

Nov. 7, 1944.

E. J. RABENDA

2,362,027

COMMUNICATION APPARATUS

Filed Nov. 13, 1943

9 Sheets-Sheet 1

FIG. 1.

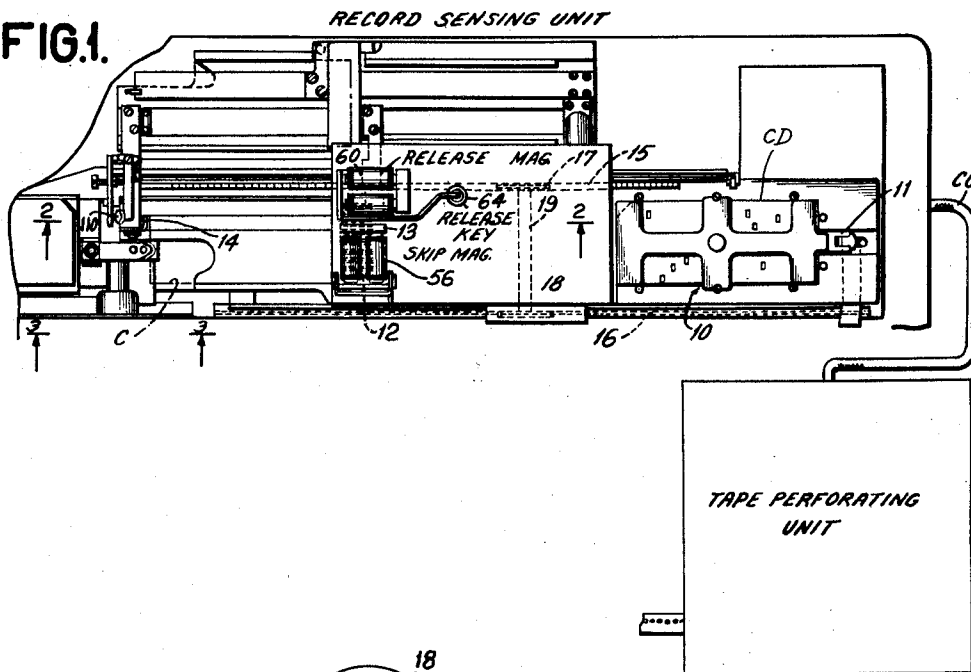
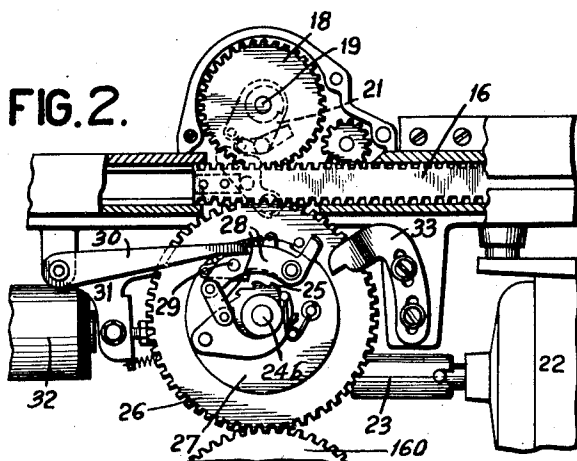


FIG. 2.



INVENTOR.
EDWARD J. RABENDA
BY *W. M. Wilson*
ATTORNEY

Nov. 7, 1944.

