

Feb. 1, 1944.

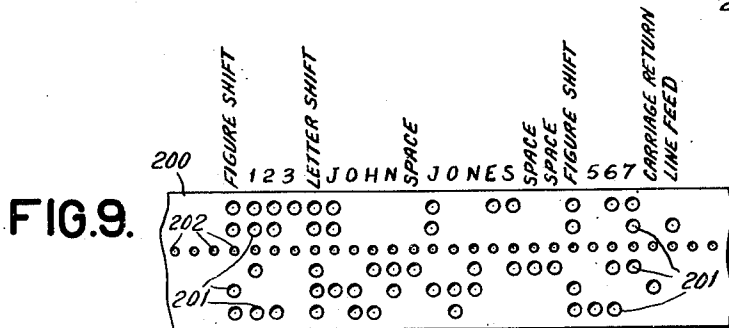
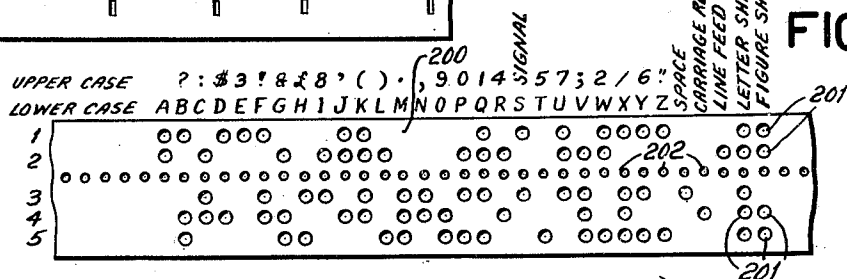
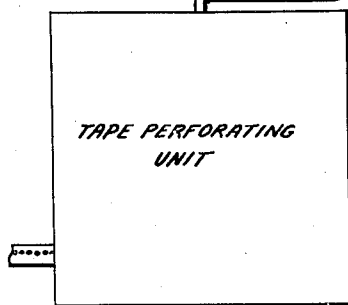
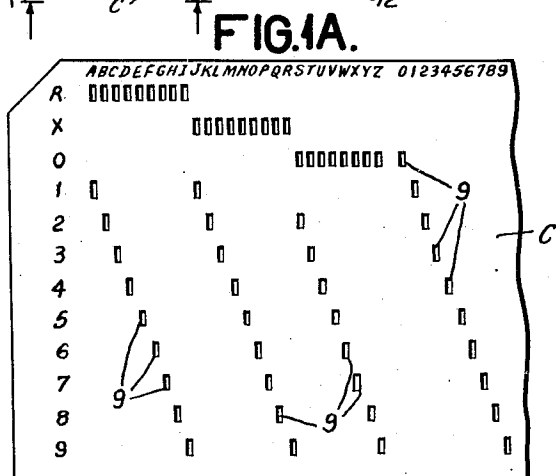
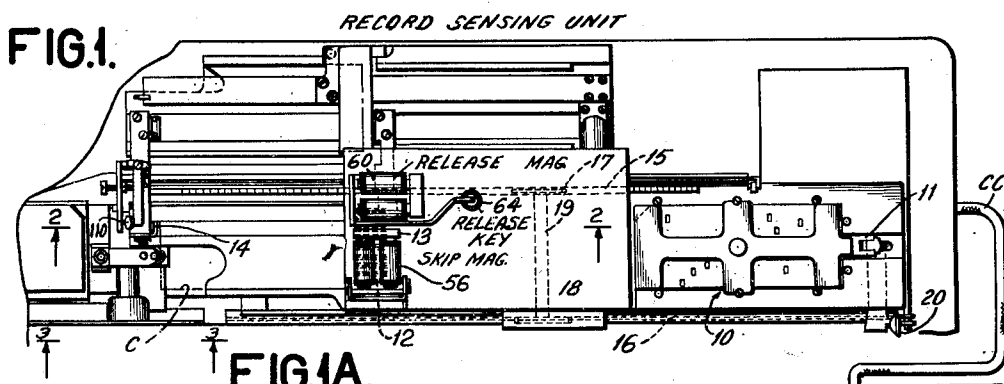
C. R. DOTY

2,340,800

RECORD CONTROLLED PERFORATING APPARATUS

Filed June 13, 1942

14 Sheets-Sheet 1



BY

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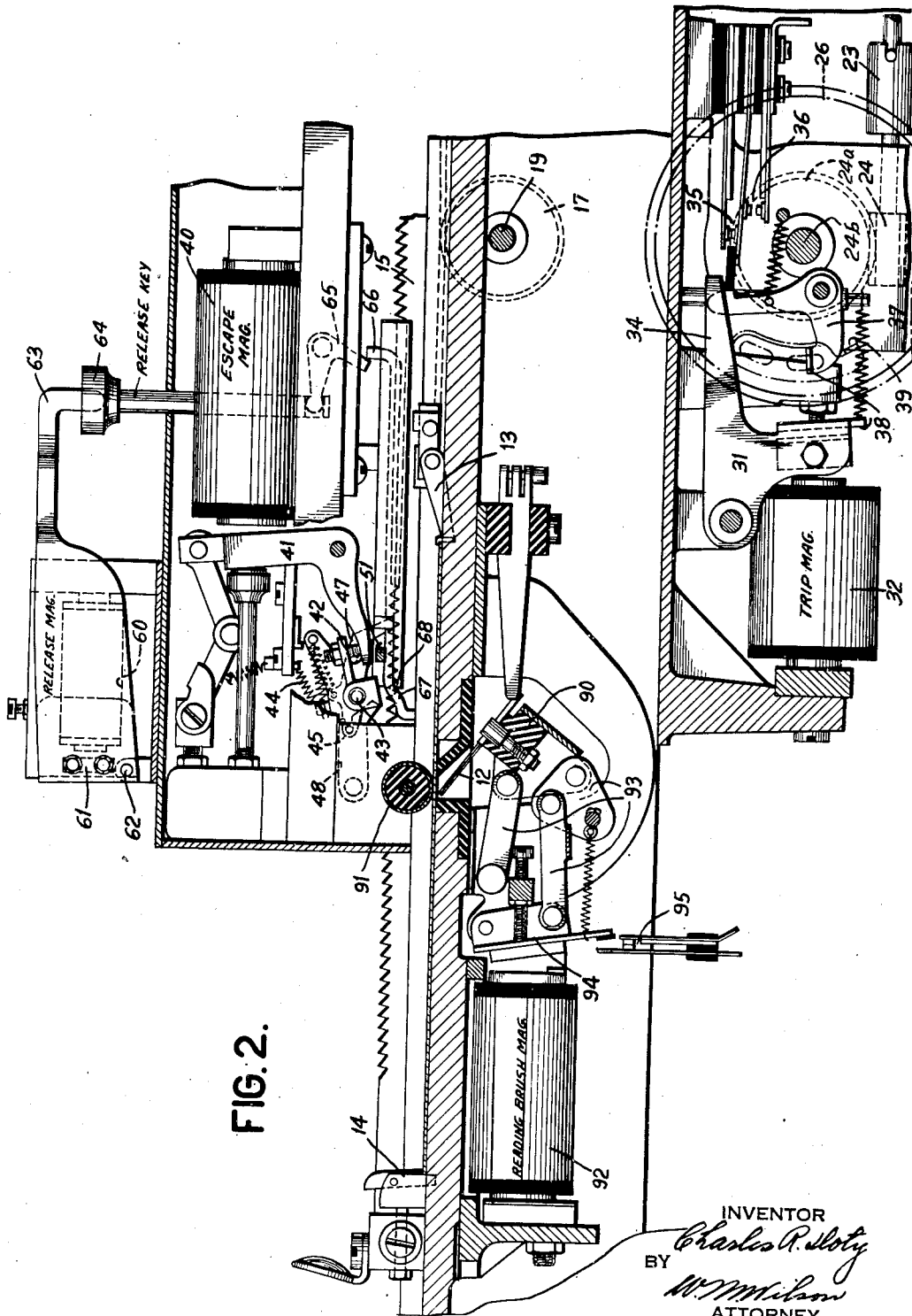
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RECORD CONTROLLED PERFORATING APPARATUS

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14 Sheets-Sheet 2



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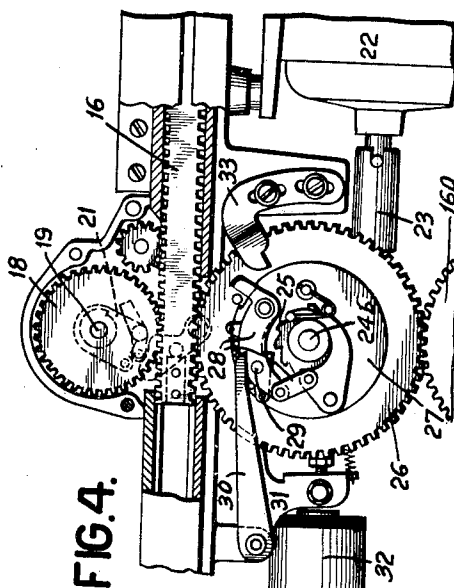
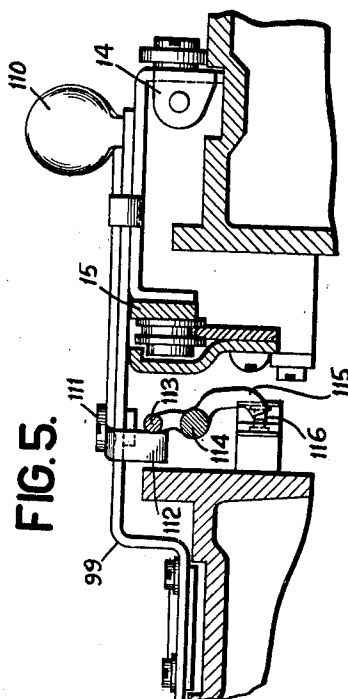
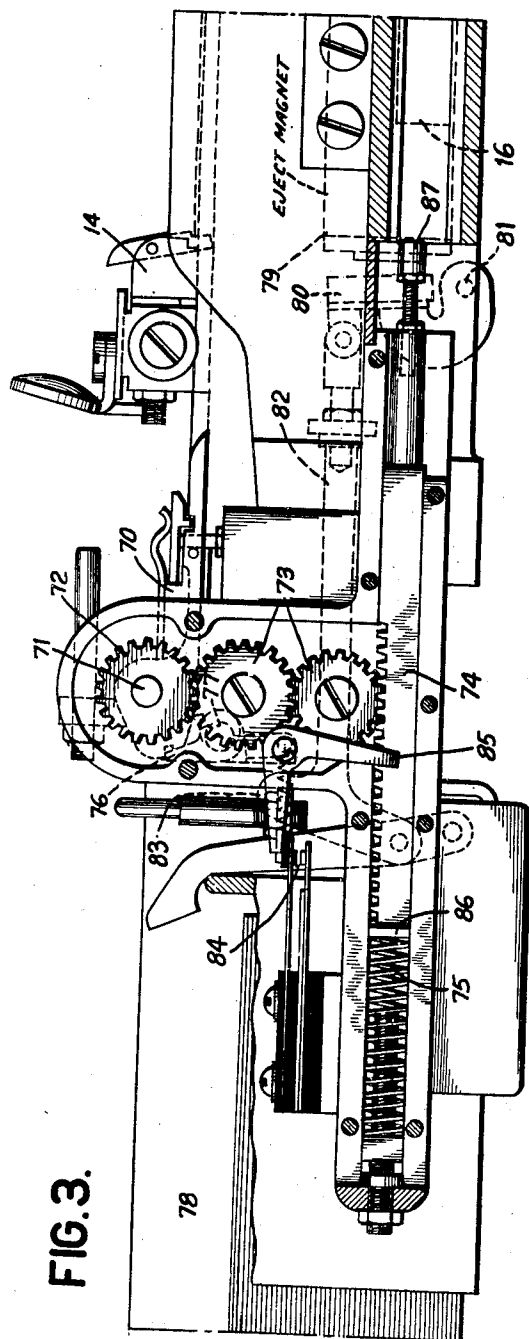
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RECORD CONTROLLED PERFORATING APPARATUS

Filed June 13, 1942

14 Sheets-Sheet 3



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Filed June 13, 1942

14 Sheets-Sheet 4

FIG. 6.

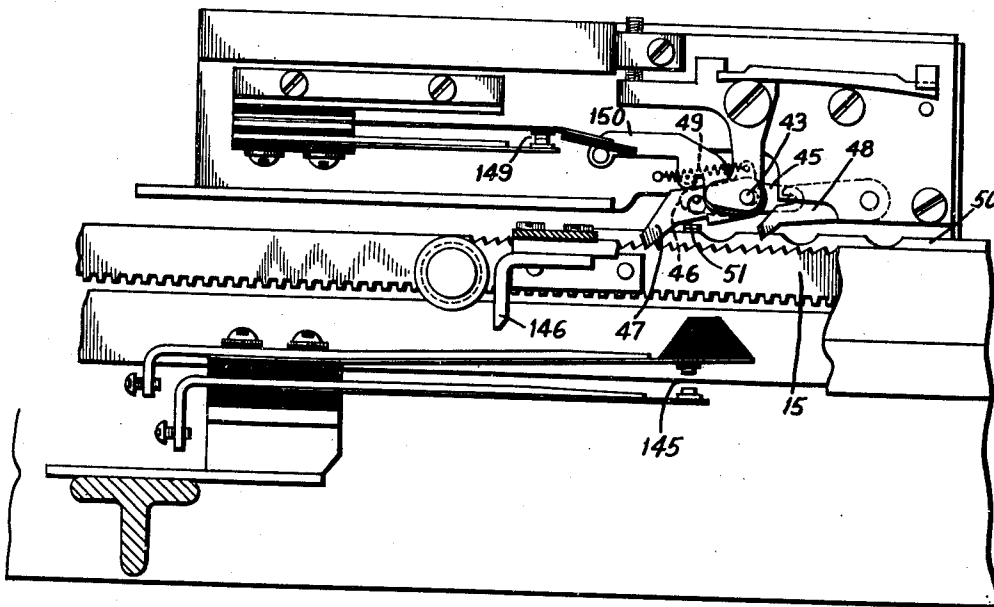
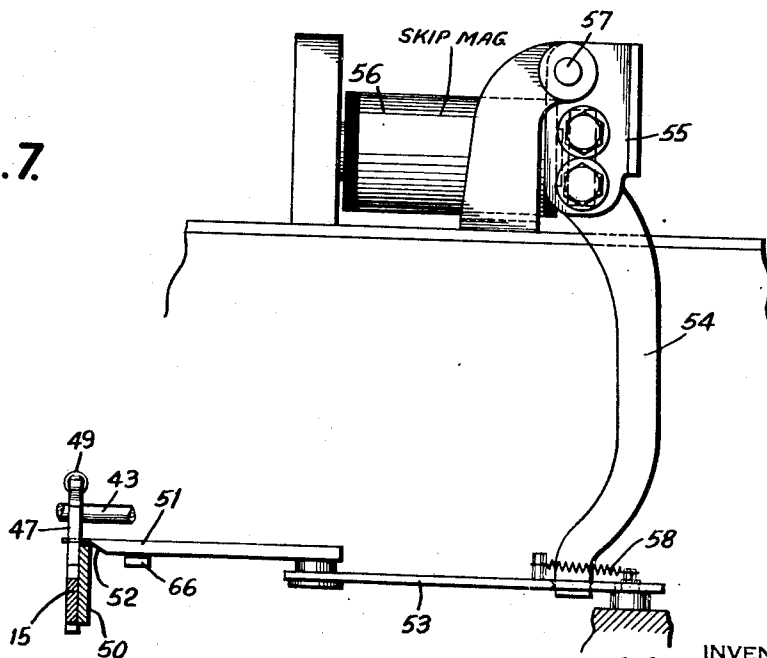


FIG. 7.



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RECORD CONTROLLED PERFORATING APPARATUS

Filed June 13, 1942

14 Sheets-Sheet 5

FIG.12.

