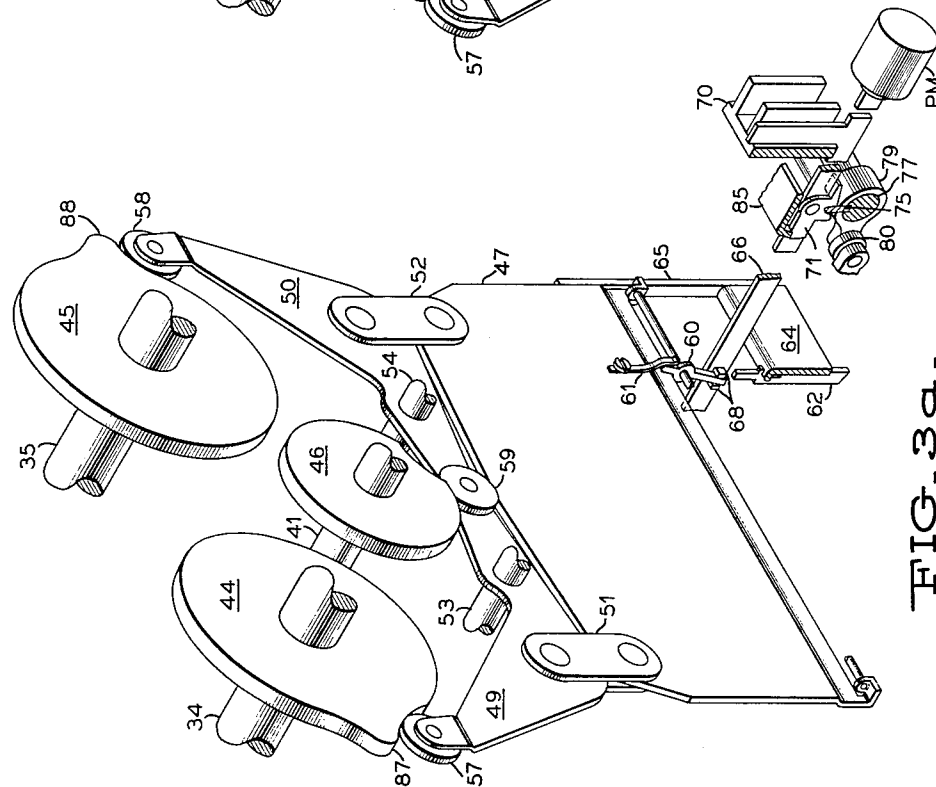


FIG. 3a.

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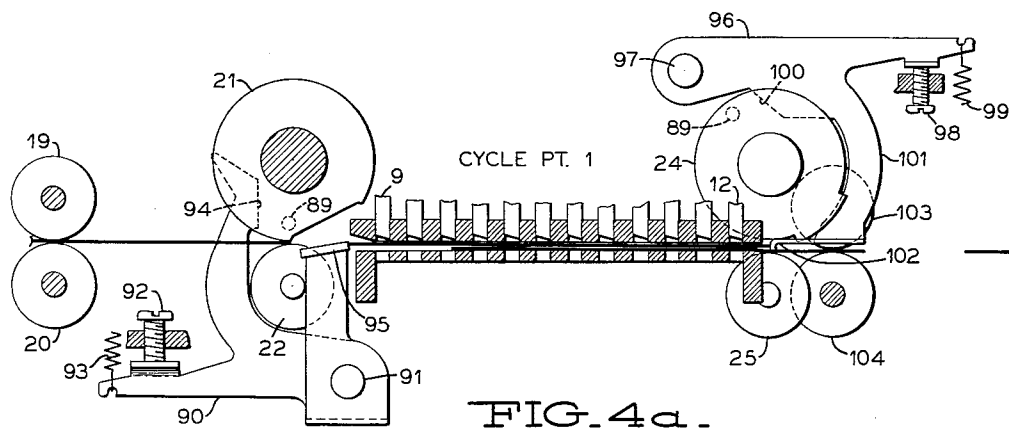
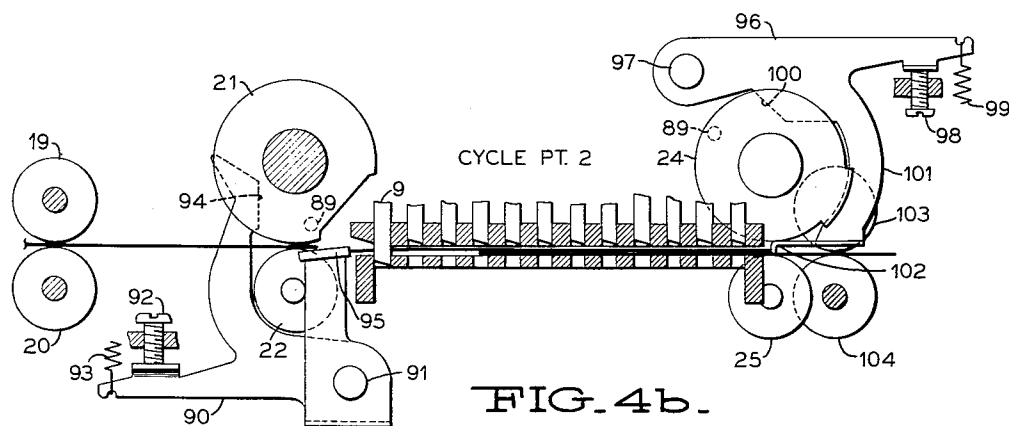
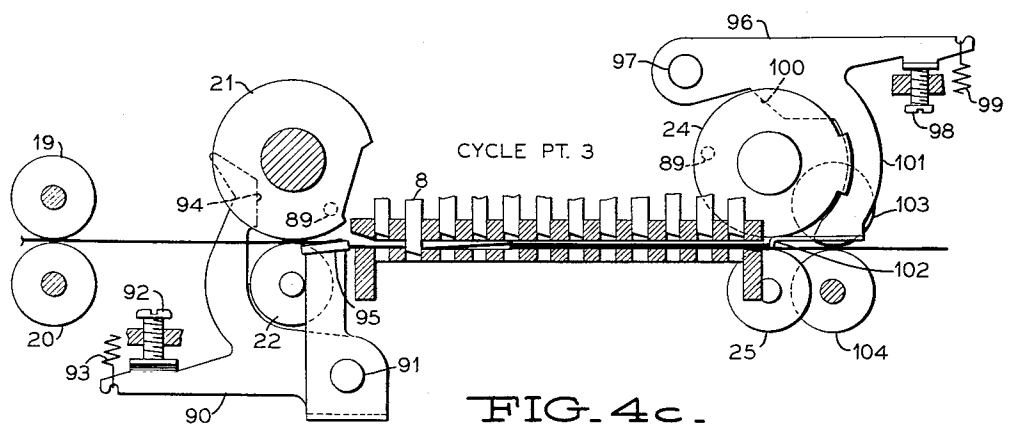
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RECORD PUNCHING MACHINE