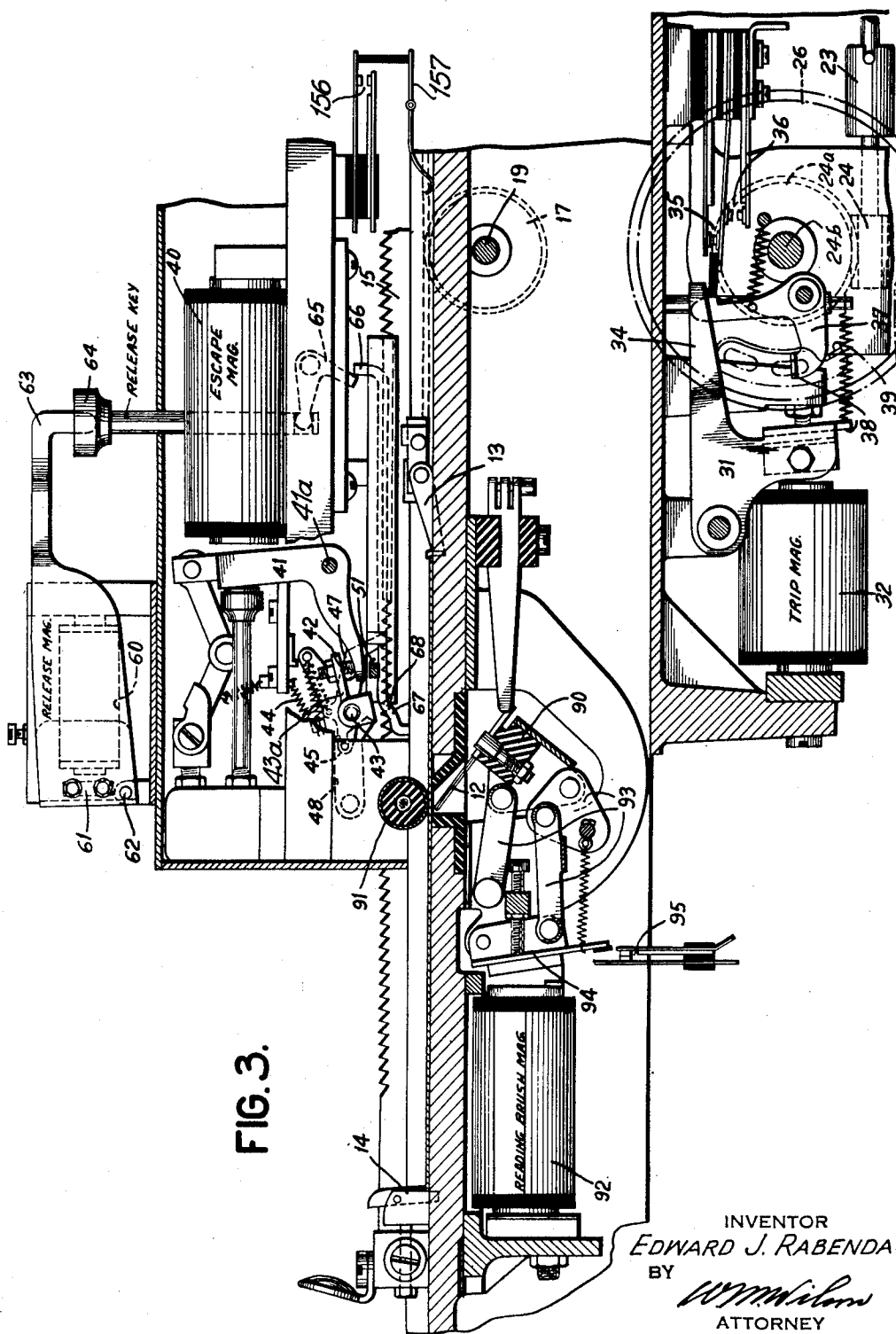
E. J. RABENDA

2,362,027

COMMUNICATION APPARATUS

Filed Nov. 13, 1943

9 Sheets-Sheet 2



INVENTOR
EDWARD J. RABENDA.
BY *Wm. M. Wilson*
ATTORNEY

Nov. 7, 1944.

E. J. RABENDA
COMMUNICATION APPARATUS

2,362,027

Filed Nov. 13, 1943

9 Sheets-Sheet 3

FIG. 4.