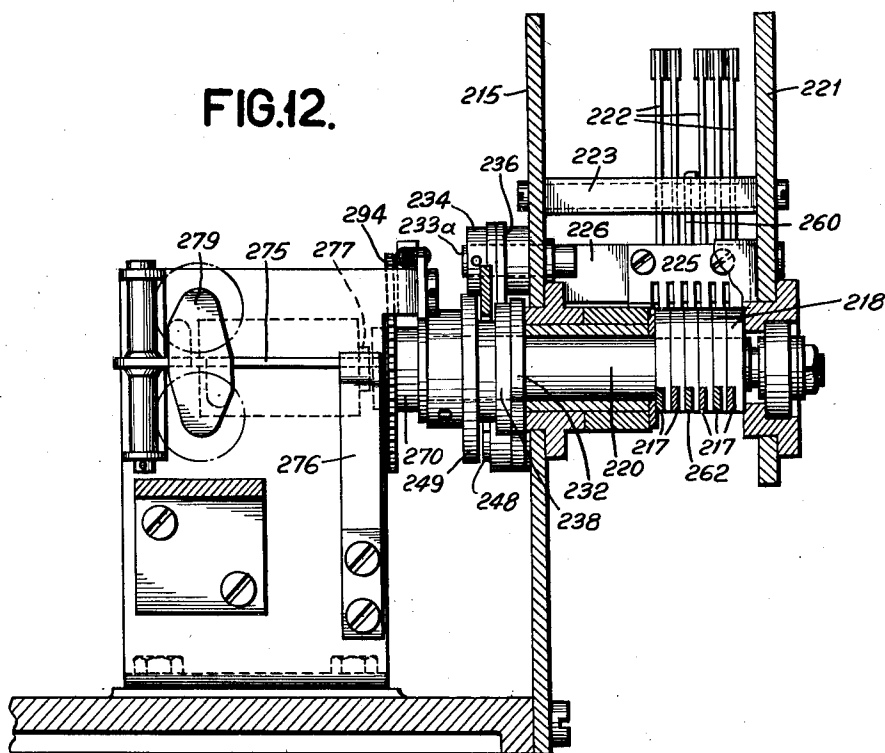
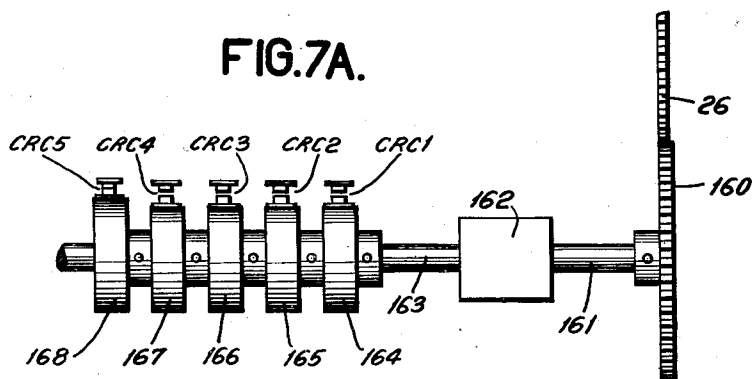


FIG.7A.



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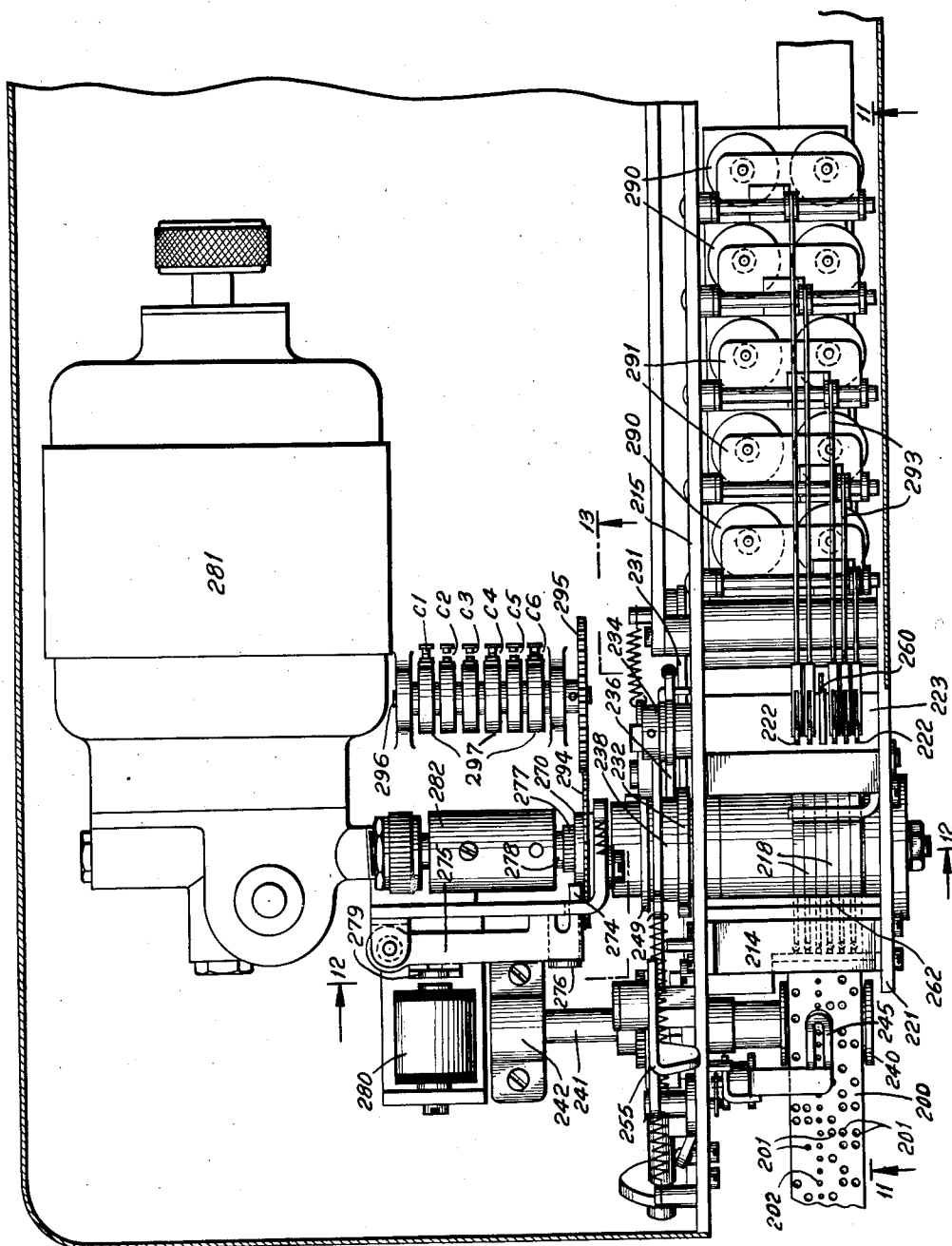


FIG. 10.

EY

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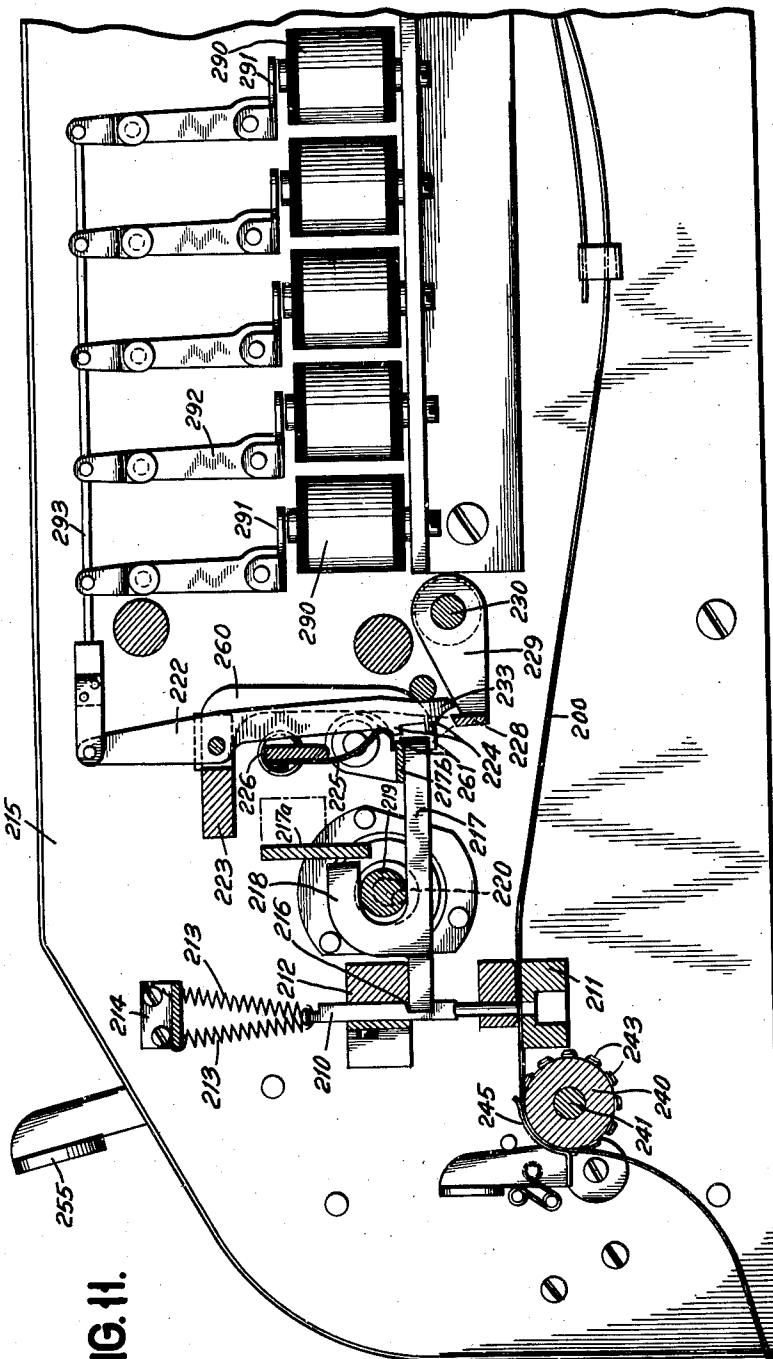


FIG. 11.

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RECORD CONTROLLED PERFORATING APPARATUS

Filed June 13, 1942

14 Sheets-Sheet 8

FIG. 13.

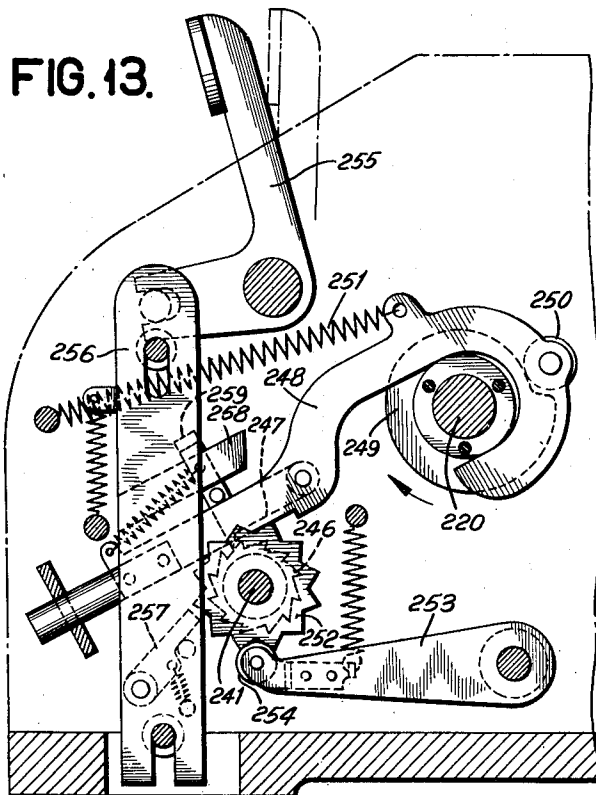


FIG. 14.

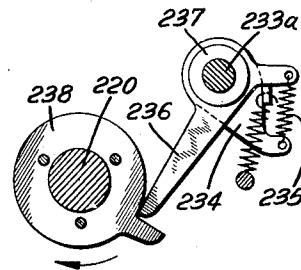


FIG. 16.

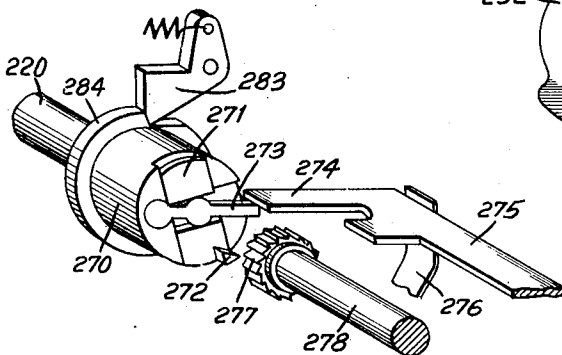
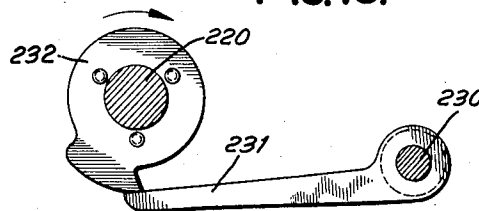


FIG. 15.



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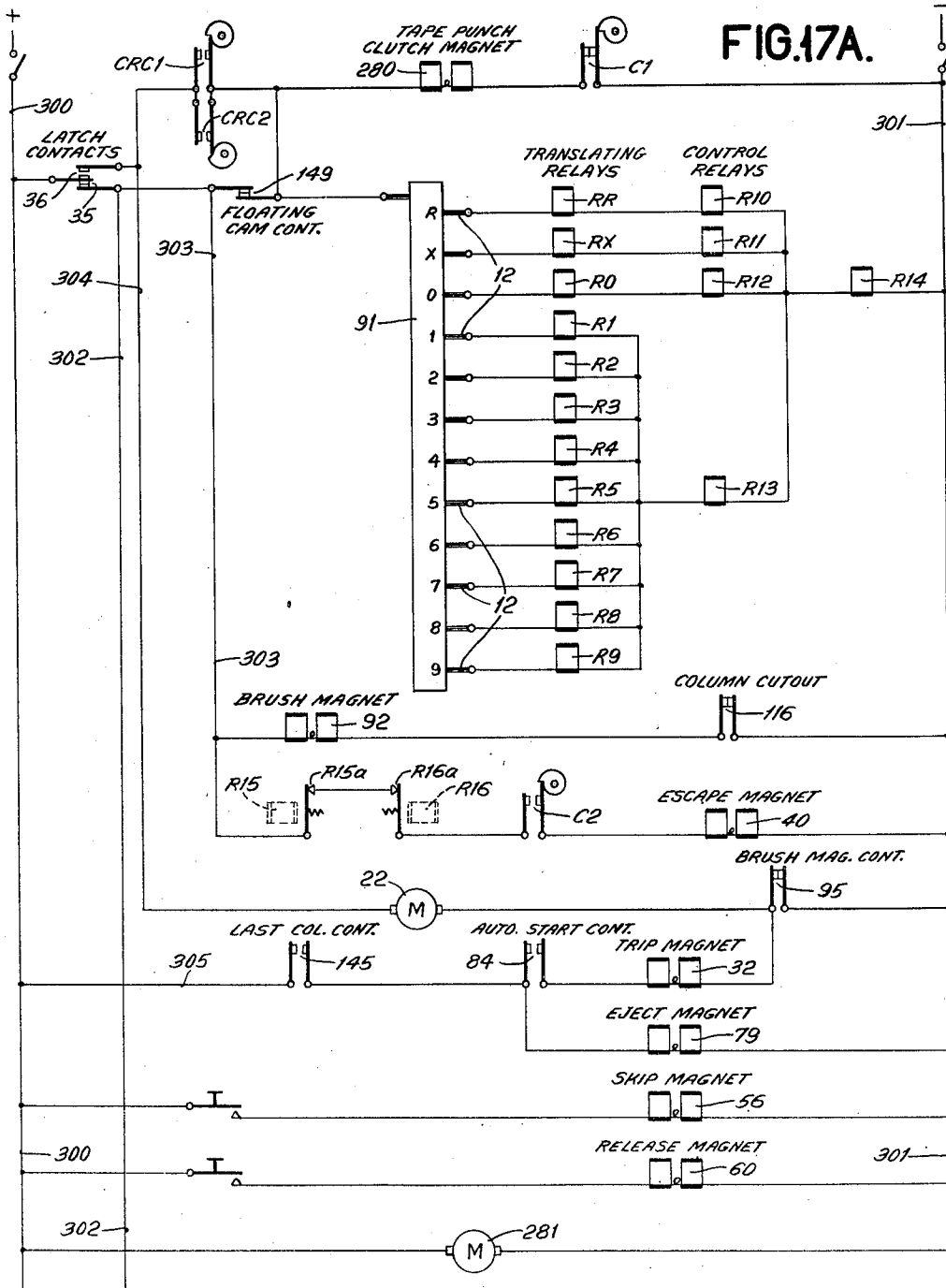
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RECORD CONTROLLED PERFORATING APPARATUS