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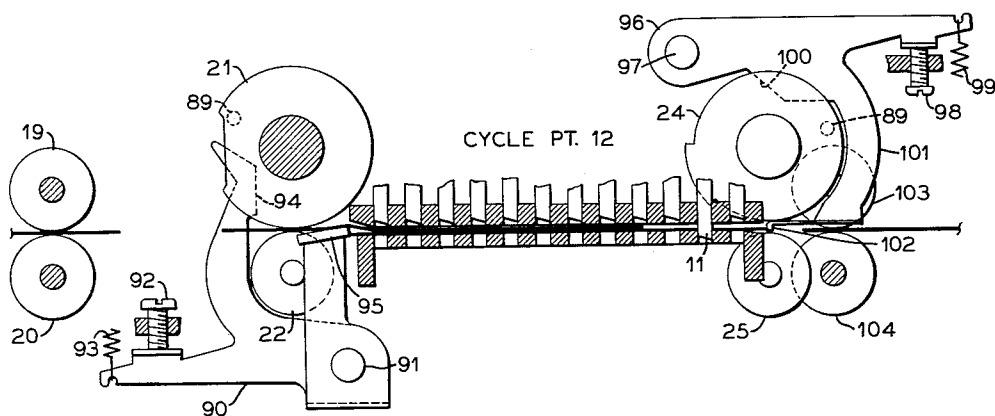


FIG. 4d.

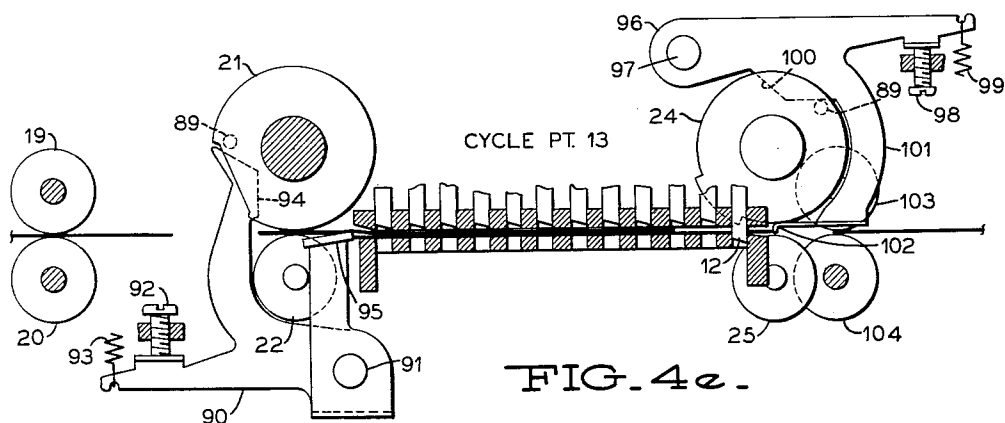


FIG. 4e.