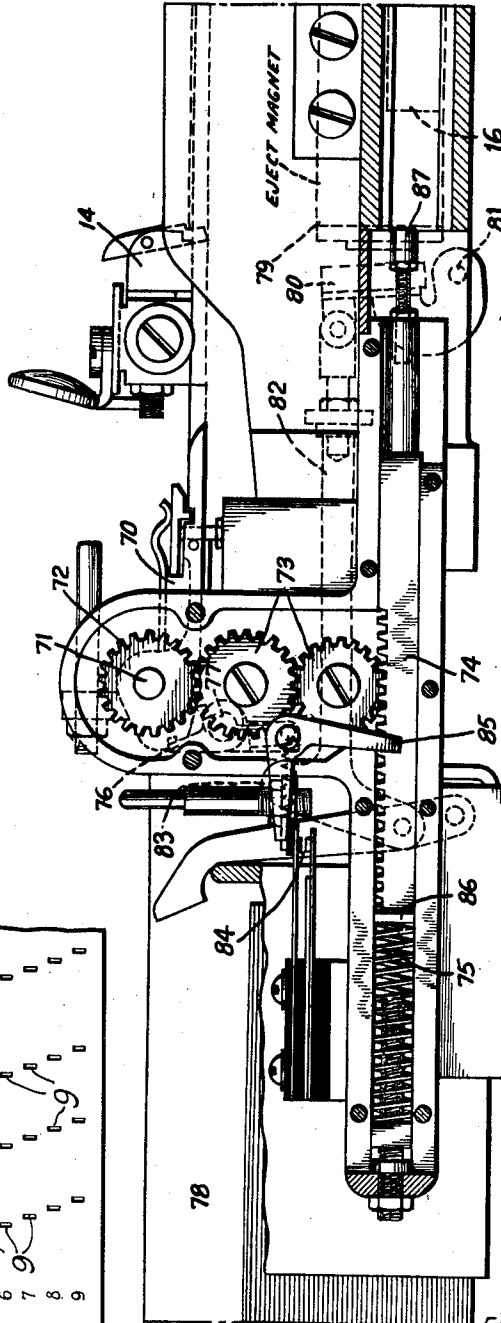


FIG. 5.

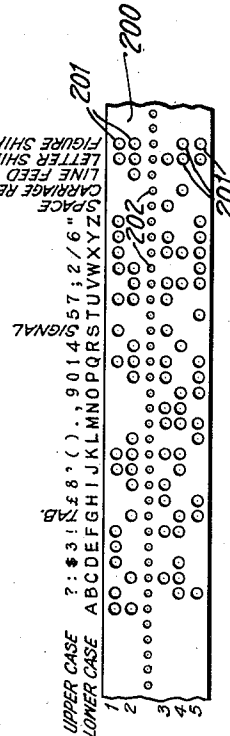
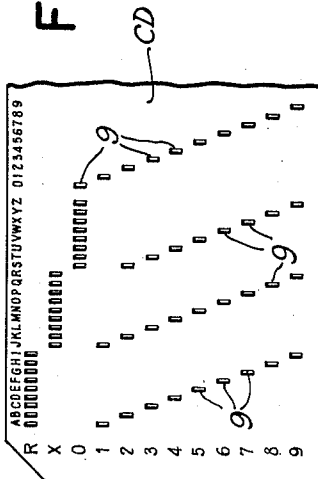


FIG. 6.

INVENTOR
EDWARD J. RABENDA.

BY

Wm. M. Linn
ATTORNEY

Nov. 7, 1944.

E. J. RABENDA

2,362,027

COMMUNICATION APPARATUS

Filed Nov. 13, 1943

9 Sheets-Sheet 4

FIG. 7.