Filed June 13, 1942

14 Sheets-Sheet 9



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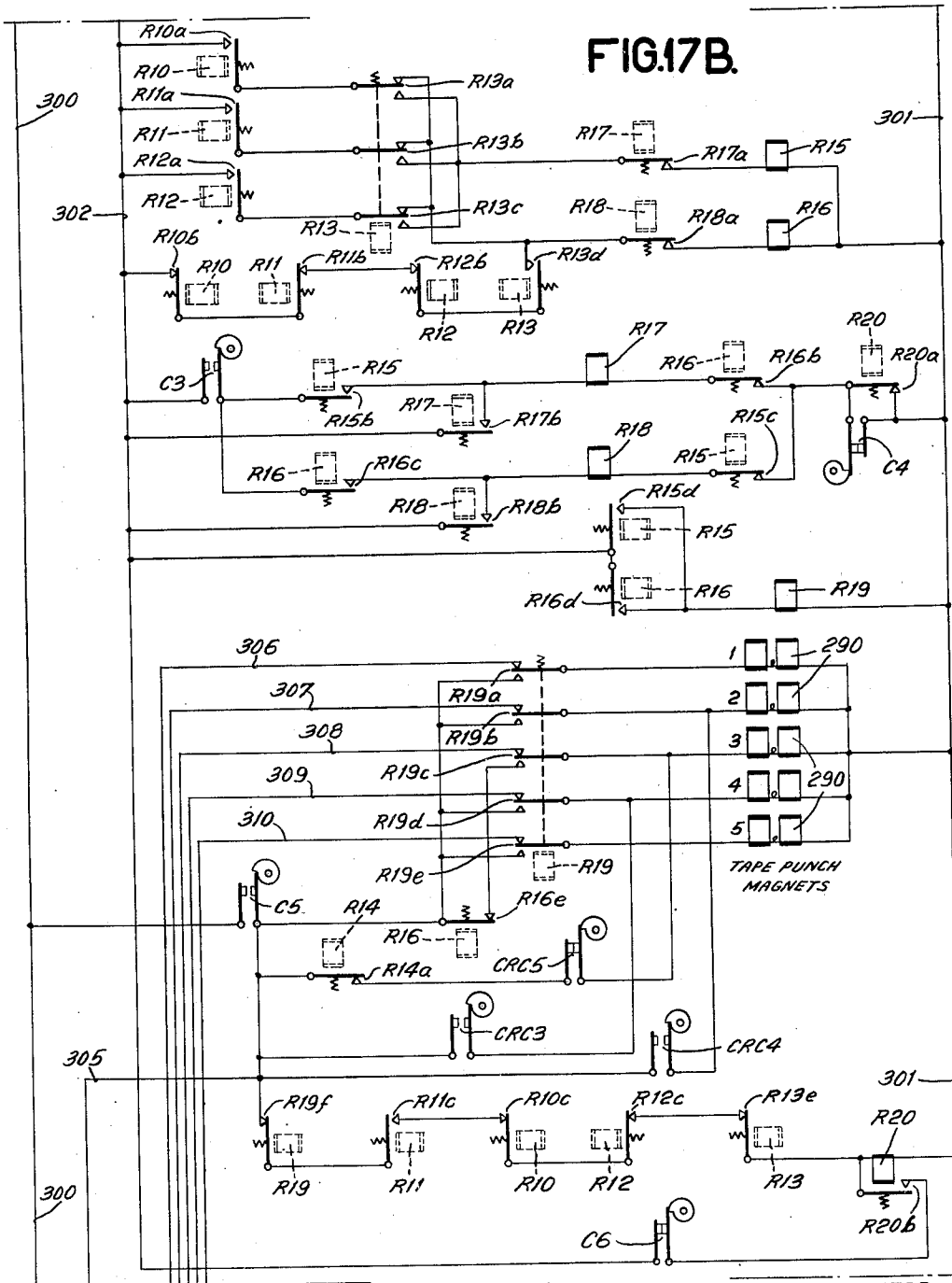
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RECORD CONTROLLED PERFORATING APPARATUS

Filed June 13, 1942

14 Sheets-Sheet 10



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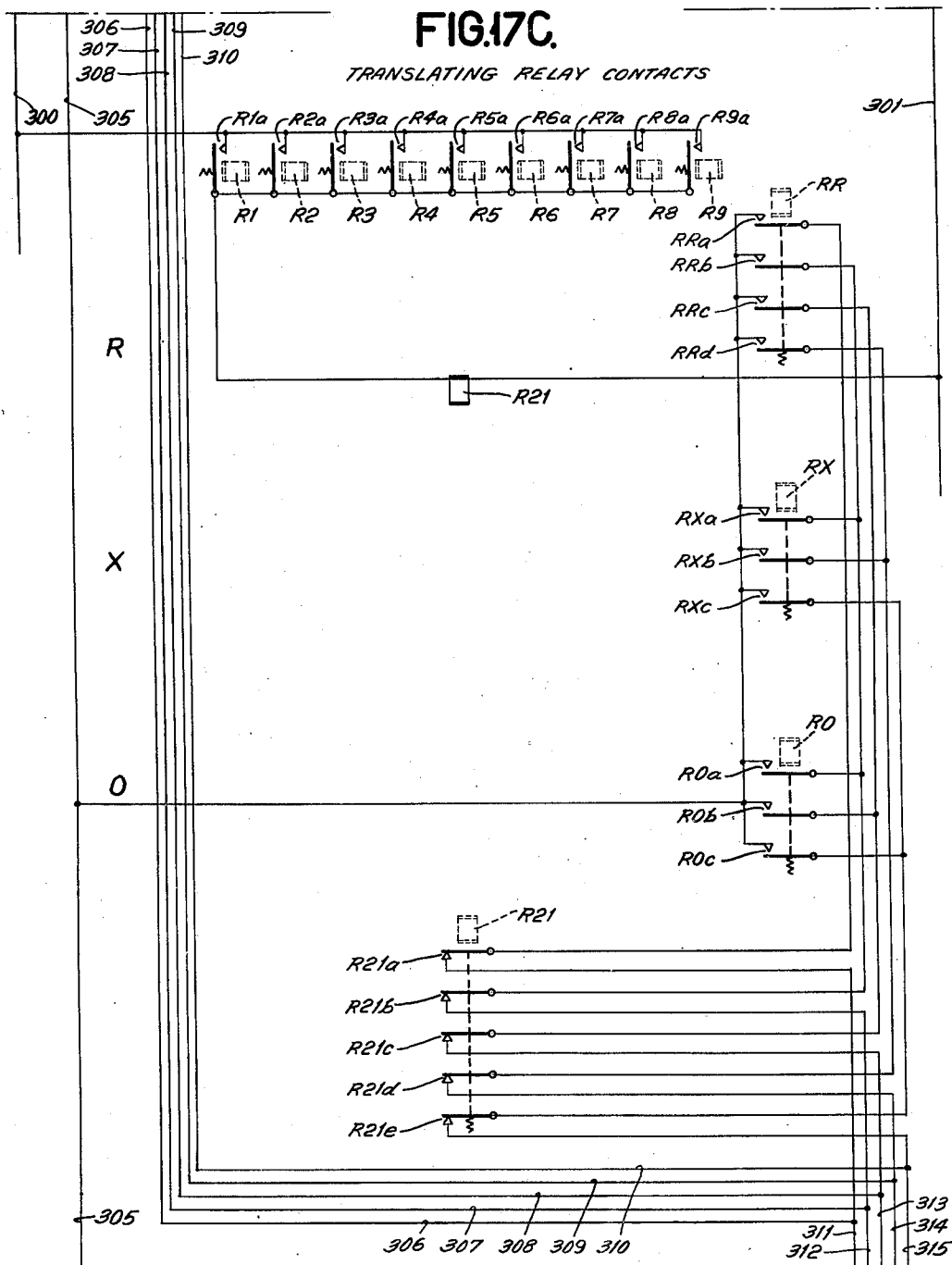
RECORD CONTROLLED PERFORATING APPARATUS

Filed June 13, 1942

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FIG. 17C.

TRANSLATING RELAY CONTACTS



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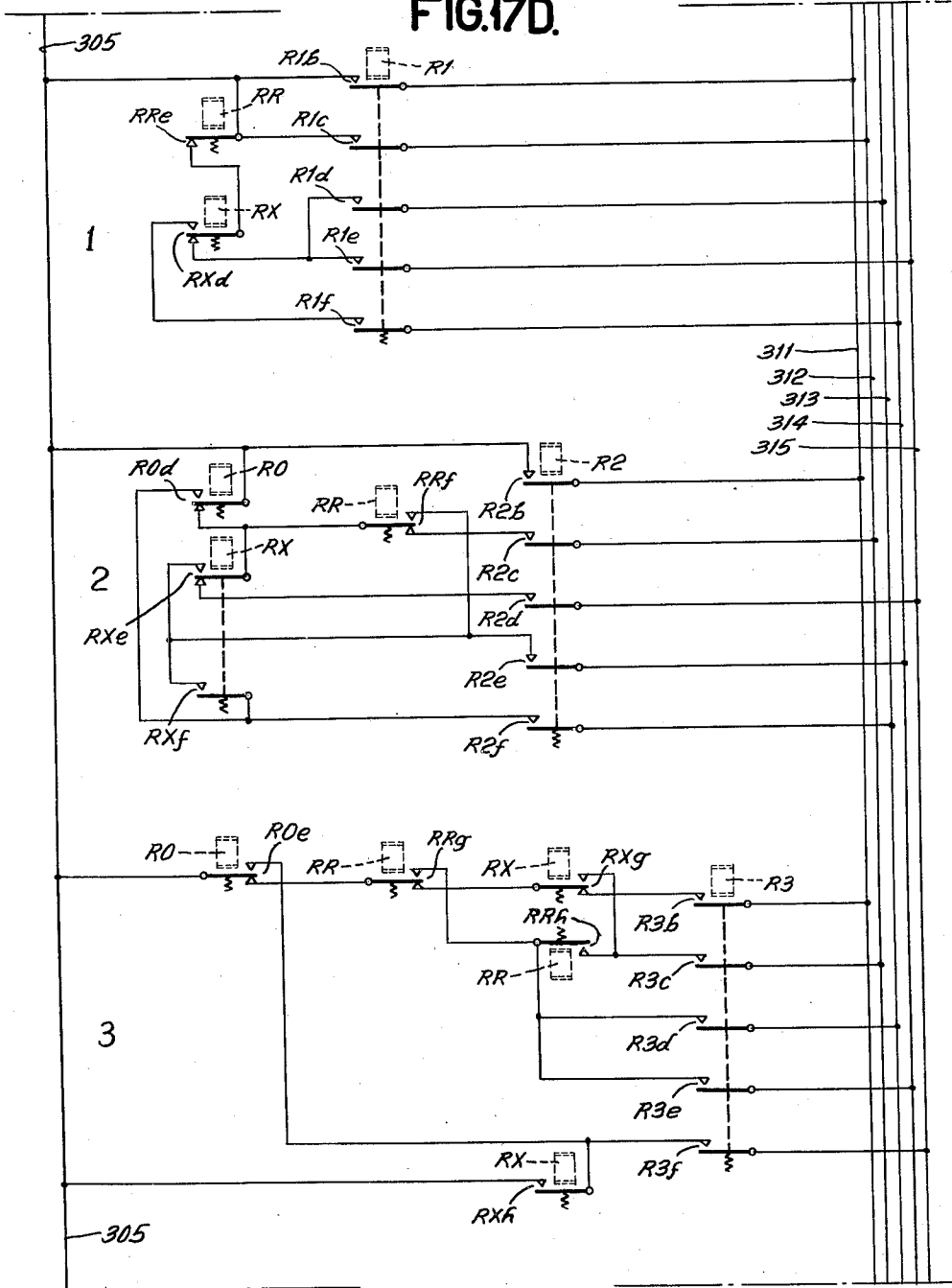
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14 Sheets-Sheet 12

FIG. 17D.



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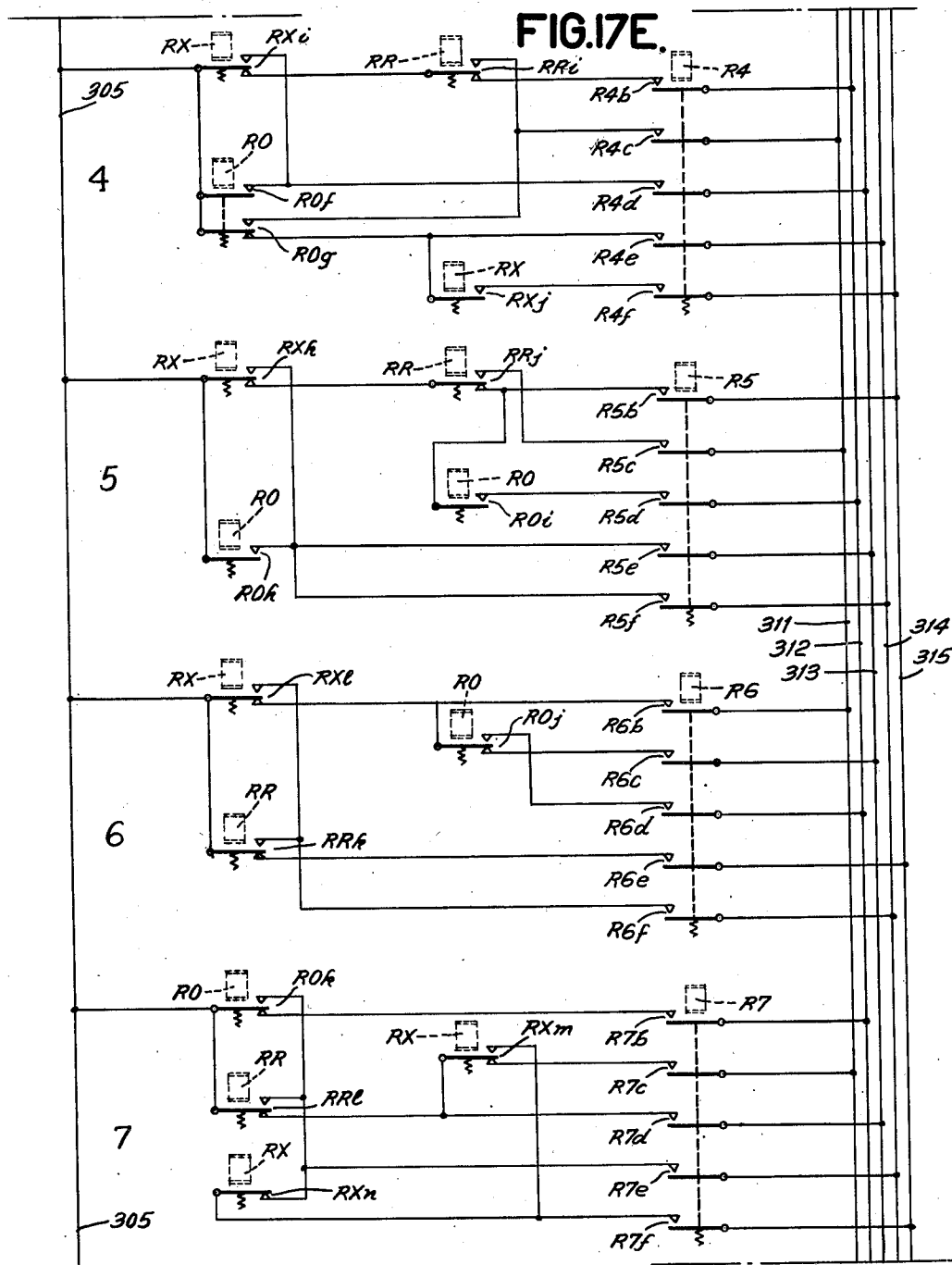
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RECORD CONTROLLED PERFORATING APPARATUS

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14 Sheets-Sheet 13

FIG. 17E.



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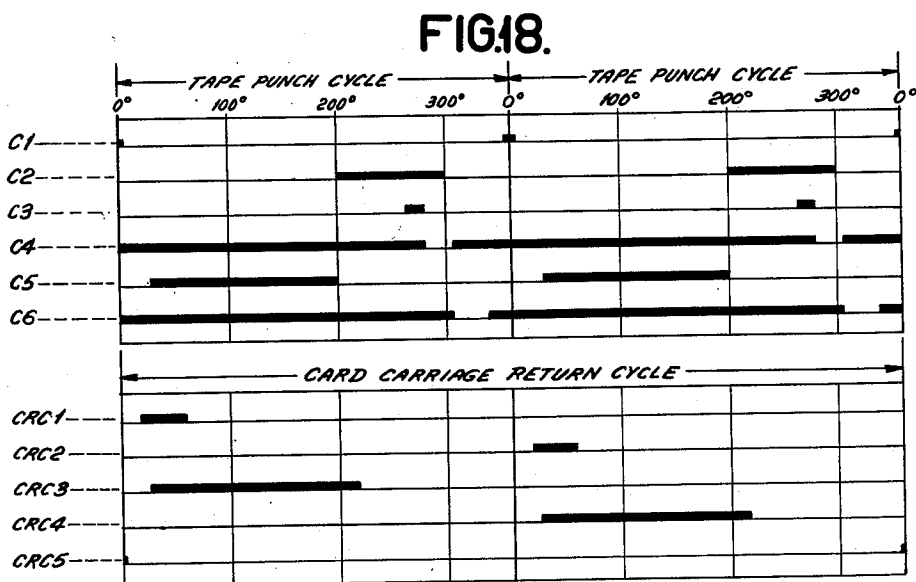
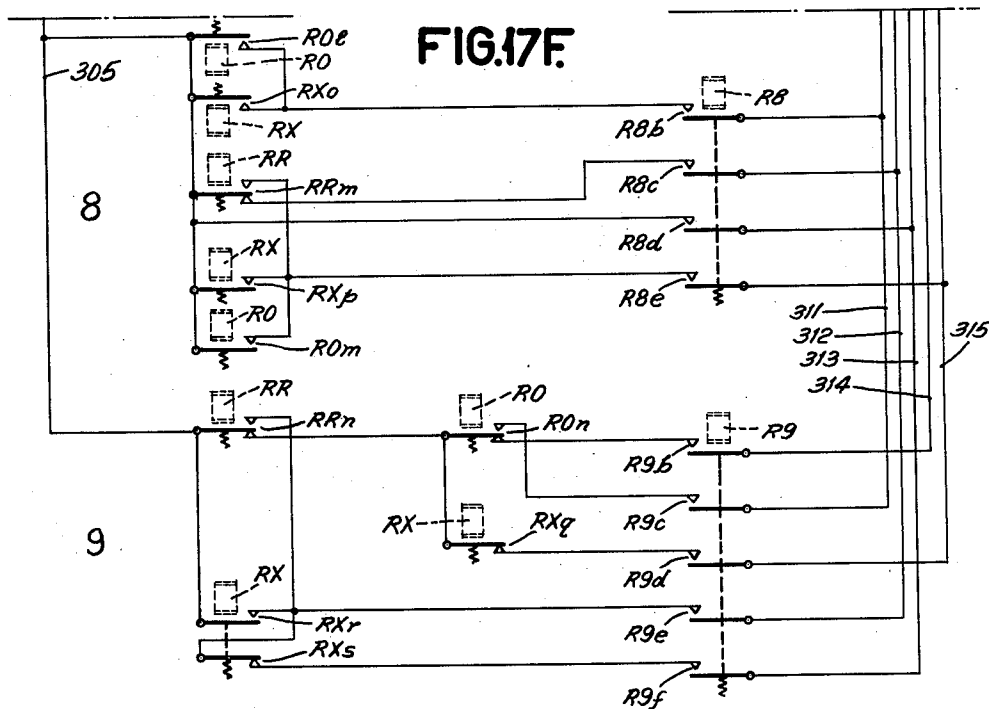
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RECORD CONTROLLED PERFORATING APPARATUS

Filed June 13, 1942

14 Sheets-Sheet 14



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UNITED STATES PATENT OFFICE

2,340,800

RECORD CONTROLLED PERFORATING
APPARATUS

Charles R. Doty, Yonkers, N. Y., assignor to International Business Machines Corporation,
New York, N. Y., a corporation of New York

Application June 13, 1942, Serial No. 446,877

34 Claims. (Cl. 164—115)

This invention relates to record controlled perforating apparatus, and more particularly to such apparatus wherein the data designations are recorded on a sheet in a code different from the code of the data designations sensed on the control record.