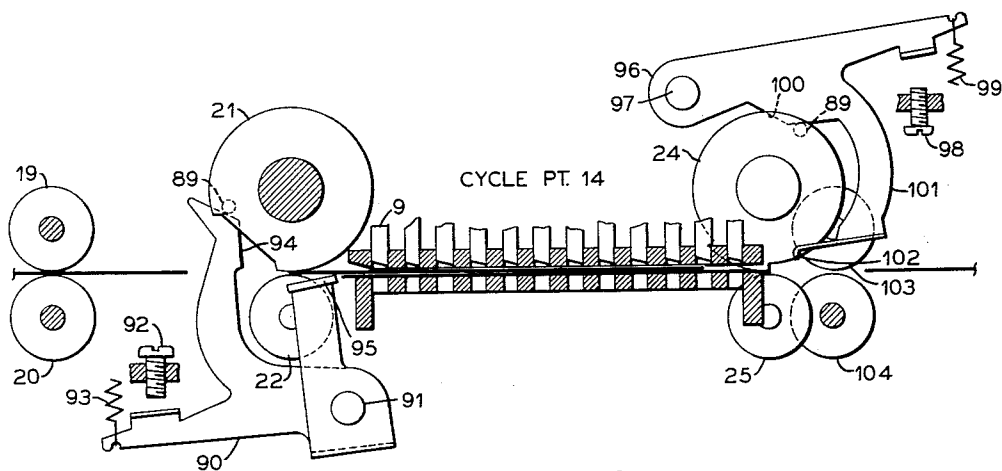


FIG. 4f.

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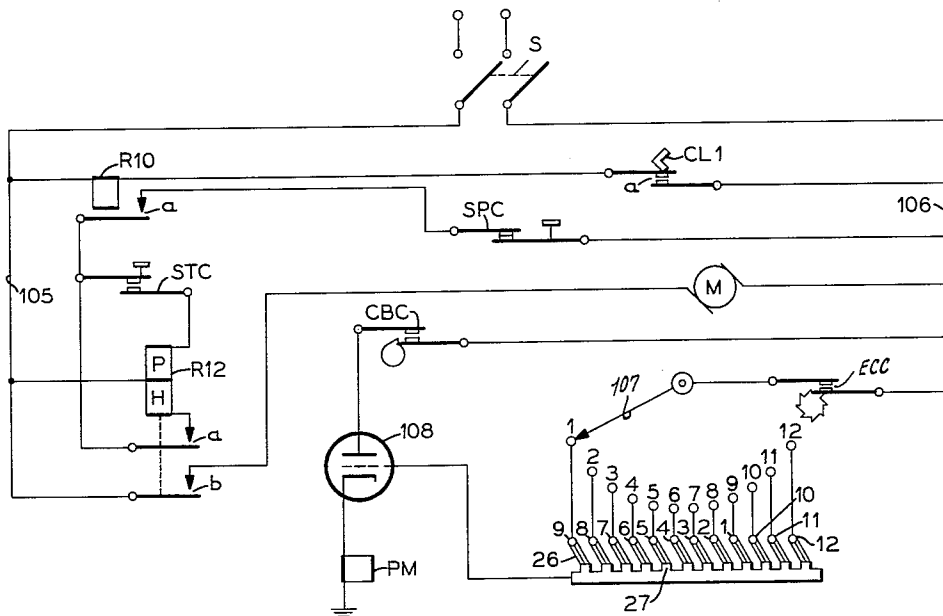


FIG. 5.

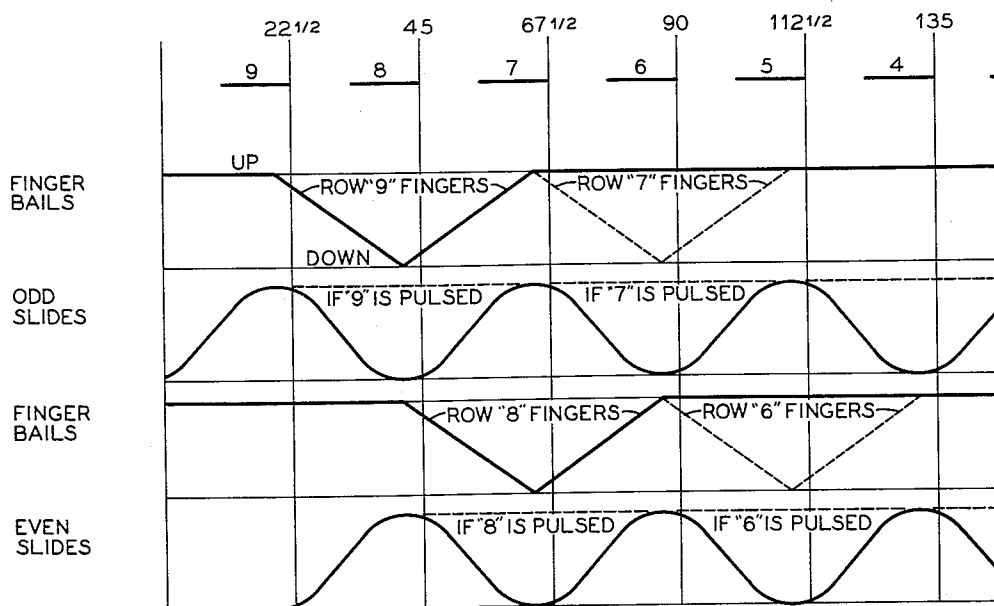


FIG. 6.