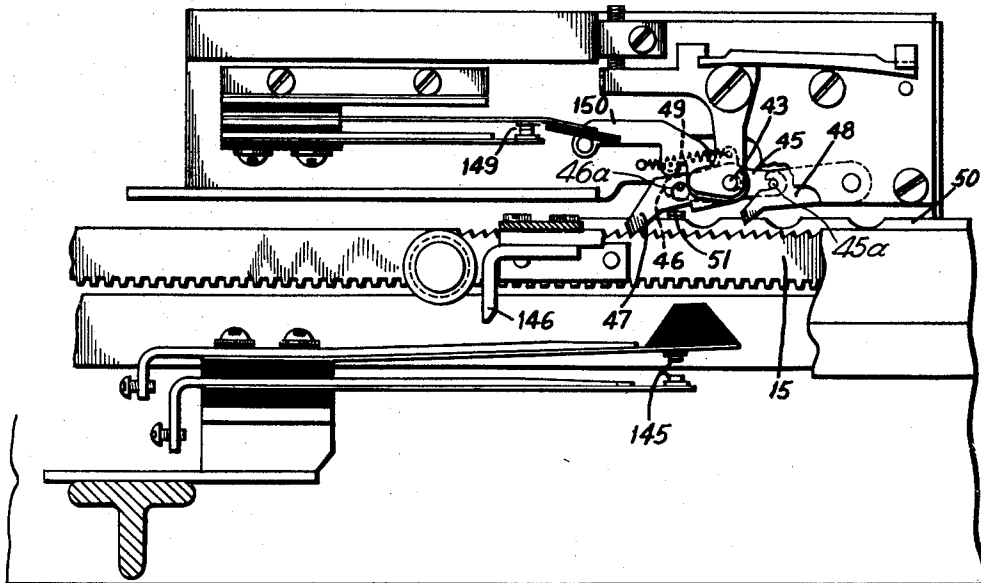


FIG. 8.

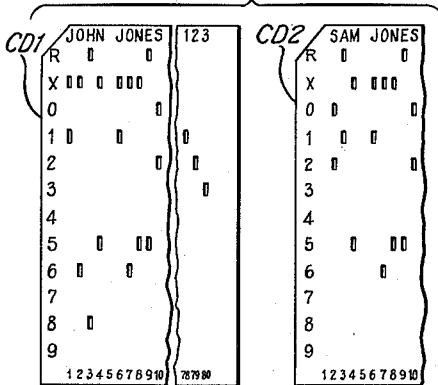


FIG. 9.

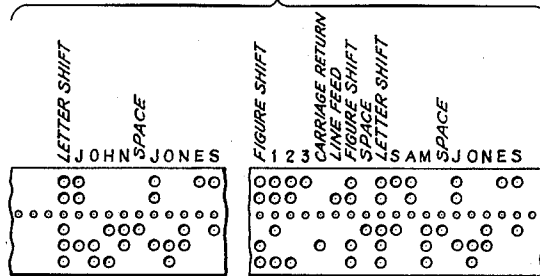
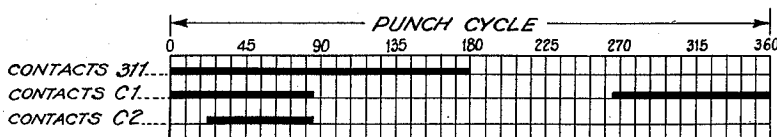


FIG. 10.



INVENTOR
EDWARD J. RABENDA.

BY
W. M. Wilson
ATTORNEY

Nov. 7, 1944.