A primary object of the present invention resides in the provision of improved apparatus whereby the information recorded on statistical or tabulating cards may be perforated in telegraphic tape suitable for controlling the operations of remotely situated printing telegraph transmission and recording devices.

In the usual printing telegraph or teletypewriter systems, a five-unit Baudot or Teletype selecting code is employed to represent the various symbols to be transmitted. This code provides a maximum of thirty-two different combinations so that thirty-two different signals may be transmitted over the telegraph system by this code. In order to enable the transmission of more than thirty-two different characters and symbols, the same code combinations, for example, are employed for designating alphabetical and numerical data; thus, it is necessary to employ a key signal for identifying the data designating code combinations or signals as alphabetical or numerical. Also, when teletypewriters or "printers" are controlled by telegraphic tapes, it is necessary that the "functional" signals (such as "carriage return") which control the teletypewriter type basket position are punched in the tape preceding the characters to be printed. These mentioned signals are punched in the tape at the beginning of each line, and for any changes from letters to numerals, or vice versa, that may occur during the printing of each line.

Accordingly, the following provisions must be made in the telegraphic tape, (1) that the "letters" and "figures" key signals or codes must be perforated in the tape preceding the character designating perforations to indicate whether the coded perforations designate alphabetical or numerical data, and (2) that "carriage return" and "line feed" signals or codes must be perforated in the tape before the character designations of the next line are recorded on the tape. These latter signals return the teletypewriter carriage to the left-hand margin, and space the paper to the next printing line.

In the present commercial statistical or tabulating systems, it is common practice to record the information or data on tabulating cards by perforations which are arranged, singly or in different combinations, in different positions in ad-

jacent vertical columns. The statistical code, such as the Hollerith code, employed in such tabulating systems is wholly different from the five-unit code used in printing telegraph systems.

Thus, whenever it is desired to prepare a telegraphic tape in accordance with the data contained on statistical cards, and automatically under the control of such cards, it is necessary to provide the following features, (1) suitable translating means whereby the sensed data in statistical code on the cards are automatically converted into, and recorded on the tape, in the telegraphic code, (2) suitable means to determine whether the columnar data on the cards are alphabetical or numerical, and to automatically provide the corresponding key code, "letters" or "figures" on the tape preceding the character designating perforations, (3) additional means to determine the presence of any blank columns on the cards and to automatically provide for a "space" signal or code on the tape under such conditions, and (4) other additional means to automatically provide for the insertion of "carriage return" and "line feed" signals before recording the next line of characters on the tape.

The specific embodiment to be described serves merely as one illustrative form of the invention, and comprises a suitable statistical record card sensing unit, whereby each card is advanced to present successively the columns of alphabetical and numerical data designations to individual sensing elements. Groups of translating and control relays are selectively controlled by the sensing elements. The selectively controlled translating relays translate or convert the Hollerith code into the Baudot code, and control selectively the energization of code combinations of the tape punch magnets so that the alphabetical and numerical data sensed on the cards are recorded in telegraphic code on the tape. The selectively controlled control relays condition selectively a group of supervisory circuits in order to determine whether the sensed data in each column of the card contains alphabetical or numerical data, or is a blank column. In the former event, the tape punch unit is automatically controlled by the said supervisory circuits, so that its magnets are energized to perforate, first, the key signal or code "letters" or "figures," depending upon which character group (alphabetical or numerical group) the sensed data is related to, and then the code designations corresponding to the sensed data. The alphabetical or numerical data, at such times, are stored, in the translating relays, until the corresponding key code des-

ignations are recorded in the tape. In the event a blank column is detected, provision is made, whereby the said supervisory circuits cause a "space" signal automatically to be perforated in the telegraphic tape, and also cause the card sensing unit to be controlled to sense the next column of the card. Provisions are also made, whereby the usual "R," "X," and "0" perforations on the card are sensed, translated and automatically represented on the telegraphic tape by suitable code designating perforations.

Accordingly, in addition to the said mentioned features, another object of the present invention resides in the provision of an improved recording apparatus wherein alphabetical and numerical data, which is recorded in statistical code and disposed indiscriminately in various columns of a statistical card, are translated into a telegraphic code, and analyzed to determine and identify the character group to which the sensed data belongs.

Another object of the present invention resides in the provision of an improved recording apparatus for determining whether the indiscriminately disposed data in various columns of a statistical card are alphabetical or numerical, and for recording automatically identifying key code designations on a telegraphic tape, said key code designations being recorded prior to the corresponding character designating perforations.

Another object of the present invention resides in the provision of an improved recording apparatus for automatically detecting alphabetical and numerical data, and blank columns, indiscriminately arranged on record cards, and recording identifying designations on the telegraphic tape accordingly.

Another object of the present invention resides in the provision of an improved recording apparatus for automatically recording "carriage return" and "line feed" signals successively on a telegraphic tape upon the analysis of the last effective column of a statistical card.

Another object of the present invention resides in the provision of an improved recording apparatus for automatically recording "carriage return" and "line feed" signals on a telegraphic tape upon return of a reciprocable card carriage for picking up a new card.

Still another object of the present invention resides in the provision of an improved perforating apparatus having cyclically operable punch elements which are set into operation upon the sensing of each new column of a statistical card.

Still another object of the present invention resides in the provision of an improved perforating apparatus wherein the cyclically operable punch elements are controlled in a start-stop manner, and operated two cycles whenever a key code is recorded in the telegraphic tape.

Still another object of the present invention resides in the provision of an improved perforating apparatus wherein the key code is recorded during the first cycle of operation of the punch elements and the character designating perforations are recorded during the second cycle.

Still another object of the present invention resides in the provision of an improved perforating apparatus wherein the advancement of the next column of a statistical card is suppressed whenever any key code is recorded in the telegraphic tape.

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 example, the principle of the

invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a plan view of the sensing unit and shows diagrammatically the electrically connected record sensing and tape perforating units.

Fig. 1A is a detail of a statistical record card having coded data designating perforations formed therein in statistical code.

Fig. 2 is a section taken along lines 2—2 of Fig. 1.

Fig. 3 is a view of the left end of the card feeding mechanism showing the card ejecting devices, the view being taken substantially in the direction of lines 3—3 of Fig. 1.

Fig. 4 is a detail showing the clutch mechanism of the card carriage mechanism and the related driving motor.

Fig. 5 is a detail of the cut-out control device of the card feeding mechanism.

Fig. 6 is a detail of the card carriage escape-mechanism.

Fig. 7 is a detail of the skip magnet and the controlled mechanism.

Fig. 7A is a detail of the cam controlled contacts controlled by the card carriage return mechanism.

Fig. 8 is a detail showing the telegraphic code employed herein.

Fig. 9 is a fragmentary section of a telegraphic tape perforated by the present apparatus.

Fig. 10 is a plan view of the tape perforating unit.

Fig. 11 is a sectional view of the perforating unit taken along the lines 11—11 of Fig. 10.

Fig. 12 is a sectional view taken along the lines 12—12 of Fig. 10.

Fig. 13 is a sectional view taken along lines 13—13 of Fig. 10 showing the tape feeding means.

Fig. 14 is a detail of the cam control means for the resetting means of the perforating unit.

Fig. 15 is a detail of the cam control means for the locking means of the perforating unit.

Fig. 16 is an exploded view of the start-stop clutch means of the perforating unit.

Figs. 17A to 17F arranged sequentially below each other is a diagram of the circuit connections of the apparatus.

Fig. 18 is a timing diagram.

General description

Before describing in detail the individual record sensing and tape perforating units which are shown electrically connected in Fig. 1, by a cable connection CC, and the operation of the present apparatus, a general outline of the functional operations thereof will be set forth briefly.

Individual record cards C (Fig. 1) having columns of alphabetical and numerical data recorded thereon, in the Hollerith code, are presented to a sensing station, by means of a reciprocable card carriage comprising a pusher 13 and guide 14. The individual columns of data are fed, step by step, to the group of individual sensing brushes 12 (a sensing brush 12 being provided for each index point position). The said sensing brushes 12 are connected to individual translating relays of the group RR, RX, R0, R1-R9 (see Fig. 17A), which relays are controlled selectively in accordance with the sensed data designations on the record cards. A plurality of control relays R10-R14 are connected to certain ones of the translating relays so as to be controlled selectively by the brushes in accordance with the data sensed on the cards.

The individual translating relays are provided with groups of translating contacts (see Figs. 17C-17F) connected in cascaded relationship, which contacts, in turn, are connected to the common conductors 311-315. The said translating relays and associated contacts are effective to translate or convert the data designations sensed in statistical code to the five-unit telegraphic code, and, accordingly, control selectively the energization of the punch magnets 290 in different code combinations, thereby causing the code designating perforations representing the data sensed on the record cards to be punched in the telegraphic tape 200 (Fig. 9).

In order to distinguish properly, whether the code designations in the telegraphic tape are alphabetical or numerical data, a plurality of supervisory circuits are provided, which circuits are selectively controlled by the said control relays. The said supervisory circuits include the relays R15-R19 (Fig. 17B), which relays are conditioned selectively in order to supervise the tape punch operations. Whenever, alphabetical data are sensed on the record cards, relays R15-R19 and their associated circuits are conditioned to cause the punch to record a "letters" key signal or code preceding the data designations representing the alphabetical data, and whenever, numerical data are sensed the said relays and circuits are conditioned to cause the punch to record a "figures" key signal or code preceding the numerical data designations. It is to be understood, whenever two or more columns of data sensed on the cards relate to the same group of characters, namely, the alphabetical or numerical character group, it is not necessary to provide an individual key signal or code before each character code designation to be recorded in the telegraphic tape 200. A single key signal or code preceding a group of successive code designations representing characters of the same group is sufficient.

The tape punch unit is operated in a start-stop manner, under control of a clutch magnet 280, and normally is operated one cycle for recording the character code designating perforations. However, whenever a change from alphabetical to numerical characters, or vice versa, is sensed in the record cards, the sensed data is stored in the said translating relays during a preliminary punch cycle. Under these conditions, the said conditioned relays R15-R19 and associated circuits cause the punch unit to operate two cycles, so that during the first cycle the said key signal or code is recorded, and during the second cycle the said character code designations are recorded.

Whenever a blank column is detected in the record card, the said control relays R10-R14 condition additional circuits, whereby the punch unit is controlled to record automatically a "space" signal or code in the telegraphic tape 200, and the record card sensing unit is controlled, whereby the next column of the card is fed to the sensing brushes 12 in order to be analyzed.

During the time, the reciprocable card carriage is returned to pick up a new card and present its first column to the sensing brushes, the cam controlled contacts CRC1-CRC5 (Figs. 7A, 17A and 17B) are set into operation, under control of card carriage returning mechanism including gear 26, to condition additional circuits, whereby the punch unit is controlled to record automatically a "carriage return" signal in the tape followed by a "line feed" signal.

The individual card sensing and tape punch units will now be described in sufficient detail for a full comprehension of the present invention. In view of the fact, that the mechanical arrangement of the card feeding and ejecting mechanism is substantially the same as that found in the machines known as the "international duplicating key punch, and alphabetical verifier," such as shown, for example, in U. S. Patent No. 1,914,263 granted June 13, 1933 to Lake et al., U. S. Patent No. 2,107,161 granted February 1, 1938, to Page, and the copending application Serial No. 296,961, filed September 28, 1939, the following condensed description thereof is deemed sufficient. The tape punch to be described is set forth and claimed in a copending application, Serial No. 438,973 filed April 15, 1942, by A. C. Holt.

Control record

Referring now to Fig. 1A, the control record is shown to comprise a well known tabulating machine record card, generally designated C, of the type quite commonly used in the Hollerith electric tabulating systems. Differentially positioned control representations, such as perforations 9, are used to represent the various data and character designations. The perforations are differentially positioned in various columnar areas or fields of the record card, and by the differential positioning thereof different data values are imparted thereto. It is seen that the letters of the alphabet are designated by pairs of control representations or perforations, each perforation of a pair being located in one of the twelve index point positions of a columnar area. Commonly, the index point positions indicated as "R" and "X" are referred to in the tabulating systems as the "twelve" and "eleven" index point positions respectively.

The Hollerith character code shown in Fig. 1A is quite an arbitrary one and different well known codes which have been used in statistical systems may be employed in the present recording system. It will be noted by reference to the said code in Fig. 1A that the alphabet is divided into three groups. The letters of the first group A to I are designated by different combinations of a perforation in the "R" index point position with perforations in the one to nine index point positions. The letters of the second group J to R are designated by perforations in the "X" position and combination of perforations in the one to nine positions, while the letters of the third group S to Z are identified by combinations of a "0" perforation with perforations in the two to nine index point positions. The individual numerical characters are represented by a single perforation in the corresponding zero to nine index point positions. The record cards may have as many columnar areas for the reception of the data designating perforations as may be desired. The description to be set forth hereinbelow relates to mechanism commonly used in tabulating systems employing the standard eighty column record card.

Record sensing unit

Record card feeding means.—Referring to Fig. 1, the record cards C to be sensed or analyzed are placed in a magazine designated 10 from which they are advanced singly by means of a picker 11 toward the left to present their first column to a card sensing position above the sensing brushes designated 12 (also see Fig. 2).

In this position, the reciprocable card carriage comprising a pusher 13 and a forward guide 14 engages the card and advances it, step by step, under control of the escapement mechanism to be described later. Pusher 13 and guide 14 are carried by an escapement rack 15 and the picker knife 11 is carried by a rack bar 16. Rack 15 has a gear 17 meshing with its lower edge (see Fig. 2) and bar 16 has a gear 18 (see Fig. 4) meshing with its upper edge, both gears being mounted on a cross shaft 19 (see Fig. 1). Due to this connection between the elements, the movement of picker 11 toward the left, as viewed in Fig. 1, is accompanied by movement to the right of pusher 13 and forward guide 14. At the commencement of operations, the picker and pusher are in the position shown in Fig. 1.

The rack 16 is provided with a finger piece 20 at its right hand extremity by means of which the rack 16 and the picker 11 may be moved toward the left to feed a card from the magazine 10. This movement is accompanied by movement of the pusher 13 in the opposite direction, the parts being so proportioned that, when the card has been advanced to present its first column to the sensing brushes 12, the pusher 13 will have moved toward the right sufficiently to engage the right hand or trailing edge of the card, and will now control the further advancement thereof in response to the operation of the escapement mechanism. A one-way clutch mechanism, generally designated 21 in Fig. 4, permits the immediate return to the right of bar 16 and picker 11 under control of a spring (not shown).

The operation of card feeding just outlined is more fully explained in Patent 1,772,186 granted to F. L. Lee et al. for a duplicating punching machine. The escapement mechanism referred to is of the same general nature as that disclosed in the Schaff Patent 1,426,223 and a brief description thereof will be given later.

Secured to the under side of the base of the machine is a motor 22 (Fig. 4) coupled to a stub shaft 23 (see Fig. 2), to which is secured a worm 24 in mesh with a worm wheel 24a secured to a shaft 24b, one end of which has secured thereto a ratchet-shaped clutch element 25. Loosely mounted on shaft 24b is a gear 26 meshing with teeth on the lower edge of rack bar 16 and on which gear is mounted a disk 27 (Fig. 4). Mounted upon disk 27 is a clutch mechanism generally designated 28, one element of which is provided with a pin 29 positioned for engagement by a finger 30 integral with the armature 31 of a trip magnet 32. With the machine at rest, the parts occupy the position shown in Fig. 4 and, when magnet 32 is energized, the finger 30 will operate the clutching mechanism to couple the disk 27 to the rotating ratchet 25, so that the disk 27 and gear 26 are rotated counterclockwise to drive the rack bar 16 toward the left. The clutching mechanism is constructed, as explained in greater detail in the patents referred to, so as to remain in engagement for substantially a complete revolution, at the completion of which time the clutching mechanism engages a fixed member 33, which effects uncoupling of the parts, whereby they may automatically return to the position shown in Fig. 4 under the influence of a spring (not shown). This power drive of rack bar 16 toward the left has the same effect as the manual movement thereof previously explained, that is, a card will be advanced to sensing position and the pusher 13 will engage the same for further step-by-step advancement, and rack bar 16 may

thereafter return to its home position without disturbing the advanced position of the card or pusher 13, this being permitted by the one-way clutch structure 21 mentioned above.