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RECORD PUNCHING MACHINE

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8 Claims. (Cl. 234—128)

This invention relates to an improvement in machines for punching record cards and more particularly to a novel arrangement for processing the record cards through the punch mechanism during punching operations.

The invention is illustrated in a punching machine of the type wherein prepunched master cards and blank detail cards are fed in succession past a punching station and a sensing station. Each master card when at the sensing station serves to set up the punches to control the punching of the following detail card at the punching station and as each detail card is punched, it serves as a master card for the following detail card. This is known as a gang punching operation; however, it will be understood that the invention may be equally applied to a punching machine for carrying out reproducing operations wherein the data on master cards in one feed are reproduced into corresponding detail cards in another feed.

The principal object of the present invention is to provide a novel mechanism for processing more than one record card through the punch station during a single punching cycle.

Another object of the present invention is to provide an improved machine for performing punching operations wherein punching occurs row by row directly from the set-up components at the cycle point pulsed.

A still further object of the present invention is to provide an improved machine for performing punching operations at high speed wherein transport means are provided to hold the card being punched stationary in the die station during a punching cycle with means for feeding the previously punched card out of the die station and the next card to be punched into the die station concurrently with the punching of the stationary card.

In the preferred embodiment of the invention, a card is moved into punch position with acceptable registration in 3 cycle points. This is accomplished by causing an incoming card to overlap the registered card and to control its entry into the die station so that it follows the progressive punch timing by a safe spacing. At the same time, a completed card is drawn through suitable exit rolls at a controlled rate such that its trailing edge maintains a safe spacing ahead of the progressive punching. Card movement and registration are controlled by pairs of gash rolls with the rolls arranged to operate adjustable card gates to provide registration. Each gate is shaped to permit passage of the overlapping card without affecting the position of the registered card. An exit gate holds registration until full penetration of the last punch at which time it moves away and down to permit an exit gash roll to effect removal of the registration card as soon as the last punch is retracted. While 3 cards are in the die station during punching of part of the card, there is never more than 2 card thicknesses and the trailing edge of a "leaving" card leads the edge of an "entering" card by 1/4 inches which is the space within which punching is done.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of examples, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

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In the drawings:

FIG. 1 is a side sectional elevation view of the machine showing the card transport mechanism.

FIG. 2 is an enlarged detail view of the punch set-up mechanism showing one of the slides in an actuated position.

FIGS. 3a and 3b are perspective views showing the details of the punch set-up mechanism.

FIGS. 4a-4f are diagrammatic views showing the operation of the feeding devices for feeding cards past the punching devices.

FIG. 5 is an electrical wiring diagram of the preferred form of the invention.

FIG. 6 is a timing diagram which can be followed to understand the operation of the various mechanical devices.

Referring to FIG. 1, it is seen that a stack of blank record cards designated C are contained in a hopper H. These cards are the well-known IBM cards having eighty columns of twelve punching positions arranged as 12, 11, 0, 1 through 9 index point positions in each column. In the present machine, the cards are fed from the hopper "12" edge first by means of an oscillating arm 10 and a reciprocating slide 11 carrying a picker 12, to a pair of feed rollers 13, 14. From rollers 13, 14 the cards are fed by three sets of rollers 15 through 20 to a pair of gash rollers 21 and associated mating rollers 22. The gash rollers control the feeding of the cards into the punching station comprising a 960 hole punch mechanism designated P and a punch die unit 23.

The perforated cards are carried out of the punching station by a pair of gash rollers 24 and associated mating rollers 25 which convey the punched cards past a sensing station comprising brushes 26 and contact strips 27 for each column of the card. These brushes are known as the punch set-up brushes. In order for each record card to be punched with the same information, a pattern card must lead the blank cards through the machine. When the first pattern card has reached the punch brushes 26, the blank card following has been registered in the punching station. A punch magnet PM (FIG. 2) is provided for each card column and as the pattern card passes brushes 26, circuits are completed through the perforations to energize the magnets PM. The magnets control the setting up of the punches in the corresponding index point positions of the blank card at the punching station. Thus, every card passing through the machine serves in its turn as the pattern card for the card directly behind it. From the sensing station, the card is carried by two sets of feed rollers 28, 29 and 30, 31 to a stacker drum 32 which deposits each card in a discharge hopper 33. There is shown in FIG. 1 the approximate relative positions of the first nine record cards, designated C1-C9, feeding out of the hopper H.