E. J. RABENDA

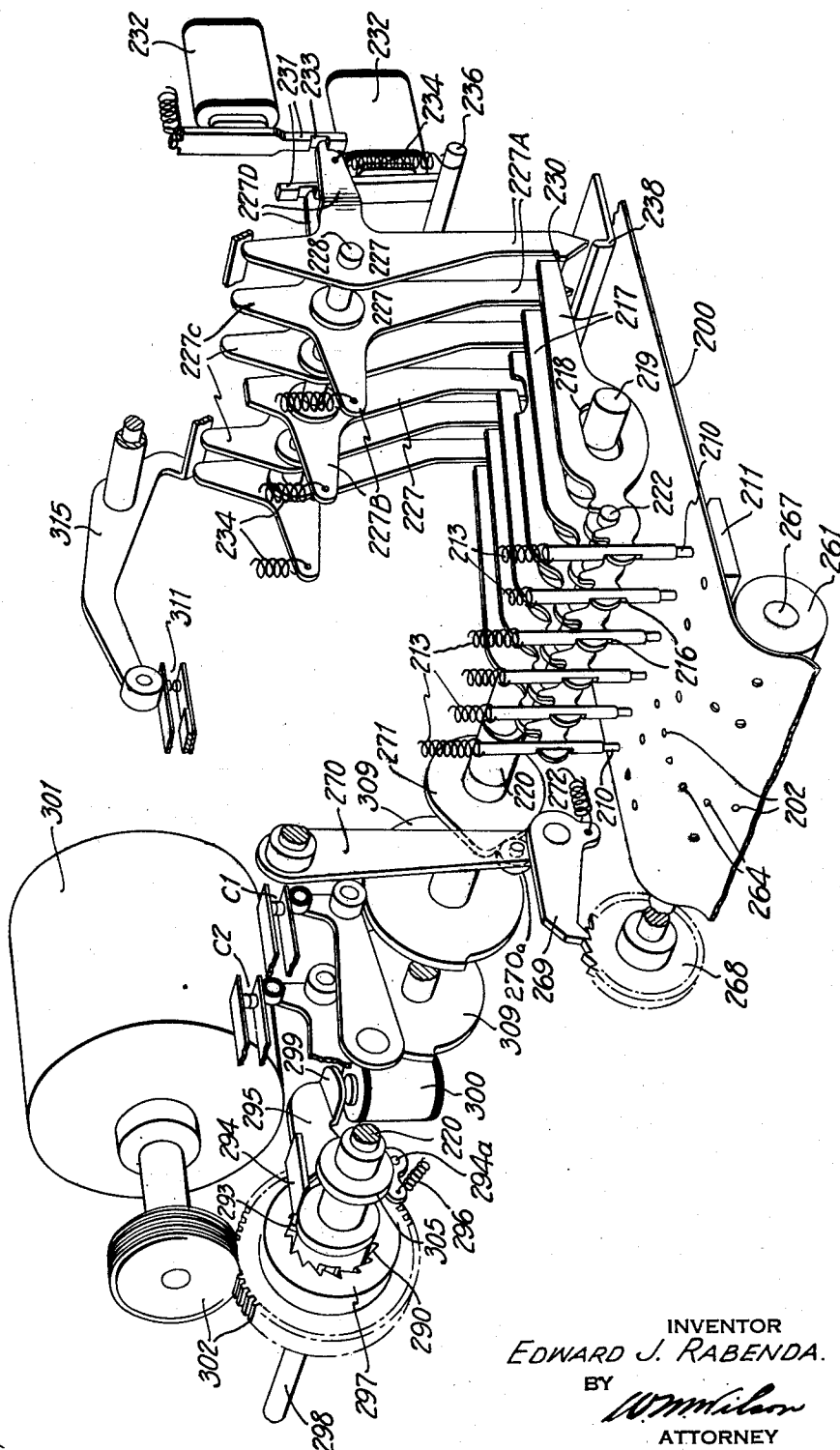
2,362,027

COMMUNICATION APPARATUS

Filed Nov. 13, 1943

9 Sheets-Sheet 5

FIG. 11.



INVENTOR
EDWARD J. RABENDA.
BY
Wm. Milner
ATTORNEY

Nov. 7, 1944.