Also integral with the armature 31 of the trip magnet 32 is an arm 34 (see Fig. 2), the free end of which is adapted to bear upon the center blade of pairs of contacts 35 and 36 to open the former and close the latter when magnet 32 is energized, and they will be maintained in such shifted position by a latching bell crank 37, the lateral extension 38 of which is adapted to be engaged by a plate 39 secured to gear 26 at the termination of the driving movement of the latter. The contacts 35 and 36 are used to control the energization of the driving motor 22 and their function will be more fully explained in connection with the circuit diagram.

Escapement means.—When the card is in position above the sensing brushes 12 (Fig. 2), further advance is controlled by the escapement mechanism which in turn is responsive to the energization of escape magnet 40. Upon energization of magnet 40, its armature 41 will be rocked about a pivot in a clockwise direction and through a screw 42 secured to rod 43 will rock the rod 43 counterclockwise against the tension of a spring 44. The rod 43 is rocked as an incident to each spacing operation and has secured to one end thereof oppositely extending arms 45, 46 (see also Fig. 6), of which arm 46 is provided with a laterally extending pin for engagement with an enlarged opening in a stepping dog 47 which is loosely pivoted on rod 43. Opposite arm 45 is provided with a pin extending into a slot formed in the locking dog 48. When rod 43 is rocked, arm 46 will, through its pin and slot connection with dog 47, lift the latter out of one of the notches of the rack 15 and at the same time arm 45 will depress locking dog 48 into a notch between the rack teeth. At this time a spring 49 advances the loosely pivoted dog 47 a short distance just sufficient to permit this dog to move above the top of the next tooth. When the locking dog is again raised, stepping dog 47, due to the movement of rack 15, will ride down along the next tooth until it strikes the end thereof and the carriage is thereby arrested. The usual spring drum (not shown) is provided to bias the rack 15 toward the right, as viewed in Fig. 6. The detailed structure in this dog and rack arrangement is well known and need not be further described, and it is sufficient to note that for each operation of the escape magnet 40, the rack 15 is advanced one step or tooth, carrying with it the pusher 13 and forward guide 14, so that the card is likewise advanced one step, each step of advancement being coextensive with the columnar spacing of the columns of the card.

Skip control means.—The machine can be provided with the usual skip bar indicated at 50 (Figs. 6 and 7) which is removably attached to the escapement rack 15 at one side thereof and provided with suitable notches and cam surfaces which cooperate with the usual skip lifter arm 51 which has a beveled end 52 (Fig. 7). The end of the lifter 51 lies under the dog 47 so that, if lifter 51 is moved toward the left, as viewed in Fig. 7, at any time that a high portion of the skip bar is in line therewith, the beveled end of the lifter will cooperate with the cam surface of the bar to raise the end of the lifter which, upon being so raised, elevates the dog 47 to release rack 15. The lifter arm 51 will drop into the next

notch in bar 50 and dog 47 will interrupt further movement of the rack beyond such point. The function of this skip bar 50 is to skip over the columns or fields which are not to be sensed. The right end of the lifter 51 is connected to a slider 53 whose right hand end is provided with an opening into which the free end of a finger 54 extends. This finger is integral with armature 55 of skip magnet 56, the armature being pivoted at 57. With this arrangement, energization of magnet 56 will cause lateral shifting of skip lifter 51 with consequent skipping operations. Upon deenergization of magnet 56, the parts are returned to normal by a spring 58.

A further means by which the card may be advanced is controlled by a release magnet designated 60 (Fig. 2) which, when energized, will rock its armature 61 about pivot 62 causing the free end of an integral finger 63 to depress a release key 64. The mechanism controlled by this key is well known in this type of machine and is briefly as follows. The lower end of key 64 through the bell crank 65 will draw a member 66 toward the right, as viewed in Fig. 2. This member 66 is suitably mounted for such movement, and at its left hand end is provided with a cam surface 67 which cooperates with the edge 68 of the supporting plate. The member 66 also extends beneath the skip lifter 51 in a position generally as indicated in Fig. 7, so that as the member 66 is moved toward the right, cam 67 cooperating with plate 68 will cause an upward tilting of the left end of the member which in turn will lift the arm 51 upwardly against the stepping dog 47, whereupon the rack will be free to advance uninterruptedly toward the left. Frictional engagement of the parts will maintain the member 66 in its shifted position so that the escapement of the rack, when initiated by the release magnet 60, will not be interrupted until the card has been fully advanced, that is, until the last card column is advanced to the sensing position.

At this time a suitable projection carried by the rack will engage a depending extension of the left extremity of member 66 and will draw the member toward the left back to the position it occupies in Fig. 2. Briefly summarizing, after the card has been initially advanced to present the first card column to the sensing brushes 12, its further advance is controlled for column-by-column movement through the escape magnet 40. Multiple column advancement is controlled through the skip magnet 56 in cooperation with the skip bar 50, and the complete release of the card from any position to its last column position is controlled by the release magnet 60.

Automatic card ejecting means.—The machine is provided with mechanism for automatically removing the sensed cards and depositing the same in a receptacle provided for the purpose. This mechanism is more fully shown and described in Patent No. 1,916,965 issued July 4, 1933, to J. M. Cunningham. Briefly, a gripper 70 occupies the position shown in Fig. 3 with its jaw open in card receiving position during the period that the card is advanced by the escapement mechanism. The gripper is carried by the rod 71 to which is secured a gear 72 which through idlers 73 is connected to a slidable rack 74 which is normally biased toward the right by a spring 75. A pivoted latching member 76 engages a latching shoulder at the left hand extremity of the gripper and thereby serves to hold the parts in the position shown in Fig. 3. When the latching member 76 is rocked counterclockwise about its

pivot 77, the spring 75 will be free to drive the rack 74 toward the right and through the gearing 73, 72 flip the gripper 70 in a counterclockwise direction. This flipping action is effected after the card has been advanced to its extreme left hand position, at which time the leading edge thereof is between the jaws of the gripper. Releasing the gripper will cause the jaws to automatically clamp the end of the card thereto so that the card will be swung in an arc about the rod 71 and deposited in the receptacle 78, suitable means being provided to cause the jaws to release the card.

For the purpose of actuating the latch member 76 there is provided the usual eject magnet 79 which, when energized, will rock its armature 80 about pivot 81 and draw a link 82 toward the right. The left extremity of the link is provided with an extension 83 which, when the link is moved, will strike a depending arm of the latch member 76 and effect the rocking action thereof which results in the ejection of the card by the gripper. This ejecting operation will bring about the automatic feeding of another card from the magazine 10 to the sensing brush. This operation is initiated by means of a pair of automatic start contacts designated 84 which are closed through a pivoted bell crank 85, a depending arm of which is engaged by an extension 86 in rack 74 when the rack has been released for movement toward the right.

In a manner to be explained in connection with the circuit diagram, the contacts 84 control the operation of the driving motor which, as explained, will cause advance of a new card from the magazine and also cause movement toward the right of card pusher 13 and forward guide 14. As the rack 16 is moved toward the left, its left hand end will engage an adjustable extension 87 carried by the rack 74 which will positively restore the rack toward the left and through the gearing shown will return the gripper to the position it occupies in Fig. 3, the latch member 76 being spring-biased to engage and hold the gripper in such position until the newly advanced card has been sensed and advanced to its last column position, whereupon the automatic ejection and initiation of a new card feeding operation will take place.

Record card sensing means.—The card sensing brushes 12 are shown in Fig. 2. There are provided twelve of these brushes positioned side by side, there being one for each of the usual twelve rows of index point positions of the card. The brushes 12 are mounted in an insulating brush holder 90 which is mounted so that the brushes 12 are given substantially a vertical movement upwardly, from the position shown in Fig. 2, to contact the card and effect electrical connections through the perforations therein with a common contact roller 91. The upward movement of the brushes 12 is controlled by the reading brush magnet 92 which, when energized, will cause the brushes 12 to move upwardly through mechanism generally designated 93. This mechanism is of the usual construction and a detailed description thereof may be found in the patents referred to. Its purpose is generally to maintain the brushes in their lower position when they are not actually sensing perforations in the card, and thereby preserve them against undue wear and also against damage by any inadvertent backward movement of the record cards. The armature 94 of magnet 92 is arranged when attracted by the magnet to open a pair of con-

tacts 95, whose function will be explained in connection with the circuit diagram.

Miscellaneous contact means.—Several contacts in addition to those described are provided in the machine, and the operation of these will be pointed out before the entire operation of the apparatus is explained in connection with the circuit diagram.

In Fig. 5, a finger piece 110 pivoted at 111 (also see Fig. 1) is shown mounted on a cross arm 99, which finger piece also has a depending arm 112. When it is desired to manually back-space the card carriage, it is done by pressing against the finger piece 110, whereupon a slight rocking thereof is effected before the card carriage actually moves. During this slight rocking, the extension 112 will rock on universal bar 113 about its pivot 114 to cause a depending arm 115 thereon to open the so-called cut-out contacts 116, which are provided in the reading brush magnet circuit to insure that this magnet is deenergized, and that the related brushes are in a down position before there is any backward movement of the card which might injure the brushes.

In Fig. 6 is shown a pair of contacts 145 known as the "last column contacts." These contacts are closed by an arm 146 secured to the escapement rack and so located that, when the escapement rack is advanced to the position in which the last column of the card is presented to the sensing brushes, the extension 146 will be in engagement with and close contacts 145. Also in Fig. 6 are shown the "floating cam" contacts 149, one blade of which is shifted by an arm 150 which is loosely pivoted on the rod 43 and which has a lateral extension resting upon the upper edge of the stepping dog 47 so that during escapement from one column to another, the incidental raising of the stepping dog 47 through arm 150 will cause opening of contacts 149 during the period that the dog is raised. In Fig. 4, the rack gear 26 is shown in driving relation with gear 160, the ratio of which gears is 1:1. Gear 160 is attached to shaft 161 as shown in Fig. 7A, which shaft is connected to a suitable uni-directional driving mechanism, generally designated 162, which can be of the usual pawl and ratchet type. The said uni-directional driving mechanism is connected to a cam shaft 163 having a plurality of suitable cams 164-168 secured thereto, which cams in turn are arranged to control the operations of suitably disposed contacts CRC1-CRC5, respectively. The purpose of these cam controlled contacts will be explained hereinbelow.

Perforated telegraphic tape

Referring now to Fig. 8, a tape 200 is shown provided with successive transverse rows of perforations 201 arranged in accordance with the well known five-unit telegraphic code, usually referred to as the Baudot or Teletype permutation code. In a five-unit code system only thirty two possible permutations are available, and, as mentioned hereinabove, for this reason, it is necessary to employ the same code combinations to represent the alphabetical characters, and the numerical and other designation characters.

In order to distinguish the alphabetical characters from the other remaining characters, for telegraphic transmission purposes, the alphabetical signals or code designations are always preceded by a "letter shift" signal or code designation, and the other remaining character signals or code designations are preceded by a "figure shift" signal or code designation. Whenever, it

is desired, in the telegraphic printed copies, to have spaces appear thereon, it is necessary to insert "space" code designations in the perforated tape. For example, in the perforated tape shown in Fig. 9, the indicated code perforations are arranged so as to designate 123JOHN JONES 567; which arrangement of code designations in the perforated tape is necessary when the tape is employed for controlling the known types of printing telegraph apparatus. The usual smaller feed perforations 202 are also shown to be provided in the tape 200, as well as the "carriage return" and "line feed" perforations which are provided at the end of each line of information.

A suitable mechanism for perforating a tape in accordance with the said Baudot or Teletype code will now be described.

Tape perforating unit

Referring now to Figs. 10, 11 and 12, the perforating apparatus is shown to include individual punch elements 210, one for each unit of the telegraphic code, and a common die block 211. The punch elements are slidably arranged in a common punch guide block 212 and are normally held in raised positions by means of individual springs 213. The said springs are supported by a bracket 214 which is suitably secured to side plate 215. The said punch guide and die blocks are also suitably secured to the side plate 215. Each punch element 210 is provided with a recess 216, into which recess is placed one end of a positionable interposer 217 having a yoke portion 218. An individual interposer 217 is provided for each punch element 210. An elongated cam or eccentric 219 is carried by, or if desired, formed on shaft 220, which shaft is suitably journaled in the side plate 215 and end plate 221. The eccentric 219 is located within the bows of the yokes of the individual and adjacently arranged interposers to support and actuate or oscillate the said interposers. Normally, during the rotation of the eccentric, the interposers are moved downwardly and upwardly (as viewed in Fig. 11) by the supporting eccentric about the pivotal connections formed by the ends of the interposers engaging the recesses of the related punch elements. Under these conditions, it is seen, that the free ends of the interposers are partially rotated, first in one direction and then the other direction, or stated in other words, the said free ends of the interposers are oscillated. Suitably disposed stop guides 217a and 217b are provided to maintain proper alignment of the said oscillated interposers.

Individual latch arms 222 are provided, one for each interposer, and are pivotally mounted in a slotted guide block 223 secured to the said side and end plates. Near the lower end of each latch arm, a pair of spaced latching fingers 224 are provided, which fingers are disposed in close proximity to, but normally held out of the path of the rotatable ends of the interposers by means of a slotted leaf spring 225 secured to a reset bail 226. The bail 226 is rotatably mounted in the said side and end plates, and is elongated sufficiently to permit engagement of the bail with all the latch arms 222. Spring 225 is elongated sufficiently so that the individual slotted sections engage the related latch arms.

Whenever it is desired to operate a punch element 210, the related latch arm is partially rotated, in a clockwise direction (as viewed in Fig. 11), against the action of the said leaf spring 225, so that its latch fingers 224 engage and latch the

free end of the related interposer. It should be mentioned, at this time, that, in the present embodiment, the shaft 220 carrying the eccentric 219 is not constantly rotated, but operated in a start-stop manner, and that the latch arms 222 are arranged to be positioned to latch the desired interposers before the rotated eccentric displaces or oscillates the said interposers. Thus, upon latching of an interposer 217 and rotation of the eccentric 219, the said interposer is positioned, by the eccentric, about the pivotal connection formed by the latch arm and the latched end of the interposer, to force the related punch element 210 downwardly (in Fig. 11), thereby causing the sheet, such as a paper tape 200, interposed between the said guide and die blocks, to be perforated. The eccentric 219 is shaped so that the lower end, or cutting edge, of the displaced punch element is forced through the paper tape, and then retracted therefrom immediately and restored to the normal position shown in Fig. 11.

Locking means are provided for holding the displaced latch arm or arms in a latched position, and for preventing displacement of undesired latch arms during the rotation of the eccentric. This means comprises a locking bail 228, which is common to all latch arms 222, and which is suitably secured to an arm 229, which arm 229 in turn is fixed to shaft 230. Shaft 230 is rotatably mounted in said side and end plates, and also has affixed thereto a spring urged cam follower arm 231 (also see Fig. 15), cooperating with cam 232 secured to the start-stop shaft 220. Cam 232 is shaped so that normally (with the shaft 220 in a stop position) the locking bail 228 is held in a position so as to be out of the path of the extension 233 of each latch arm 222. Upon displacement of the desired latch arms in the said latching position, and upon rotation of shaft 220, the follower arm 231 drops from the high portion of the cam 232 to permit the locking bail 228 to be raised (in Fig. 11) in the path of the said latch arm extensions, thereby engaging the said extensions of the displaced latch arms and locking them in the latching position, as shown in dotted outline in Fig. 11. This position of the said locking bail also prevents any faulty displacement of the normally positioned latch arms, since the bail is now effective to engage the extensions of any latch arms which inadvertently might be displaced during the rotation of shaft 220, thereby blocking further clockwise rotation of these latch arms, and preventing engagement of the latching fingers 224 and the latching ends of the related interposers 217. The said raised position of locking bail 228 is maintained until near the end of the cycle of rotation of shaft, when the high portion of cam 232 again engages the follower arm 231 to lower the said bail. Obviously, the said bail must be lowered before the latch arms 222 are positively restored by the action of the said reset bail 226. In practice, it has been found desirable to maintain the locking bail 228 in the said raised positions from the 12° point to the 285° point in the cycle of rotation of shaft 220.

For this arrangement, it is preferred to render the reset bail 226 operative from the 303° point to the 352° point in the said cycle. The said bail 226 is secured to shaft 233a (also see Fig. 12) journaled in the side plate 215, which shaft has affixed thereto a spring urged arm 234. Arm 234 (also see Fig. 14) is resiliently connected by means of spring 235 to a cam follower arm 236 secured to sleeve 237, which sleeve is loosely

mounted on shaft 233a. In this manner follower arm 236 is constantly urged against cam 238 secured to shaft 220. Said cam 238 is effective, near the end of each cycle of rotation of shaft 220 to partially rotate the follower arm 236 and shaft 233a in a counterclockwise direction (Fig. 14) to cause the bail 226 and attached spring 225 to be partially rotated in a counterclockwise direction to positively urge and restore the latch arms 222 to the normal position out of the path of the latching ends of the related interposers 217, as shown in Fig. 11.