The driving connections for the card feeding mechanism feed roller shafts and various cam shafts are not shown herein, but it is understood that these shafts are suitably connected to be constantly driven from a motor M shown diagrammatically in FIG. 5 to perform the machine functions in accordance with the machine timing shown in the timing diagram of FIG. 6.

Referring now to FIGS. 1, 2, 3a and 3b, a pair of shafts 34, 35 are mounted for rotation in machine support members 36 and 37. The shaft 34 may be driven through a suitable pulley and belt connection with the motor M and suitable gearing may be provided between the gear 38, fastened on the shaft 34, and the shaft 35 such that both shafts will be continuously rotating during operation of the motor M. Another gear 39, fastened on shaft 34, drives a gear 40 fastened on a shaft 41 journaled in the machine support members 42 and 43. Each shaft 34 and

35 is provided with a series of 12 single lobed punch operating cams designated 44, 45, which correspond to the 12 index point positions on the record cards. Similarly, shaft 41 is also provided with a series of 12 punch operating cams designated 46.

In the following description of the punch set-up mechanism, only one card selection column will be considered, it being understood that the machine is equipped with identical parts for each of the eighty columns.

A bail 47 (FIGS. 2, 3a, 3b) is provided for each index position and is positioned for vertical movement in a slotted guide bar 48. Each bail is mounted at the top to a pair of complementary bell crank levers 49, 50 by means of two pairs of connecting links 51, 52. The bell crank levers 49, 50 are pivoted on rods 53, 54 respectively, fastened to machine support members 55, 56 and these rods serve as a support about which the bell crank levers pivot to actuate the bails 47. The upper extremities of the levers 49, 50 are provided with the follower rollers 57, 58 which coast with the cams 44, 45, respectively, and the other extremity of each pair of levers is provided with a common roller 59 which coacts with its associated cam 46. It is apparent that each set of cams 44, 45, 46 and bell crank levers 49, 50 will cooperate to reciprocate the associated row bail 47 vertically for the purpose of carrying out a punching operation.

Pivotaly mounted across the bottom of each bail is a row of 80 punch selection fingers 60, one for each column of the record card. Each selection finger is biased by a spring 61 and, as will be presently described, means are provided for positioning selected fingers into alignment with their respective punch elements 62. A row of 80 punches 62 is provided for each index point position of the card and the punches are slideably mounted in the support frame 63 with each row in alignment with the associated bail 47. Associated with each row of punches is a restoring bail 64. Each restoring bail extends across the row of punches and is fastened at each end to the associated operating bail 47 by a pair of links, such as indicated at 65 (FIGS. 3a, 3b). The bails 64 cooperate with a notched portion in each punch and serve as a positive restoring means for the punches.

A magnet PM for each column controls the setting up of a finger 60 in a selected index position through a duo of slides designated 66 and 67. The fingers 60 in the even numbered index positions 12, 0, 2, 4, 6 and 8 of a column extend downwardly into a space between related lugs 68 (FIG. 3a) which project outwardly from the side of slide 66. The odd numbered fingers 11, 1, 3, 5, 7 and 9 extend downwardly between similar lugs on slide 67. These slides are supported for reciprocation in bearing blocks 69, 70 and are provided with keeper members 71 and 72 pivotally mounted thereto at 73 and 74 respectively. The keepers each have a horizontally extending ear portion adapted to engage the underside of the slides. The ear portions limit the counterclockwise movement of the keepers and enable the keepers to punch the related slide to the right when they are urged counterclockwise. A notch in the under surface of each keeper member 71, 72 receives a bail 75 and 76 respectively, and these bails are keyed into shafts 77 and 78 respectively which are mounted for rotation in the machine side frames. A pair of cam followers 79 having a common roller 80 are secured to the shafts and a spring 81 extends between bails 75 and 76 to press the roller 80 against the surface of an eccentric 82 on a constantly rotating shaft 83 which is mounted in the machine side frames. The slides 66, 67 are maintained under tension by pressure of springs 84. The eccentric 82 is so formed as to cause the bails 75 and 76 to operate 180° out of phase.

As the eccentric 83 rotates, the odd and even slides are moved alternately against the pole face of the related magnet PM, and if the magnet is not energized, the slides will be moved away from the magnet by the oscillating bails. In the instance where the magnet PM is energized

during the time that one end of a slide is moved up to its pole face, the slide is held against movement by the keeper action as explained hereinafter. The fingers 60 are moved downwardly by the cams 44, 45 and 46 which are timed to move the finger in each index position downwardly toward the related punch 62 during the reading of the corresponding index position by the sensing brushes 26. The finger travels downwardly within the restriction of the lugs 68 for engagement with the punch. When a perforation is not sensed by the brushes 26 in an index position, the finger is deflected by its oscillating slide to push the finger 60 out of line with the punch.