E. J. RABENDA

2,362,027

COMMUNICATION APPARATUS

Filed Nov. 13, 1943

9 Sheets-Sheet 6

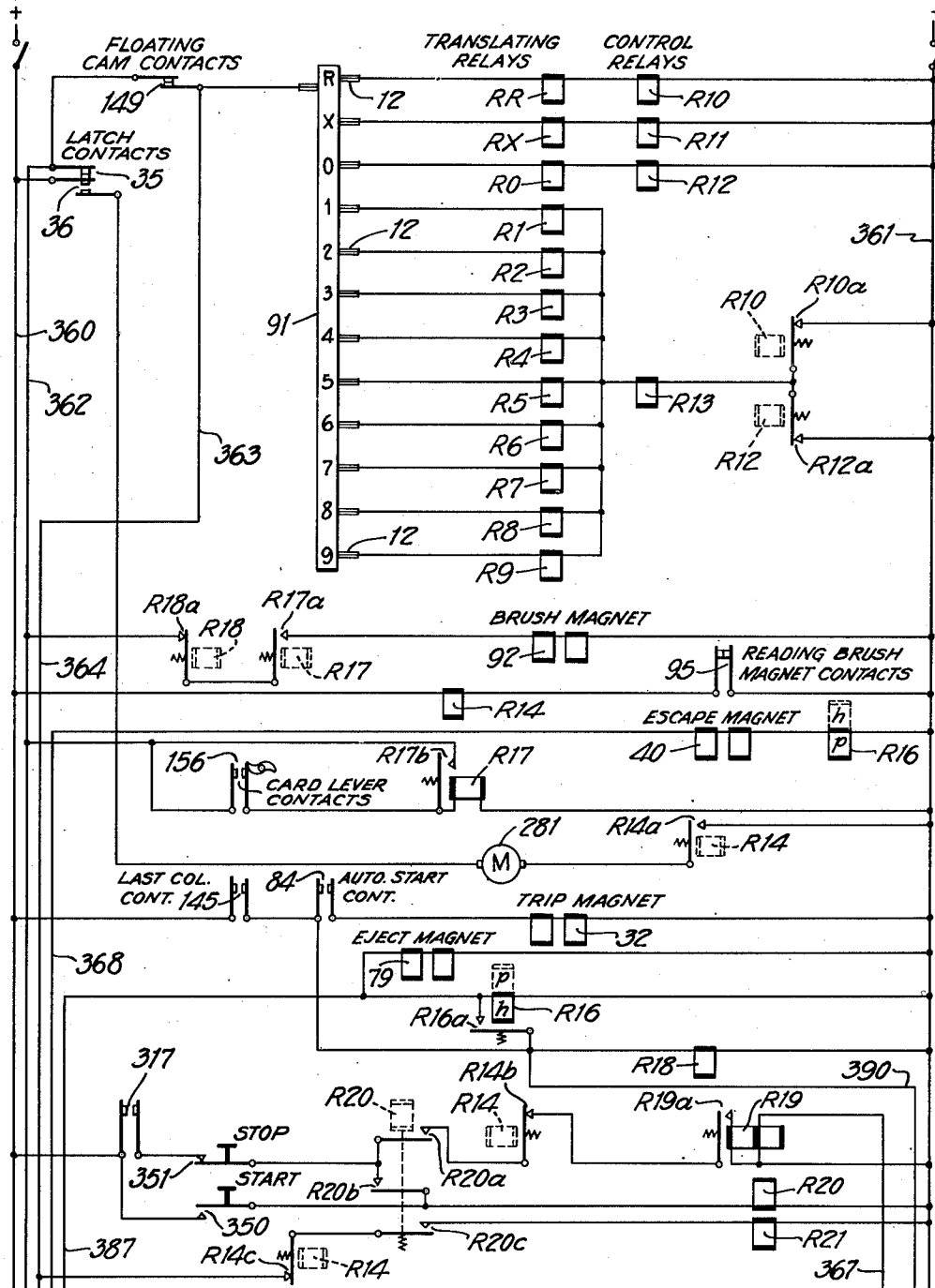


FIG.12A.

INVENTOR
EDWARD J. RABENDA.
BY
W. M. Wilson
ATTORNEY

Nov. 7, 1944.