Suitable means for intermittently advancing the paper tape 200 are provided, which means in the present arrangement are operated near the end of each cycle of rotation of the said shaft 220. Specifically, the paper feeding mechanism is called into action from the 334° point to the 356° point in each cycle. The paper tape 200 is intermittently fed from a suitable supply roll (not shown) to the punching station by feed roll 240 secured to shaft 241, which shaft is suitably journaled in side plate 215 and a suitable support 242. Said feed roll 240 is provided with equally spaced teeth 243 for engaging the feed perforations 202 in the tape 200. A positionable arcuately shaped tape finger guide 245 is provided to press the tape against the said feed roll. Shaft 241 has secured thereto a ratchet wheel 246 (also see Fig. 13) which is advanced by a spring urged cooperating pawl 247 pivotally mounted on a suitable cam follower arm 248, which arm cooperates with cam 249. Cam 249 is shaped so as to move the follower arm 48 sufficiently to the right (as viewed in Fig. 13) so that pawl 247 is positioned ahead of one of the teeth of ratchet wheel 246. Approximately, at the 334° point in the cycle, the cam roller 250 drops from the high point of cam 249 permitting the follower arm 248 to be moved toward the left (Fig. 13), by means of spring 251, thereby causing the pawl 247 to engage a tooth of the ratchet wheel and advance it one step, in a counterclockwise direction. Thus, the tape 200 is advanced to present the next position thereon to the punching station. Yieldable locking means are provided to hold the feed roll 240 in the advanced position, which comprise the cam wheel 252 secured to shaft 241 and the spring urged pivotally mounted detent arm 253 provided with a roller 254 riding on the said cam wheel.

With this type of tape feeding and locking means, it is possible, when desired, to feed the tape in a reverse direction, step by step. Manually operable lever 255 is provided for this reason, and is pivotally mounted on the side frame 215. Lever 255 is connected, by a pin and slot arrangement, to member 256 which is slidably mounted on side plate 215. Member 256 carries a spring urged, pivotally mounted pawl 257 and a camming element 258. Thus, when lever 255 is partially rotated in a clockwise direction, as viewed in Fig. 13, member 256 is raised causing pawl 257 to engage one of the teeth of cam wheel 252 and position it one step in a clockwise direction, and consequently causing the feed roll 240 to feed the tape one step, in the reverse direction. While the member 256 is being raised, the camming element 258 is effective to engage a bent over portion 259 of the pawl 247 to raise the latter above the ratchet wheel 246 so as to permit the reverse rotation of the said ratchet wheel and feed roll.

From the description up to this point, it is un-

derstood, that, at the start of each cycle of rotation of shaft 220, the latch arms 222 are positioned in any desired combination so as to be partially rotated, in a clockwise direction (Fig. 11), in order to latch the free ends of the related interposers 217. Next, the locking bail 228 is operated to engage and lock the displaced latch arms 222 in a latched position, during a major part of the cycle, and to prevent further latching operations by the remaining latch arm or arms during this cycle. Eccentric 219 is then effective to oscillate the latched interposers 217 causing the connected punch elements to be operated to perforate the paper tape 200, in accordance with the selected combination of operated punches, while the said tape is at rest at the punching station (see perforations in Fig. 9). Near the end of the cycle, after the punching operation, that is, when the punch elements are withdrawn completely from the paper tape and restored to the normal position shown in Fig. 11, the locking bail 228 is restored to its normal position, and the reset bail 226 is rendered operative to restore the latch arms to their normal positions, thereby releasing the latching ends of the related interposers. The tape feeding mechanism is also rendered operative, near the end of the cycle to advance the paper one step, thus presenting the next punching position on the tape to the said punch elements.

It should be mentioned at this time, that the feed perforations 202 are not originally provided in the paper tape 200, but are formed therein during each punching operation. For this purpose, a special latch arm 260 (see Figs. 10, 11 and 12) is provided, which is fixedly secured to the slotted guide block 223. This latch arm is also provided with latching fingers 261, similar to latching fingers 224, which fingers 261 constantly grip or engage the latching end of the related interposer 262, so that, during each punching operation, the said interposer 262 is effective to operate the connected punch element, similarly as described hereinabove. In this way, the centrally located feed perforations 202 are formed in the paper tape. It is to be noted, that latch arm 260 is not provided with an extension 233, as latch arms 222, and obviously there is no need for it, since latch arm 260 always remains in a fixed position. Also, it is to be noted in Fig. 11, that this special latch arm 260 is arranged and disposed so as not to be engaged by or interfere with the said operations of the reset bail 226 and associated leaf spring 225.

In order to control the start-stop operations of shaft 220, a well known type of electromagnetically controlled, one-revolution clutch means is provided. For a detailed description of the clutch mechanism, reference should be made to U. S. Patent No. 2,206,646 issued to Schneider, July 2, 1940. Accordingly, the brief description to be given is deemed sufficient to complete comprehension of the present invention. In Figs. 10, 12 and 16, this clutch means is shown to comprise an annular member 270 which is secured to shaft 220. A slidable and spring urged dog member 271 is disposed in a suitable channel formed in the said annular member, which dog member is provided with a single tooth 272. A dog lift lever 273 is pivotally mounted in the annular member 270, and is disposed in a suitable channel-way formed in the slidable dog member 271. The free end of the said dog lift lever extends beyond the periphery of the annular member 270 and normally is positioned against a stop 274

formed on the suitably pivoted arm 275, which arm normally is urged by leaf spring 276 so that the said stop 274 is in the path of the dog lift lever 273. With the described elements of the clutch means in this position, the dog lift lever 273 is effective to hold the dog member 271 so that the single tooth formed thereon is out of the path of a ratchet wheel 277, secured to constantly rotated shaft 278, and disposed in close proximity to the annular member 270. Secured to the said pivoted arm 275 is an armature 279 of an associated and suitably disposed magnet 280; which armature, upon momentary energization of magnet 280, positions the stop 274 of arm 275 out of the path of the dog lift lever 273, thereby releasing the latter and permitting the dog member 271 to be positioned so that its tooth 272 engages the ratchet wheel 277. Shaft 278 is constantly rotated by means of motor 281, the shaft of which is connected to shaft 278 by a suitable coupling device 282. In this manner, shaft 220 is rotated. Upon completion of a cycle of rotation of shaft 220, the dog lift lever 273 is urged against the said stop 274 to disconnect the tooth 272 of the dog member from the constantly rotated ratchet wheel 277, thus preventing further rotation of this shaft. Suitable locking means are provided for this described clutch, and comprise a suitably disposed, spring urged pawl 283 cooperating with a suitable notch formed in the flange 284 of the annular member.

It will be evident to those skilled in the art, that various types of control means can be employed for selectively positioning the latch arms 222, and thereby control selectively the operations of the punch elements 210. One type of control means will now be described, and comprises, as shown in Figs. 10 and 11, a plurality of individual magnets 290. Connected to each armature 291, of the related magnet 290, is an arm 292 provided with a loosely connected link 293 extending to and suitably connected with one of the latch arms 222. Each armature is connected to one of the latch arms in the said manner, so that, upon energization of a magnet 290, the attracted armature 291 positions the attached link 293 to the right, as viewed in Fig. 11, thereby causing the related latch arm 222 to be positioned in the described latching position. The circuit control means employed for controlling the selective operations of the punch control magnets 290, and the clutch control magnet 280 will be described hereinbelow.

Also, secured to shaft 220 is a gear 294 (see Fig. 10) in mesh with gear 295, the latter being secured to a suitably supported cam shaft 296. The said cam shaft carries a plurality of cams 297 which are arranged to control the suitably disposed related contacts C1—C6. The purpose of the cam controlled contacts will be understood as the description progresses.

Operation

Referring now to Figs. 17A to 17F, arranged sequentially one below the other, the operation of the described units will be explained in connection with the circuit diagram.

As mentioned hereinabove, the columns of data designations in the record cards must be sensed to determine the nature of the data designating perforations of each column, or whether a column is blank and devoid of any data designations, that is, each column of the card must be analyzed to determine whether the punched data are alphabetical or numerical. It also was mentioned that like code combinations are employed for

designating alphabetical and numerical characters in the five-unit Baudot or Teletype code, thus, the data designating perforations in the telegraphic control tape must be preceded by a key code signal or designation, such as a "letters" or "figures" signal or designation.

In order to simplify the description to follow, assume that the first eighteen columns of the record card C to be sensed is arranged with data designations representing: 123John Jones 567; and that the card sensing unit is conditioned so that the first column of the record card C is under the sensing brushes 12.

Numerical data.—Upon closure of the latch contacts 35 and the floating cam contacts 149, a circuit is completed from conductor 300 through said contacts 35 and 149, contact roll 91, brush 12 sensing the "1" perforation, coils of translating relay R1 and control relays R13 and R14 to conductor 301, thus, energizing the said relays.

At the same time, a circuit is also completed from conductor 300 through contacts 35 and 149, coils of the tape punch clutch magnet 280, and cam controlled contacts C1 (closed at this time, see Fig. 18) to conductor 301, thus energizing the said clutch magnet. In this manner, shaft 220 of the tape punch is called into operation to effect rotation of the associated eccentric 219 and cam elements of the related cam controlled contacts C1 to C5.

The transferred contacts R13a to R13c (Fig. 17B) exercise no controlling effects during numerical sensing operations; however, closure of contacts R13d permits a circuit to be established from conductor 300 through contacts 35, conductor 302, normally closed contacts R10b, R11b, and R12b, said contacts R13d, normally closed contacts R18a, and coil of relay R16 to conductor 301, thus energizing the said relay.

Contacts R16a are opened to insure an open circuit to the escape magnet 40 of the sensing unit; contacts R16b are opened to insure an open circuit to coil of relay R17; contacts R16d are closed to complete a circuit from conductor 300 through contacts 35, conductor 302, said contacts R16d, coil of relay R19 to conductor 301, thus, energizing the said relay and causing contacts R19a to R19e to be transferred, and contacts R19f to be opened.

The said transferred contacts connect the "1," "2," "4" and "5" punch magnets 290 directly to cam controlled contacts C5. The "3" punch magnet 290 is connected to contacts R16e, which are opened at this time during numerical sensing operations.

Upon closure of the said contacts C5, near the beginning of the punch cycle (see Fig. 18), the "1," "2," "4" and "5" punch magnets 290 are connected to conductors 300 and 301 to energize the said magnets, thereby causing the "figures" code designating perforations to be punched in the first transverse row of the telegraphic tape 200, as indicated in Fig. 9.

Upon completion of punching the "figures" perforations, the cam controlled contacts C2 are closed, as indicated in Fig. 18, tending to establish a circuit to the escape magnet 40 to advance the next column of the card to the sensing brushes 12, however, due to the said open contacts R16a, a circuit cannot be completed to the said magnet, consequently, the first column of the card remains under the said sensing brushes during a subsequent punch cycle, maintaining the said relays R1, R13 and R14 energized.

Shortly before the cam controlled contacts C2

are opened, the cam controlled contacts C3 are closed to establish a circuit from conductor 300 through contacts 35, conductor 302, the said cam contacts C3, the said closed contacts R16c, coil of relay R18, contacts R15c and R20a to conductor 301, thus, energizing the said relay. A holding circuit for relay R18 is immediately established through contacts R18b connected directly to conductor 302.

Opening of contacts R18a causes relay R16 to be deenergized and the related contacts R16d to be opened, the latter contacts, in turn, causing relay R19 to be deenergized and restoring the said transferred contacts R19a to R19e, and the opened contacts 19f, to their normal positions, as indicated in the circuit diagram.

As described hereinabove, near the end of each punch cycle, the tape feeding mechanism of the punch unit is operated to advance the tape 200 one step, thus presenting the next portion of the tape to be punched to the punch elements.

Upon completion of the punch cycle, cam controlled contacts C1 are closed, as indicated in Fig. 18, to again cause the tape punch clutch magnet 280 to be energized, thereby releasing the said punch shaft 220 and initiating a second punch cycle. During this second punch cycle the tape is punched in accordance with the code combination for the sensed numerical data "1." It should be noted that relays R16 and R19 cannot be energized during this second punch cycle, due to the said opened contacts R18a, thus the contacts R19a-R19e remain in their untransferred positions during the remainder of the said second cycle. The said contacts R19a-R19e now connect the individual punch magnets 290, by means of the related conductors 306-310, to the individual conductors 311-315, respectively, the latter being connected to groups of translating contacts of the translating relays RR, RX, R0, and R1-R9, which groups of translating contacts are connected together in a cascaded relationship.

Now, upon closure of cam controlled contacts C5, during the said second punch cycle, a circuit is completed from conductor 300 through the said cam contacts C5, conductor 305, contacts R1b and R1c, and normally closed contacts RRe, RXd to contacts R1d and R1e, conductors 311, 312, 313, 315, respectively, conductors 306, 307, 308, 310, respectively, contacts R19a, R19b, R19c, R19e, respectively, and the "1," "2," "3," "5" magnets 290 respectively, to conductor 301; thus, energizing the said magnets and causing the code designating perforations representing the numeral "1" to be punched in the second transverse row of the telegraphic tape 200, as indicated in Fig. 9.

After the said punching operation is completed, during this second punch cycle, cam controlled contacts C2 are closed and are effective to cause energization of the escape magnet 40, and cause the next, or second, column of the card to be fed to the sensing brushes, by means of a circuit completed from conductor 300 through contacts 35, conductor 303, normally closed contacts R15a and R16a, said cam contacts C2 to escape magnet 40 and conductor 301.

It is recalled, upon energization of the escape magnet 40 and operation of the described escapement mechanism of the sensing unit, that the floating cam contacts 149 are opened, until the next column of the card is presented to the sensing brushes. Opening of contacts 149 causes the translating relay R1 and control relays R13 and R14 to be deenergized.

Upon closure of the said floating cam contacts another punch cycle (third) is initiated due to the completion of the previously traced circuit to the punch clutch magnet 280 through the contacts 35, 149 and C1. At the same time, a circuit is completed from conductor 300 through contacts 35 and 149, contact roll 91, brush 12 sensing the "2" perforation, coils of translating relay R2 and control relays R13 and R14 to conductor 301, thus energizing the said relays.

Since the said second column of the record card C has numerical data punched therein, namely, the numeral "2" as assumed in the present example, it is not necessary to punch again the "figures" key code designation in the tape preceding the actual code designation for the said numeral "2." As mentioned hereinabove, whenever, a group of data designations, representing all numerical or all alphabetical data, are arranged in successive columns on a record card, it is only necessary to provide one key code designation preceding each group of numerical or alphabetical data designations on the telegraphic tape. Thus, in the chosen example, the first three columns of data on the record card are numerical, therefore, in converting and punching this data on the telegraphic tape, it is merely necessary to provide a single key code designation, namely, the "figures" key preceding the three transverse rows of perforations in the tape representing the numerical data sensed in the said three successive columns on the card.

This is accomplished in the circuit diagram by maintaining the control relay R18 energized at all times during the sensing of a similar group of data designations. The holding circuit for relay R18 is maintained through contacts R18b until relay R15 is energized to open the said contacts R15c in the previously traced holding circuit. As mentioned previously, contacts R18a are held open, under these conditions, to prevent energization of relay R16 and in turn R19, thus maintaining the R19a-R19e contacts in their normal indicated positions, whereby the tape punch magnets 290 are connected directly to the differently connected groups of contacts of the translating relays.

Thus, upon closure of the cam controlled contacts C5, during the third punch cycle, the following punch magnet circuits are established: from conductor 300 through the said cam contacts C5, conductor 305, contacts R2b, normally closed contacts R0d, RRf and contacts R2c, normally closed contacts RXe and contacts R2d, conductors 311, 312 and 315, respectively, conductors 306, 307 and 310 respectively, normally closed contacts R19a, R19b, and R19e, respectively, and the "1," "2," and "5" punch magnets 290, respectively, to conductor 301; thus, energizing the said magnets and causing the code designating perforations representing the numeral "2" to be punched in the third transverse row of the telegraphic tape 200, as indicated in Fig. 9.

After the said punching operation is completed, during this third punch cycle, the cam controlled contacts C2 are closed and are effective to cause energization of the escape magnet 40, as previously described, to present the next or third column of the card to the sensing brushes.

Upon closure of the floating cam contacts 149 and cam contacts C1, the punch clutch magnet 280 is energized to initiate a fourth punch cycle as described hereinabove; also, as described, a circuit is completed to the brush 12 sensing the "3" perforation to effect energization of the

translating relay R3 and control relays R13 and R14.

Upon closure of the cam contacts C5, a circuit is completed through the normally closed contacts ROe, RRg, RXg and contacts R3b to contacts R19a and the "1" punch magnet 290 just as previously traced, to energize the said magnet to cause the code designation representing the numeral "3" to be punched in the fourth row of the telegraphic tape 200, as indicated in Fig. 9. Whereupon, the escape magnet 40 is energized, upon closure of cam contacts C2, to present the next, or fourth, column of the card to the sensing brushes.