When a perforation is sensed by the brushes 26, the magnet PM is momentarily energized and holds the slide which approaches its pole face from following the related oscillating bail until the related keeper is moved to latching position. The finger which is moved downwardly by a bail 47 is not deflected by the slide, and the related punch 62 is actuated.

The keepers 71 and 72 are pivotally mounted on the slides 66 and 67, as previously explained, and if a slide does not follow its oscillating bail because of the attraction of energized magnet PM, then the keeper is rocked clockwise about its pivot point (FIG. 3b) by the bail into latching engagement with a cooperating brace. These braces are designated 85 and 86 (FIG. 2) and extend between the machine side frames. It should be noted that if the magnet is not energized, the keeper remains in its counterclockwise position and passes under the brace. This is accomplished by providing the springs 84 with sufficient tension so that the slides 66 and 67 are pulled to the left faster than the bails 75 and 76 can rock the keepers 71 and 72 counterclockwise. The slides can therefore be said to lead the bails. The magnet PM, however, is of sufficient strength to hold a slide against the pressure of its spring 84. This insures that the slide will make its full oscillating cycle. As soon as the keeper is partially latched, the magnet PM can be de-energized and the slide will move more sufficiently to take up the required latching lead. The slide is thus retained in its position near the magnet PM until the bail has almost completed its return stroke. The keeper is then moved counterclockwise until it is free of the latch block.

The cams 44, 45 have their respective lobes 87 and 88 timed to start row nine at cycle point 1, row eight at cycle point 2 and so on through row twelve at cycle point 12. FIG. 6 shows the timing of the finger bails and column slides relative to the read pulses. The punching pulses are fed to the punch magnets at cycle point timing, "9" hole first, and punching occurs simultaneous with brush reading. For example, to punch a "9" hole in column 10, the "9" read pulse occurs at cycle point 1 and causes the column 10 punch magnet to be energized while the column 10 odd digit slide is oscillated against its core. Now all the odd digit fingers in column 10 are aligned with their punches, and the odd slide keeper locks them there through 2 cycle points. During this time the row nine bail 47 operates the punch through the finger 60 in the nine index point position. The other odd fingers in column 10 do not cause punching to take place because their respective row bails have not been operated. The action just described is similar for punching of all the digits.

As was previously mentioned, in order to realize the advantages of the high speed punching mechanism just described, it was found desirable to move a record card into punch position with acceptable registration in 3 cycle points. To more fully understand the meaning of the term "cycle point," it may be pointed out that one machine cycle, which corresponds to 360° of the machine index, is divided into units called cycle points. The most logical unit of division is the distance between successive punching positions on the card; therefore, the distance from the "9" punching position to the "8" punching position, or vice versa if the card is fed "12" edge first,

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represents one cycle point while the distance from the "9" or "12" position in one card to the "9" or "12" punching position in the following card is one cycle. There are 12 punching positions on the card and each punching position is $\frac{1}{4}$ inch from the next. Therefore, for each cycle point the card moves $\frac{1}{4}$ inch on its path through the machine and with a card that is $3\frac{1}{4}$ inches wide it requires 13 cycle points to advance a card past any given point. In illustrating the present invention, the cards are fed $\frac{3}{4}$ inch apart and one cycle, then, is made up of 16 cycle points. It is to be understood that machine cycles comprising more or less cycle points may also be used in carrying out the principles of the present invention, depending upon the rate of card feed desired.

FIGS. 4a-4f show the processing of cards through the punch and die station at cycle point times 1, 2, 3, 12, 13 and 14 respectively. As was previously mentioned, an incoming card is caused to overlap the registered card being punched and the entry of the incoming card into the die is controlled so that it follows the progressive punch timing by a safe margin. At the same time a completed card is drawn through the exit rolls at a controlled rate such that its trailing edge maintains a safe spacing ahead of the progressive punching. In the present embodiment, for example, at the time any punch contacts the registered card, the entering card is $\frac{1}{2}$ inch away and the leaving card is $\frac{3}{8}$ inch away. Likewise, at the same time any punch is retracted clear of the card, there is $\frac{1}{4}$ inch clearance for the entering card and $\frac{7}{8}$ inch clearance for the leaving card. Since the registered card cannot leave until the 12 punch is withdrawn, this card is in the die station for 14 cycle points.

Card movement and registration are controlled by the two pairs of gash rolls 21 and 24 which are continuously driven from the motor M along with their mating rollers 22 and 25. Each gash roll carries a pin 89 which operates on the cam surface of the adjustable card gates to provide registration. The gate mechanism at the entrance to the punching unit comprises a pair of bell crank arms 90 which are pivoted at 91 and normally tensioned clockwise against a pair of adjustable stop screws 92 by springs 93. Each of the arms 90 has a camming surface 94 for coaction with the pins 89 and a turned up portion 95 which serves to engage the trailing edge of the card.