E. J. RABENDA

2,362,027

COMMUNICATION APPARATUS

Filed Nov. 13, 1943

9 Sheets-Sheet 7

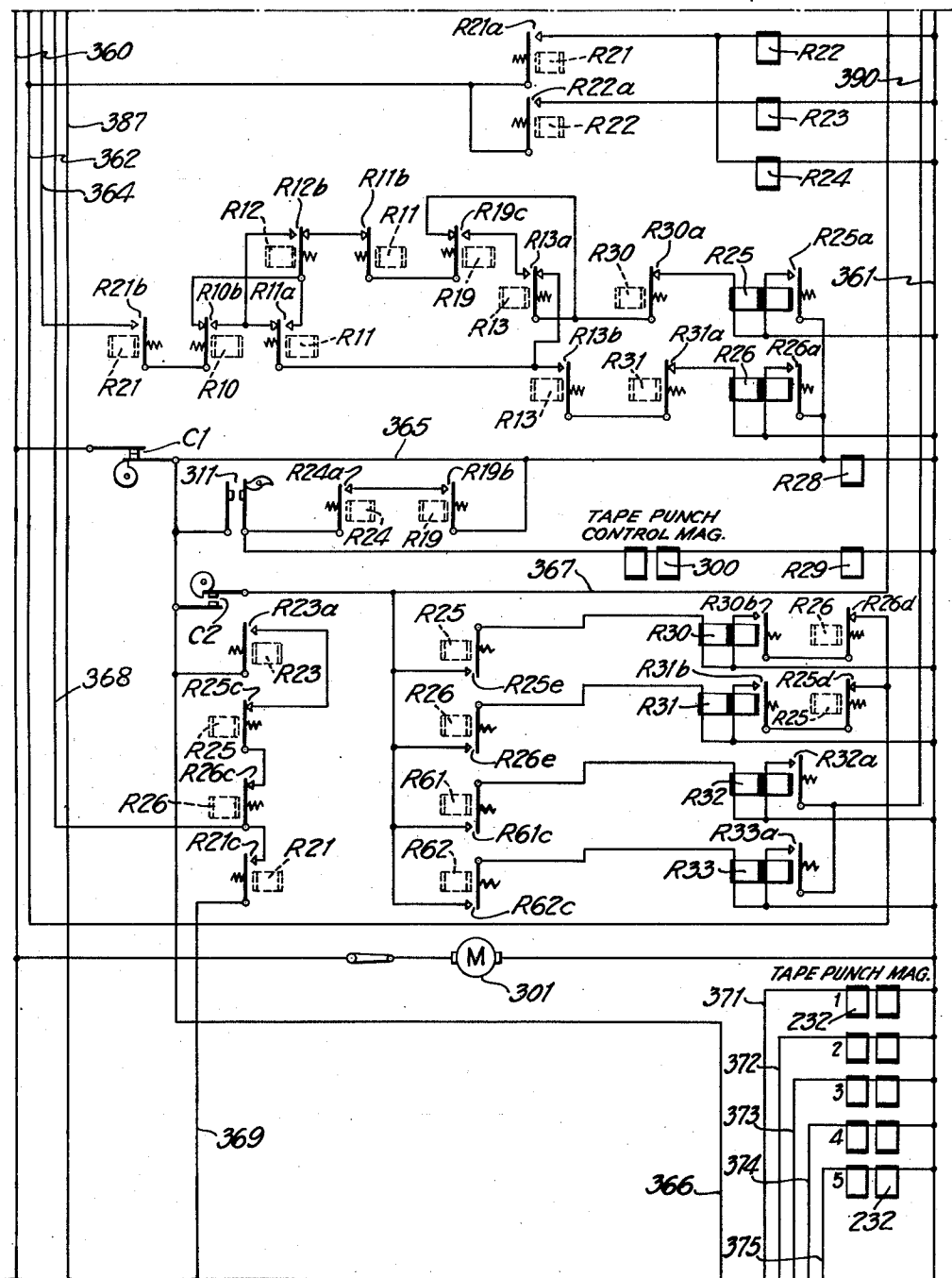


FIG.12B.

INVENTOR
EDWARD J. RABENDA.

BY

W. M. Milne
ATTORNEY

Nov. 7, 1944.