Alphabetical data.—It is remembered in the chosen example, that the fourth column in the record card is perforated to represent the alphabetical character "J." Since the preceding column contained numerical data, it is necessary to cause the machine to automatically punch the "letters" key before the code designation for "J" is punched in the telegraphic tape.

Upon closure of the cam contacts 149 and C1, the punch clutch magnet 280 is energized to initiate a fifth punch cycle, and also upon closure of cam contacts 149 and C1, circuits are completed from conductor 300 through contacts 35 and 149 to the contact roll 91, brushes 12 sensing the "X" and "1" perforations, translating relays RX and R1, and control relays R11 and R13, respectively, and control relay R14 to conductor 301, thus energizing the said translating and control relays.

A circuit is now completed from conductor 300 through contacts 35, conductor 302, contacts R11a, transferred contacts R13b, normally closed contacts R17a, coil of relay R15 to conductor 301, thus energizing the said relay. Opening of contacts R15a insures an open circuit to the escape magnet 40, when cam contacts C2 are closed during this fifth punch cycle; contacts R15c open the described holding circuit for relay R18, dropping out this relay; contacts R15d close to cause relay R19 to be energized and effect transferring of the contacts R19a-R19e, and opening of the contacts R19f. Opening of contacts R11b prevents the energization of relay R16 during this cycle, or any cycle relating to sensing and punching of alphabetical data.

Thus, upon closure of cam contacts C5, conductors 300 and 301 are connected to all the punch magnets 290, by means of the transferred contacts R19a-R19e, and normally closed contacts R16e, causing the said magnets to be energized and punch the key code designation for alphabetical characters in the fifth transverse row in the telegraphic tape 200, as indicated in Fig. 9, namely, the "letters" key code or designation.

After the punching of the "letters" key designation, cam contacts C3 are closed to complete a circuit from conductor 300 through contacts 35, conductor 302, said cam contacts C3, closed contacts R15b, coil of relay R17, normally closed contacts R16b and R20a to conductor 301, thus energizing the said relay. A holding circuit for this relay is established immediately through its related contacts R17b connected directly to conductor 302, which holding circuit is maintained until the said contacts R16b are opened.

Opening of contacts R17a causes relay R15 to be deenergized, the contacts R15d of which cause relay R19 to be deenergized, thus restoring the contacts R19a-R19f to their normal positions. It is seen from the described connections, that relay R15 cannot be energized again, during sub-

sequent sensing operations, until numerical data is sensed in the card to cause the energization of relay R16.

It was mentioned, that, since contacts R15a are open at the time the cam contacts C2 close in this fifth punch cycle, card feeding operations are suppressed during this said cycle. Upon closure of cam contacts C1, at the end of the fifth cycle, the punch clutch magnet 280 is energized to initiate the sixth punch cycle. Since cam contacts 149 were not operated during the said fifth cycle, the translating relays RX and R1, and control relays R11, R13, and R14 are constantly energized.

During this sixth cycle, upon closure of cam contacts C5, the sensed alphabetical data is translated and converted into the telegraphic code, and punched in the tape accordingly, by means of the following circuits: from conductor 300 to the said cam contacts C5, conductor 305, closed contacts R1b and R1c, normally closed RRe contacts, transferred contacts RXd and closed R1f contacts, conductors 311, 312 and 314, respectively, conductors 306, 307 and 309, respectively, normally closed contacts R19a, R19b and R19d, respectively, the "1," "2" and "4" punch magnets 290, respectively to conductor 301; thus, energizing the said punch magnets and causing the code designating perforations representing the alphabetical character "J" to be punched in the sixth transverse row of the telegraphic tape 200, as indicated in Fig. 9.

Now, upon completion of the described punching operation, cam contacts C2 are closed, and are effective to complete a circuit through the escape magnet 40 (contacts R15a and R16a being closed at this time) to cause the next column of the card to be presented to the sensing brushes. During the said card feeding operation, the floating cam contacts are opened to deenergize the said translating relays RX and R1 and control relays R11, R13 and R14. At the end of the sixth punch cycle, cam contacts C1 are closed, and upon closure of the floating cam contacts 149, the punch clutch magnet 280 is energized to initiate the seventh punch cycle; also at the same time, the brushes 12 sense the "X" and "6" perforations, representing the alphabetical data "0" in the fifth column of the record card, to cause energization of the translating relays RX and R6, and the control relays R11, R13 and R14. Since relay R17 is still energized, the contacts R11a and R13b cannot establish a circuit to relay R15 during this cycle, consequently, relay R19 remains deenergized at this time, thereby maintaining the direct connections of the punch magnets 280 to the contacts of the translating relays through the normally closed contacts R19a-R19e.

Upon closure of cam contacts C5, during the seventh punch cycle, circuits are completed from conductor 300 through the said cam contacts C5, conductor 305, transferred contacts RX1 and closed contacts R6f, normally closed contacts RRe and closed contacts R6e, conductors 314 and 315, respectively, conductors 309 and 310, respectively, normally closed contacts R19d and R19e, respectively, and the "4" and "5" punch magnets 290, respectively, to conductor 301; thus, energizing the said punch magnets and causing the code designating perforations representing the letter "0" to be punched in the seventh row of the telegraphic tape 200, as indicated in Fig. 9.

Similarly, upon sensing the data designating

perforations for the characters "H" and "N" in the sixth and seventh columns of the record card, the corresponding code designating perforations representing the said "H" and "N" characters are punched in the eighth and ninth rows, respectively, of the telegraphic tape 200, as indicated in Fig. 9.

It should be mentioned in conjunction with the sensing of alphabetical data in the record card that, upon energization of any one of the relays R1-R9, a circuit is completed from conductor 300 to one of the contacts R1a-R9a and coil of relay R21 to conductor 301, thus energizing the said relay and causing the contacts R21a-R21e to be opened. Opening of the said contacts prevents back circuits when the RR, RX, and RO are operated in combination with the said relays R1-R9.

Blank columns.—To continue with the chosen example, it is remembered that the eighth column of the record card is a blank column, and the description to follow applies to any blank columns detected on the card so that repetition thereof is not necessary. Upon feeding or advancing the blank eighth column to the sensing brushes, and upon closure of the floating cam contacts 149, no circuits can be completed to the translating and control relays, however, the circuit to the punch clutch magnet 280 is completed to initiate another (the tenth) punch cycle, as previously described.

Since contacts R14a remain closed during this tenth punch cycle, a circuit is completed as follows, upon closure of cam contacts C5, from conductor 300 through said cam contacts C5, said contacts R14a, cam controlled contacts CRC5, the "3" punch magnet 290 to conductor 301. The said punch magnet causes a single perforation to be punched, in the "3" position, in the telegraphic tape 200, in the tenth row, as indicated in Fig. 9, and represents a "space" signal or designation.

This space signal or designation is punched in the telegraphic tape each time a blank column in the record card is detected. It is to be noted, that the control circuits required for effecting the punching of the space signal, in the tape, do not disturb the previously conditioned circuits to relays R17 or R18. For example, in the preceding punch cycle (the ninth), the holding circuit to relay R17 was maintained through contacts R17b and R16b, to prevent the energization of relay R15. This holding circuit for relay R17 is not disturbed, therefore, it is not necessary to cause a key code designation to be punched in the tape, if the data in the next column is alphabetical data. Similarly, had the holding circuit for relay R18 been established immediately prior to the detection of the blank column, this holding circuit for relay R18 would remain undisturbed so that relay R16 could not be energized, upon the sensing of a numerical designation, therefore, it would not be necessary to cause a numerical key code designation to be punched in the tape, if the data in the next column were numerical.

In the example set forth, the next five columns, in the card, following the blank column are the alphabetical data "JONES," and as mentioned, the last data designations punched in the telegraphic tape prior to the "space" signal were alphabetical, therefore a key code designation is not required to precede the code designations representing "JONES." In view of the detailed description just set forth regarding the sensing and punching of numerical and alphabetical data, it

is believed that further description for the punching of the remaining data designations indicated in Fig. 9, is not necessary.

Carriage return and line feed signals.—Assume now, upon completion of sensing the eighteenth column of the card representing the numeral "7," and upon energization of the escape magnet 40, that the card carriage, by means of a skip bar, is advanced to the last column position to effect closure of the last column contacts 145. A circuit is then completed from conductor 300 through conductor 305 to the said contacts 145, to the eject magnet 79 and conductor 301, thus energizing the said magnet. As described hereinabove, during the ejecting operation, the auto start contacts 84 are closed, whereupon the circuit just traced to the last column contacts 145 is extended through the said contacts 84, the trip magnet 32 and brush magnet contacts 95 to conductor 301, thus energizing the said trip magnet.

It is recalled, that energization of the trip magnet 32 also causes the latch contacts 35 to be opened and contacts 36 to be closed. A circuit is now established through the closed contacts 36 to the drive motor 22, of the sensing unit, to cause the reciprocable card carriage to be returned to pick up a new card from the magazine and present its first column to the card sensing position. It is noted that the normally energized brush magnet 92 is deenergized during this card ejecting and feeding operation, due to the opening of the latch contacts 35. It is noted, too, since the floating cam contains 149 are held open, during the mentioned skip operation and also during the card ejecting and feeding operation, that the punch clutch-magnet 280 remains deenergized, until a special control operation is initiated. The said latch contacts 35 and 36 and the floating cam contacts 149 are restored to the normal positions, shown in the circuit diagram, when the first column of the new card is presented to the sensing brushes.

Upon returning of the card carriage, the cam contacts CRC1 are closed to complete the following circuit to the punch clutch magnet to initiate another punch cycle: conductor 300, closed latch contacts 36, said contacts CRC1, the punch clutch magnet 280 and cam contacts C1 to conductor 301. Cam contacts CRC3 are also closed at this time so that, upon closure of cam contacts C5, a circuit is completed from conductor 300 through the said contacts C5 and CRC3 to the "4" punch magnet 290, thus causing the "carriage return" signal or code designation to be punched in the tape 200, as indicated in Fig. 9.

The timing and speed of operation of the sensing unit and punch unit is such that the punch unit is capable of completing at least two punch cycles during the time required for returning the card carriage to pick up a new card from the magazine. This timing condition is indicated accordingly in Fig. 18. Thus, during the first half of the card carriage return cycle or operation, the punch unit completes the described cycle during which the carriage return signal is recorded. During the second half of the card carriage return cycle, cam contacts CRC2 are closed to energize the punch clutch magnet 280 to initiate another punch cycle, during which cycle, cam contacts CRC4 are closed as well as cam contacts C5 to permit the following circuit to be established: conductor 300, said cam contacts C5 to the "2" punch magnet 290 and con-

ductor 301, thus causing the "line feed" signal to be punched in the tape 200, as indicated in Fig. 9.

It is to be noted, that cam contacts CRC5 are opened at the start of the card carriage return cycle and remain so during most of the cycle, so that a false circuit cannot be completed through the contacts R14a which are closed during this said cycle. It is also to be noted, that either relay R15, or R16 which might be energized, at the time the card carriage is returned, is deenergized during the card carriage return cycle due to the opening of the latch contacts 35 at this time. Thus, it is always necessary to record the "letters" or "figures" key code each time the first column of the new card, containing alphabetical or numerical data, respectively, is sensed.

"R," "X" and "0" designations.—Provision is also made in the present invention to record in the telegraphic tape 200 corresponding code designating perforations whenever the "R," "X," or "0" perforations are sensed and are not employed in any alphabetical combination. It is well known in the statistical machine art, that the "R" and "X" perforations are used separately and individually for functional control purposes in statistical machines. Thus, it might be desired to employ the present telegraphic tape for controlling the reproduction of punched record cards as well as control the operations of printing telegraph devices. In such cases, recording of the said "R" and "X" holes must be provided for. It is proposed to use the "figures" and "K" designating perforations in the telegraphic tape for representing the presence of an "R" perforation in the card, and the "figures" and "G" designating perforations for representing an "X" perforation. The "0" perforation in the record card when not used in combination represents the numeral zero.

Upon sensing an "R" perforation in any column in the card, the translating relay RR and control relays R10 and R14 are energized as described in detail hereinabove. The tape punch clutch magnet 280 also is energized at the same time as previously described. Assuming that the last signal punched in the tape was numerical, the "1," "2," "3" and "4" punch magnets 290 would be energized immediately (upon closure of the cam contacts C5) to record the "K" perforations in the tape, by means of the following circuits: conductor 300, cam contacts C5, conductor 305, contacts RRa, RRb, RRc and RRd, contacts R21a, R21b, R21c, R21d, respectively, conductors 311, 312, 313, and 314, respectively, conductors 306, 307, 308 and 309, respectively, contacts R19a, R19b, R19c, and R19d, respectively, the "1," "2," "3," and "4" punch magnets 290, respectively, and conductor 301. However, had the last signal punched in the tape been alphabetical, the usual "figures" key code would necessarily have to be punched before the "K" code designations. This is accomplished by establishing the following supervisory circuit due to the closure of contacts R10a: conductor 300, latch contacts 35, conductor 302, said contacts R10a, normally closed contacts R13a, contacts R18a and relay R16 to conductor 301. It is recalled that energization of relay R16 causes relay R19 to be energized for a single punch cycle, and is then deenergized due to the opening of the said contacts R18a. Thus, the transferred contacts R19a-R19e connect the desired punch magnets 290 directly to the cam contacts C5, so that upon closure of the latter, the "figures" key code designations are recorded in the tape 200 prior to the "K"

code designations. In view of the detailed description hereinabove, it is deemed unnecessary to trace again the control circuits causing the "K" code designations to be automatically perforated in the said tape during the said following punch cycle.

The procedure for perforating the "G" code designations in the tape, upon sensing an "X" perforation in the card is similar to that for the "R" perforation in the card. Relays RX and R11 are energized instead of relays RR and R10. Contacts R11a exercise the same supervisory control operations as contacts R10a. And the RXa, RXb, and RXc contacts cause the energization of the "2," "4" and "5" punch magnets 290, during the punch cycle, precisely as outlined before, to record the "G" code designations in the telegraphic tape.

Under certain circumstances, in printing telegraph practice, it is desirable to have the paper carriage tabulate under control of a "figures" G signal. To accommodate such practices, provision is made to restore relay R17 or R18 to the normal deenergized condition, depending upon which relay was energized, whenever the "figures" G signal is recorded. Due to this operation, it is necessary, before the next character is recorded in the telegraphic tape, to condition the described supervisory circuits so that a "letters" or "figures" key code is recorded prior to the character designations. This provision is as follows: Contacts R11c establish an additional circuit, upon closure of cam contacts C5, from conductor 300 to the said cam contacts C5, normally closed contacts R19f, said contacts R11c, normally closed contacts R10c, R12c, R13e and relay R20 to conductor 301, thus energizing the said relay. A holding circuit for relay R20 is established immediately through the contacts R20b and cam contacts C6. This holding circuit is maintained until near the end of the punch cycle, when the said cam contacts C6 are opened, as indicated in Fig. 18. The contacts R20a, which are connected in parallel with cam contacts C4, are held open at the time, in the punch cycle, cam contacts C4 are opened, and since both contacts R20a and C4 form part of the holding circuit for relay R17 or R18, the latter is deenergized at this time in the cycle. With both relays R17 and R18 deenergized, when the next column in the card is read, it will be necessary to operate the punch unit, as described hereinabove, to record a "letters" or "figures" key code before the sensed data can be recorded.

In order to prevent relay R20 from being energized, during a preliminary punch cycle, whenever the "letters" or "figures" key code is recorded, normally closed contacts R19f are provided in the pick-up circuit, so that whenever relay R19 is energized, the described pick-up circuit to relay R20 is opened. During any character punch cycle, except one controlled by a single "X" perforation, one or more of the control relays R10, R12, R13 will be energized and the pickup circuit of relay R20 will accordingly be held open by contacts R10c, R12c or R13e.

Upon sensing a "0" perforation, the translating relay R0 and control relays R12 and R14 are effective, as previously described, to control the magnets of the punch unit to record the code designations for the numeral zero, namely the "2," "3" and "5" punch magnets. The "figures" key code is punched in the tape preceding the zero code designating perforations, if the preceding character happened to be alphabetical, precisely as described for the "R" and "X" designations.

While there have 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:

1. Apparatus for perforating a tape in telegraphic code controlled by statistical records having columns of alphabetical and numerical data indiscriminately recorded thereon in statistical code, comprising means for feeding individual records, means for sensing the columns of coded data on a record, selectively controlled means for automatically determining whether the sensed data in each column is of the alphabetical or numerical group, a plurality of punch elements, supervisory means controlled by the said determining means for rendering certain code combinations of the punch elements effective for perforating key code designations in the telegraphic tape identifying the sensed data as alphabetical or numerical, and selectively controlled means called into action under control of the said supervisory means for translating the sensed data into telegraphic code and selectively rendering code combinations of punch elements effective for perforating character designations in the said tape in accordance with the sensed data.

2. The invention set forth in claim 1 wherein step by step feeding means are provided for presenting the successive columns of data on a record to the sensing means, and means under control of the said supervisory means for permitting the said feeding means to be rendered operative.

3. The invention set forth in claim 1 wherein step by step feeding means are provided for presenting the successive columns of data on a record to the sensing means, and means rendered effective, under control of the said supervisory means, for suppressing operation of the feeding means whenever the key code designations are recorded in the tape and until the recording of the subsequent character designation is effected.