In similar fashion the gate mechanism at the exit of the punching unit comprises a pair of bell crank arms 96 which are pivoted at 97 and normally tensioned clockwise against a pair of adjustable stop screws 98 by springs 99. Each of the arms 96 has a camming surface 100 for coaction with the pins 89 and a turned down portion 101 having a gate element 102 attached thereto for positioning the card at the punching station.

Each gate is shaped to permit passage of the overlapping card without affecting the position of the registered card. Referring to FIG. 4f, at the 14th cycle point the last or 12 index point position of the registered card has been punched (FIG. 4e) and the 12 punch has been retracted. The registered card is now ready to be fed out of the punching station and it may be seen that at cycle point 14 time the stop gate 102 has been cammed up out of the path of the card, and the protrusion on exit gash roll 24 is in position to start feeding the registered card out of the punching station and to the continuously running feed rolls 103 and 104 at the entrance to the sensing brushes. It may be seen that also at cycle point 14 time, the entrance gate 95 has been cammed counterclockwise, and the next card to be punched has been fed over the top of the card that was punched by the protruding portion of the gash roll 21. The oncoming card lacks approximately two cycle points of being in registration position in the punch station. The cards continue to feed during cycle points 15 and 16, and at cycle point 1 (Fig. 4a), it may be seen that the gates 95 and 102 have now been restored to their normal position wherein they retain the new card in registered position beneath

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the punches. The card that was punched has since reached the rolls 103, 104 which feed this card completely out of the punching station and into the sensing station.

FIG. 4b shows the punching of a 9 hole at cycle point 2 and FIG. 4c the punching of an 8 hole at cycle point 3. Punching progresses in this fashion until cycle point 14 at which time the registered card is ejected as described before. As was previously mentioned, when there are 3 cards in the die station during punching, there is never more than 2 card thicknesses and the trailing edge of a "leaving" card leads the 12 edge of an "entering" card by $1\frac{1}{4}$ inches which is the space within which the registered card is punched.

Referring now the wiring diagram shown in FIG. 5, it is seen that the closure of switch S connects the machine to the source of electrical energy through the two main lines 105 and 106.

For the gang punching operation, a master card is inserted at the bottom of a group of blank cards in the punch hopper H. The cards in the hopper actuate a card lever CL1 to close contacts CL1a and energize a relay magnet R10 through a circuit as follows: From line 105, through relay R10, card lever contacts CL1a, to line 106. The start key ST is then depressed and a circuit may be traced from line 105 through the pickup coil of motor relay R12, start key contacts STC, relay contacts R10a (now closed), stop key contacts SPC (normally closed), to line 106. The energized motor relay closes contacts R12a to complete a circuit through its hold coil. The b contacts of relay R12 are also closed to complete a circuit through the motor M which causes the motor to operate. The motor will keep running, and the cards will be fed from the hopper H as long as they are present or until the stop key SP is depressed.

During the second card feeding cycle, which takes place immediately, the master card is registered at the punching station but no punching occurs since as yet there is no card at the sensing brushes 26. During the third card feeding cycle the master card enters the sensing brushes 26 as the first blank card immediately following the master card is registered at the punching station. Since the punching pulses are fed to the punch magnets PM at cycle point timing "9" hole first with the cards moving "12" edge leading, the reading sequence to the punch magnets must occur opposite to the direction of feed. The reverse reading device comprises the contact strips 27 for each column so placed that at cycle point 1 the "9" row on the card is under brush "9," at cycle point 2 the "8" row is under brush "8," etc. For a record card that is $3\frac{1}{4}$ inches wide with $\frac{1}{4}$ inch in between each of the 12 punching positions, the contact strips 27 would be made $5\frac{1}{2}$ inches long with $\frac{1}{2}$ inch between adjacent sensing brush centers.

Flight sensing occurs with an emitter arm 107, under the control of emitter cam contacts ECC, pulsing the "9" brushes at cycle point 1 time, the "8" brushes at cycle point 2 time, and so on as the card advances. As the emitter arm successively makes contact with the emitter spots 1-12 at cycle point times 1-12 respectively of the card feed cycle, cam contacts ECC also close at each cycle point time to establish successive circuits from the power supply S to the spots 1-12. The emitter spots are connected to the sensing brushes in reverse order; that is, spot 1 is connected to brush "9," spot 2 to brush "8" and so on. As a result, at cycle point 1 time, for example, row "9" of the record will be under the "9" sensing brushes and if "9" holes are present in any of the 80 columns, the corresponding punch magnets, there being one punch magnet PM for each column, will be energized. As shown in FIGS. 4a and 4b, although the punch magnets are energized at cycle point 1 time to punch a "9," the actual penetration of the record does not occur until cycle point 2 time.

For controlling the 80 punch magnets PM, there are provided 80 thyatron tubes 108. Each punch magnet is

connected in the cathode circuit of a related tube 108 and the plate circuit of each tube includes a pair of circuit breaker contacts CBC. The 80 circuit breaker contacts CBC are timed to make and break for each cycle point of machine operation to condition the tubes for operation coincident with the sensing of each row of index point positions on the record. When a hole is encountered, the pulse circuit is directed from the sensing brush and contact strip 27 to the grid of the related tube 108 to switch the tube into a state of conduction and effect energization of the punch magnet. The circuit breaker contacts CBC will subsequently open to drop out the tube and punch magnet and then close again to condition the tube for the next cycle point of operation.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, 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:

1. In a machine for punching records, a punching station, means for continuously feeding records to said punching station, means at said punching station for stopping a record to be punched, means for effecting progressive punching of said record in the direction of feed, and means for feeding a following record to be punched into said punching station and progressively toward said stopping means as punching operations are taking place on said first record.

2. In a machine for punching records, a punching station, means for continuously feeding records to said punching station, means at said punching station for stopping a record to be punched, means for effecting progressive punching of said record in the direction of feed, means for feeding a following record to be punched into said punching station and progressively toward said stopping means as punching operations are taking place on said first record, and means effective at the completion of punching of said first record for ejecting same from the punching station, said stopping means operating to stop said following record and said punching means operating to commence punching of said following record during ejection of said first record.

3. In a machine for punching records having a punching row by row station and means for progressively punching a record at rest in said punching station, the combination of means for ejecting a punched record from said punching station, means for positioning a second record to be punched in said punching station as said first record is being ejected, means for operating said punching means to punch said second record as said first record is being ejected, and means for feeding a third record into said punching station as said second record is being punched and said first record is being ejected.

4. In a machine for punching records having rows of index point punching positions representing in row order the data 9, 8, 7 through 0, 11 and 12, a punching station, means for feeding records to said punching station with row 12 leading, means for registering each record to be punched at rest in said punching station, punching instrumentalities at said punching station, means for progressively operating said instrumentalities to punch a registered record row by row starting with row 9 first, and

means for feeding a record over said registered record and into said punching station and progressively along behind said operating punching instrumentalities as the row by row punching of said registered record is taking place.

5. A machine as in claim 4 including means for ejecting said registered record from the punching station at the completion of punching of row 12 thereon, said registering means operating to register said second record during said ejection.

6. In a machine for punching records having rows of index point punching positions representing in row order the data 9, 8, 7 through 0, 11 and 12, a punching station, a sensing station, means for feeding records to said punching station and sensing station with row 12 leading, means for registering each record to be punched at rest in said punching station, punching instrumentalities at said punching station, sensing instrumentalities at said sensing station, means for controlling said sensing instrumentalities to progressively sense the records row 9 first as they feed through the sensing station, and means controlled by said sensing instrumentalities for operating said punching instrumentalities to progressively punch the records in the punching station row 9 first.

7. In a machine for punching records having rows of index point punching positions, a punching station, rows of punching instrumentalities at said punching station, means for continuously feeding records to said punching station, means for registering each record to be punched at rest in said punching station, a sensing station, sensing instrumentalities at said sensing station, means for feeding records from said punching station past said sensing instrumentalities for row by row sensing of the index point positions on the records, means for controlling said sensing instrumentalities to effect said row by row sensing progressively from the trailing edge to the leading edge of each record, and means controlled by said sensing instrumentalities for operating said punching instrumentalities to punch each record registered in the punching station progressively from the trailing edge to the leading edge.

8. In a machine for punching records having a punching station and means for progressively punching a record at rest in said punching station, the combination of rotary members for cyclically ejecting a punched record from said punching station, a cyclically operable gate member for positioning a record to be punched at rest in said punching station during the ejection of a punched record, means for operating said punching means to punch a positioned record as the previously punched record is being ejected, other rotary members for cyclically feeding a record into said punching station during the punching of a record and the ejection of a record that has been punched, and means at the entrance to said punching station for diverting the incoming record over the record being punched.

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UNITED STATES PATENT OFFICE
CERTIFICATION OF CORRECTION

Patent No. 3,011,697

December 5, 1961

Joseph C. Baker

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 67, for "illustratesd" read -- illustrated --; column 2, line 17, for "Refering" read -- Referring --; line 58, for "it undestood" read -- it is understood --; column 3, line 57, for "punch" read -- push --; column 5, lines 66 and 67, for "counterlockwise" read -- counterclockwise --; column 6, line 14, after "now" insert -- to --; line 31, for "throguh" read -- through --; column 7, line 49, strike out "row by row"; line 50, after "punching", first occurrence, insert -- row by row --; column 8, line 2, for "pogressively" read -- progressively --; line 12, for "punchinnng" read -- punching --.

Signed and sealed this 11th day of September 1962.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

DAVID L. LADD

Commissioner of Patents