4. The invention set forth in claim 1 wherein control magnets are provided for the related punch elements, and the said translating means comprise a plurality of selectively controlled relays, each relay having a group of control contacts connected in cascade relation for selectively controlling the energization of code combinations of the said control magnets, thereby rendering the related punch elements effective to record the said designations.

5. The invention set forth in claim 1, wherein the determining and translating means comprise groups of individual relay means for controlling the operations of the said supervisory means and punch elements, respectively.

6. The invention set forth in claim 1 wherein cyclically operable punch elements are provided, start-stop control means for rendering the punch elements operative for one cycle, and control means for influencing the said start-stop control means each time the said key code or character designations are to be recorded in the tape and thereby rendering the punch elements operative.

7. The invention set forth in claim 1 wherein cyclically operable punch elements are provided, start-stop control means for rendering the punch

elements operative for one cycle, and control means for influencing the said start-stop control means successively for causing the punch elements to be operative for two successive cycles, the said supervisory means being effective for causing the key code designations to be recorded during the first cycle and the said translating means being effective for causing the character designations to be recorded during the second cycle.

8. The invention set forth in claim 1 wherein additional control means are provided for automatically causing the punch elements to record a special designation upon the detection of a blank column on a record.

9. The invention set forth in claim 1 wherein additional control means are provided for automatically causing the punch elements to record a "space" code designation upon the detection of a blank column on a record.

10. The invention set forth in claim 1 wherein step by step feeding means are provided for presenting the successive columns on a record to the sensing means, and additional control means for automatically causing the punch elements to record a "space" code designation upon the detection of a blank column on a record and rendering the said feeding means operative for presenting the next column to the sensing means.

11. The invention set forth in claim 1, wherein additional means are provided, under control of the feeding means, for automatically causing the punch elements to record a "carriage return" designation followed by a "line feed" designation upon the sensing of the last effective column in a record.

12. The invention set forth in claim 1, wherein additional means are provided for automatically causing the punch elements to record a "carriage return" designation followed by a "line feed" designation upon the sensing of the last effective column in a record, and other means for conditioning the said supervisory means whereby a key code designation must necessarily be recorded upon the sensing of the first column of the next record.

13. The invention set forth in claim 1 wherein the said feeding means includes a reciprocable card carriage, means for feeding the carriage in one direction to present the columns of data to the said sensing means, and means for returning the carriage into position to be moved by the said last mentioned means; and additional means, under control of the said returning means, for automatically controlling the punch elements for recording a "carriage return" designation followed by a "line feed" designation during the carriage return movement.

14. Apparatus for perforating a tape in telegraphic code controlled by statistical records having columns of alphabetical and numerical data indiscriminately recorded thereon in statistical code, comprising means for sensing successively the columns of coded data on a record, a plurality of translating and control relays controlled selectively by the sensing means in accordance with the sensed data, a plurality of punch elements and related control magnets therefor, means selectively controlled by the translating relays for controlling the energization of certain combinations of the said magnets for rendering the related punch elements effective for perforating character designations in the tape, in telegraphic code, in accordance with the sensed data, and means controlled by the said

control relays for automatically causing certain other combinations of said magnets to be energized for rendering the related punch elements effective for perforating key code designations between two character designations in the said tape, whenever alphabetical and numerical data are sensed in successive columns, or vice versa.

15. Apparatus for perforating a tape in telegraphic code controlled by statistical records having columns of alphabetical and numerical data indiscriminately recorded thereon in statistical code, comprising means for sensing the columns of coded data on a record, means for translating the sensed data in each column on the record into a telegraphic combinational code, means controlled by the sensing means for selectively controlling the translating means in accordance with the data sensed, a plurality of punch elements and related control means therefor, means selectively controlled by the translating means for controlling certain of the said control means for rendering the related punch elements effective for perforating character designations in the tape, in telegraphic code, in accordance with the sensed data, and additional means, under control of the sensing means, for automatically controlling different other ones of the said control means for rendering the related punch elements effective for perforating key code designations between two character designations in the tape, whenever alphabetical and numerical data are sensed in successive columns, or vice versa.

16. Apparatus for perforating a tape in telegraphic code controlled by statistical records having data recorded thereon in statistical code, comprising means for sensing the coded data on a record, means for translating the sensed data on the record into a telegraphic combinational code, a plurality of punch elements and related control means therefor, means controlled by the translating means for controlling certain of the said control means for rendering the related punch elements effective for perforating designations in the tape, in telegraphic code, in accordance with the sensed data, and additional means, under control of the sensing means, for automatically controlling different other ones of the said control means for rendering the related punch elements effective for perforating key code designations in the tape for identifying the said data designation.

17. Apparatus for perforating a tape in telegraphic code controlled by statistical records having data recorded thereon in statistical code, comprising means for sensing the coded data on a record, means for translating the sensed data on the record into a telegraphic code, a plurality of punch elements and related control means therefor, means controlled by the translating means for controlling certain combinations of the said control means for rendering the related punch elements effective for perforating designations in the tape, in telegraphic code, in accordance with the sensed data, additional normally ineffective means for controlling other combinations of the said control means for rendering the punch elements effective for perforating key code designations in the tape, and means under control of the sensing means for rendering the said additional means automatically effective for causing the key code designations to be perforated in the tape for identifying the said data designations.

18. Apparatus for perforating a tape in telegraphic code controlled by statistical records hav-

ing columns of alphabetical and numerical data indiscriminately recorded thereon in statistical code, comprising means for sensing the columns of coded data on a record, means for translating the sensed data in each column on the record into a telegraphic code, a plurality of punch elements and related control means therefor, means controlled by the translating means for controlling certain combinations of the said control means for rendering the related punch elements effective for perforating character designations in the tape, in telegraphic code, in accordance with the sensed data, additional normally ineffective means for controlling other combinations of the said control means for rendering the related punch elements effective for perforating key code designations in the tape, whereby the character designations are properly identified as to alphabetical or numerical data, and means under control of the sensing means for rendering the said additional means automatically effective for causing the proper key code designations to be perforated in the tape preceding the data designations to be identified, whenever alphabetical and numerical data are sensed in successive columns, or vice versa.

19. Apparatus for perforating a tape in telegraphic code controlled by statistical records having columns of alphabetical and numerical data indiscriminately recorded thereon in statistical code, comprising means for sensing the columns of coded data on a record, means for translating the sensed data in each column on the record into a telegraphic code, a plurality of punch elements, control means controlled by the translating means for controlling the operations of certain combinations of the punch elements and rendering the latter effective for perforating character designations in the tape, in telegraphic code, in accordance with the sensed data, additional control means for controlling the operations of other combinations of the punch elements and rendering them effective for perforating key code designations in the tape, whereby the character designations are properly identified as to alphabetical or numerical data, and supervisory means, under control of the sensing means, for automatically rendering the first mentioned control means ineffective and the said additional control means effective whenever a change from alphabetical to numerical data is sensed in successive columns, or vice versa.

20. Apparatus for perforating a tape in telegraphic code controlled by statistical records having columns of alphabetical and numerical data indiscriminately recorded thereon in statistical code, comprising means for sensing the columns of coded data on a record, a plurality of punch elements, means for translating the sensed data in each column on the record into a telegraphic code and rendering certain code combinations of the punch elements effective for perforating character designations in the tape, in telegraphic code, in accordance with the sensed data, means for determining whether the sensed data in each column is alphabetical or numerical, and supervisory means controlled by the said determining means for rendering the said translating means ineffective, said supervisory means including additional means for automatically rendering different other code combinations of the punch elements effective for perforating key code designations in the tape, whereby the character designations are properly identified as to alphabetical or numerical data.

21. Apparatus for perforating a tape in tele-

graphic code controlled by statistical records having columns of alphabetical and numerical data indiscriminately recorded thereon in statistical code, comprising means for sensing a column of coded data on a record, a plurality of punch elements, means capable of translating the said sensed data into telegraphic code and rendering a certain code combination of punch elements effective for perforating character designations in the tape, in telegraphic code, in accordance with the sensed data, means capable of determining whether the said sensed data is alphabetical or numerical, and supervisory means controlled immediately by the said determining means for rendering a different code combination of the punch elements effective for perforating key code designations in the tape identifying the sensed data as alphabetical or numerical, said supervisory means including additional means for automatically rendering the said translating means effective for causing the character designating perforations to be recorded in the tape after the recording of the said key code.

22. Apparatus for perforating a tape in telegraphic code controlled by statistical records having columns of alphabetical and numerical data indiscriminately recorded thereon in statistical code, comprising means for sensing the columns of coded data on a record, punch means, selectively controlled means for determining automatically whether the sensed data in each column is alphabetical or numerical, means capable of translating the said sensed data into telegraphic code and rendering the punch means effective for recording code combinations of designating perforations in the tape in accordance with the sensed data, and supervisory means controlled by the said determining means for rendering the punch means effective to record the data sensed in successive columns in the event the two successively sensed columns contain either alphabetical or numerical data solely, said supervisory means including additional means for rendering the punch means ineffective to record immediately the data sensed in the second column in the event the two successively sensed columns contain both alphabetical and numerical data.

23. Recording apparatus controlled by statistical records having columns of alphabetical and numerical data indiscriminately recorded thereon in statistical code, comprising means for sensing the columns of coded data on a record, telegraphic recording means, selectively controlled means for determining automatically whether the sensed data in each column is alphabetical or numerical, means capable of translating the said sensed data into telegraphic code and rendering the telegraphic recording means operative in accordance with the sensed data, and supervisory means controlled by the said determining means for rendering the said recording means operative to record the data sensed in successive columns in the event the two successively sensed columns contain either alphabetical or numerical data solely, said supervisory means including additional means for rendering the recording means ineffective to record immediately the data sensed in the second column in the event the two successively sensed columns contain both alphabetical and numerical data.

24. Apparatus for perforating a tape in telegraphic code controlled by statistical records having columns of data recorded thereon in statistical code, comprising means for sensing the coded data in the individual columns of a record, feed-

ing means including a reciprocable record carriage for presenting successive columns of the coded record data to the sensing means, cyclically operable punch elements and start-stop control means for normally maintaining the said elements inoperative, means under control of the said carriage for influencing the said start-stop control means and rendering the punch elements operative, for a cycle of operation, each time a new column of coded data is presented to the sensing means, means controlled by the sensing means for translating the sensed coded data in different columns of the record into groups of code combinations of electrical impulses, said translating means comprising a plurality of relay means, each of the latter having a group of contacts connected in cascade relationship, and means controlled by said contacts and responsive to said code combinations of impulses for rendering certain code combinations of punch elements effective, during each cycle, for perforating the tape in telegraphic code in accordance with the sensed data.

25. Apparatus for perforating a tape in telegraphic code controlled by statistical records having columns of data recorded thereon in statistical code, comprising means for sensing the coded data in the individual columns of a record, means for presenting successive columns of the coded record data to the sensing means, a plurality of reciprocable punch elements and cyclically operable oscillating means therefor, continuously operating driving means, start-stop control means for normally maintaining the driving and oscillating means disengaged and thereby maintain the said elements inoperative, means, under control of the presenting means, for influencing the said start-stop control means and rendering the latter effective to cause engagement of the said driving and oscillating means and render the punch elements operative, for a cycle of operation, each time a new column of coded data is presented to the sensing means, means controlled by the sensing means for translating the sensed coded data in different columns on the record into telegraphic combinational codes, and means controlled by the said translating means for rendering certain code combinations of punch elements effective, during each cycle, for perforating the tape in telegraphic code in accordance with the sensed data.

26. Apparatus for perforating a tape in telegraphic code controlled by statistical records having columns of data recorded thereon in statistical code, comprising a group of individual means for sensing the coded data in the individual columns of a record, means for presenting successive columns of the coded record data to the said sensing means, a plurality of reciprocable punch elements and cyclically operable oscillating means therefor, the number of punch elements being less in number than the individual sensing means, continuously operating driving means, start-stop control means for normally maintaining the driving and oscillating means disengaged and thereby maintain the said elements inoperative, means, under control of the presenting means, for influencing the said start-stop control means and rendering the latter effective to cause engagement of the said driving and oscillating means and render the punch elements operative, for a cycle of operation, each time a new column of coded data is presented to the sensing means, and means controlled by the said sensing means for rendering certain code combinations

of punch elements effective, during each cycle, for perforating the tape in telegraphic code in accordance with the sensed data.

27. A perforating apparatus controlled by data bearing statistical cards comprising punch means for recording data designations, a reciprocable card carriage, means for feeding the carriage in one direction during the recording of the data, means for returning the carriage into position to be moved by the said last mentioned means, and means under control of the said returning means for rendering the punch means effective to record predetermined functional indicating designations during the carriage return movement.

28. A perforating apparatus controlled by data bearing statistical cards comprising punch means for recording data designations, a reciprocable card carriage, means for feeding the carriage in one direction during the recording of the data, means for returning the carriage into position to be moved by the said last mentioned means, and means under control of the said returning means for rendering the punch means effective to record a "carriage return" designation followed by a "line feed" designation during the carriage return movement.

29. A perforating apparatus controlled by statistical records bearing columns of data and comprising a plurality of punch elements, means for sensing the columns of data, means controlled by the latter for rendering certain combinations of the punch elements effective to record data designations in accordance with the sensed data, additional means for detecting a blank column of the record, and means under control of the detecting means for rendering a different combination of punch elements effective to record by positive marking a particular designation upon the detection of a blank column.

30. A perforating apparatus controlled by statistical records bearing columns of data comprising punch means, means for sensing the columns of data, means controlled by the latter for rendering the punch means effective to record data designations in accordance with the sensed data, additional means for detecting a blank column of the record, and means under control of the detecting means for rendering the punch means effective to record a "space" designation upon the detection of a blank column.

31. In an apparatus controlled by records having two different types of characters, such as numerical and alphabetical, represented thereon by positioned code points which are distinctively positioned for each character; record reading means including means to sense the code representations of the characters successively; means including a group of code elements operable singly and in various combinations to manifest code signals; translating means controlled by said reading means selectively to operate said code elements, to manifest code signals of a second code in which each of certain signals representing different characters of one of said types also represents a single character of the other type; supervisory means controlled by said sensing means and differently responsive to the record code representations of the two different types of characters; designating means controlled by said supervisory means to operate said code elements to manifest either of two different key signals designating, respectively, the two different types of characters; and disabling means conditioned by said designating means to prevent a second operation of the latter to operate said code

elements to manifest the same key signal twice in succession.

32. In an apparatus controlled by records having two different types of characters, such as numerical and alphabetical, represented thereon by positioned code points which are distinctively positioned for each character; cyclically operating record reading means including means to sense the code representations of the characters successively; means including a group of code elements operable singly and in various combinations to manifest code signals; cyclically operating translating means controlled by said reading means selectively to operate said code elements, to manifest code signals of a second code in which each of certain signals representing different characters of one of said types also represents a single character of the other type; supervisory means controlled by said sensing means and differently responsive to the record code representations of the two different types of characters; designating means controlled by said supervisory means to operate said code elements to manifest either of two different key signals designating, respectively, the two different types of characters; disabling means conditioned by said designating means to prevent a second operation of the latter to operate said code elements to manifest the same key signal twice in succession, and means to delay the operation of said translating means by one cycle each time said designating means is operated.

33. In an apparatus controlled by records having two different types of characters, such as numerical and alphabetical, represented thereon by positioned code points which are distinctively positioned for each character; record reading means including means to sense the code representations of the characters successively; means including a group of code elements operable singly and in various combinations to manifest code signals; translating means controlled by said reading means selectively to operate said code elements, to manifest code signals of a second code in which each of certain signals representing different characters of one of said types also represents a single character of the other type; supervisory means controlled by said sensing means and differently responsive to the record code representations of the two different types of characters; designating means controlled by said supervisory means to operate said code elements to manifest either of two different key signals designating, respectively, the two different types of characters; disabling means condi-

tioned by said designating means to prevent a second operation of the latter to operate said code elements to manifest the same key signal twice in succession; and restoring means associated with said translating means so as to be responsive to the sensing on the record of a code representation of a particular character, said restoring means being adapted to restore to normal condition said disabling means.

34. In an apparatus controlled by records having characters of both letters and figures type represented thereon by positioned code points, which are distinctively positioned for each character, the figures characters being represented by single code points and the letters characters being represented by combinations of a plurality of code points; record reading means including means to sense the code representations of the characters successively; means including a group of code elements operable singly and in various combinations to manifest code signals; translating means controlled by said reading means selectively to operate said code elements, to manifest code signals of a second code in which each of certain signals representing different letters characters also represents a single figures character; supervisory means controlled by said sensing means and differently responsive to the sensing, on the record, of single code points and combinations of a plurality of code points, respectively; figures designating means adapted to be energized by said supervisory means on sensing single code points to operate said code elements to manifest a figures key signal, letters designating means adapted to be energized by said supervisory means on sensing combinations of a plurality of code points to manifest a letters key signal; normally inoperative disabling means, one for each of said designating means, each disabling means being conditioned by its own designating means to prevent a second operation of said code elements to manifest the same key signal twice in succession; restoring means operated by each designating means to restore the disabling means pertaining to the other designating means to normal condition; and additional restoring means associated with said translating means so as to be responsive to the sensing of a single code point in a particular code position of the record, said additional restoring means being adapted to restore to normal condition the disabling means pertaining to said figures designating means.

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