E. J. RABENDA

2,362,027

COMMUNICATION APPARATUS

Filed Nov. 13, 1943

9 Sheets-Sheet 8

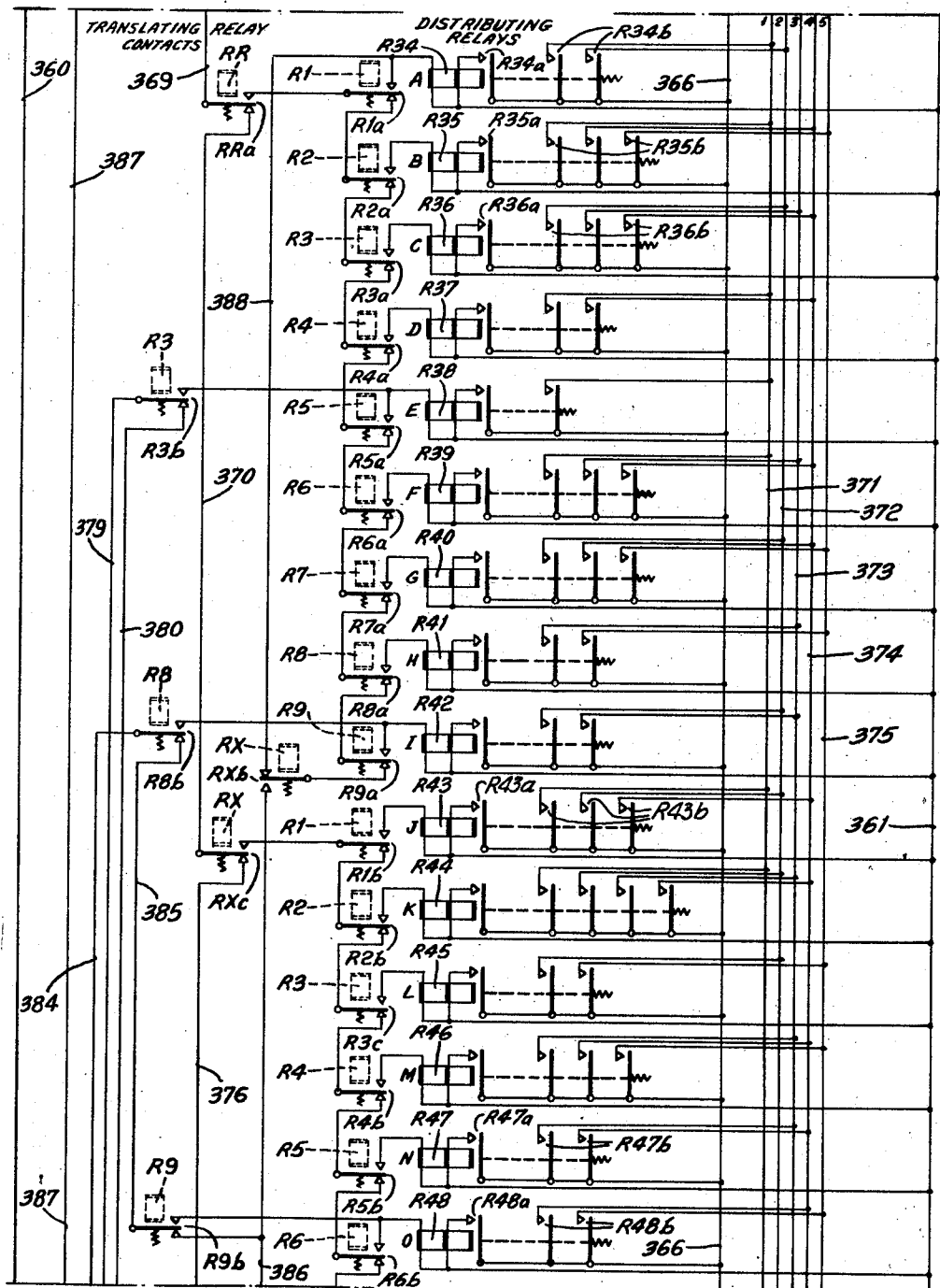


FIG. 12C.

BY

INVENTOR
EDWARD J. RABENDA.

W. M. Malone
ATTORNEY

Nov. 7, 1944.

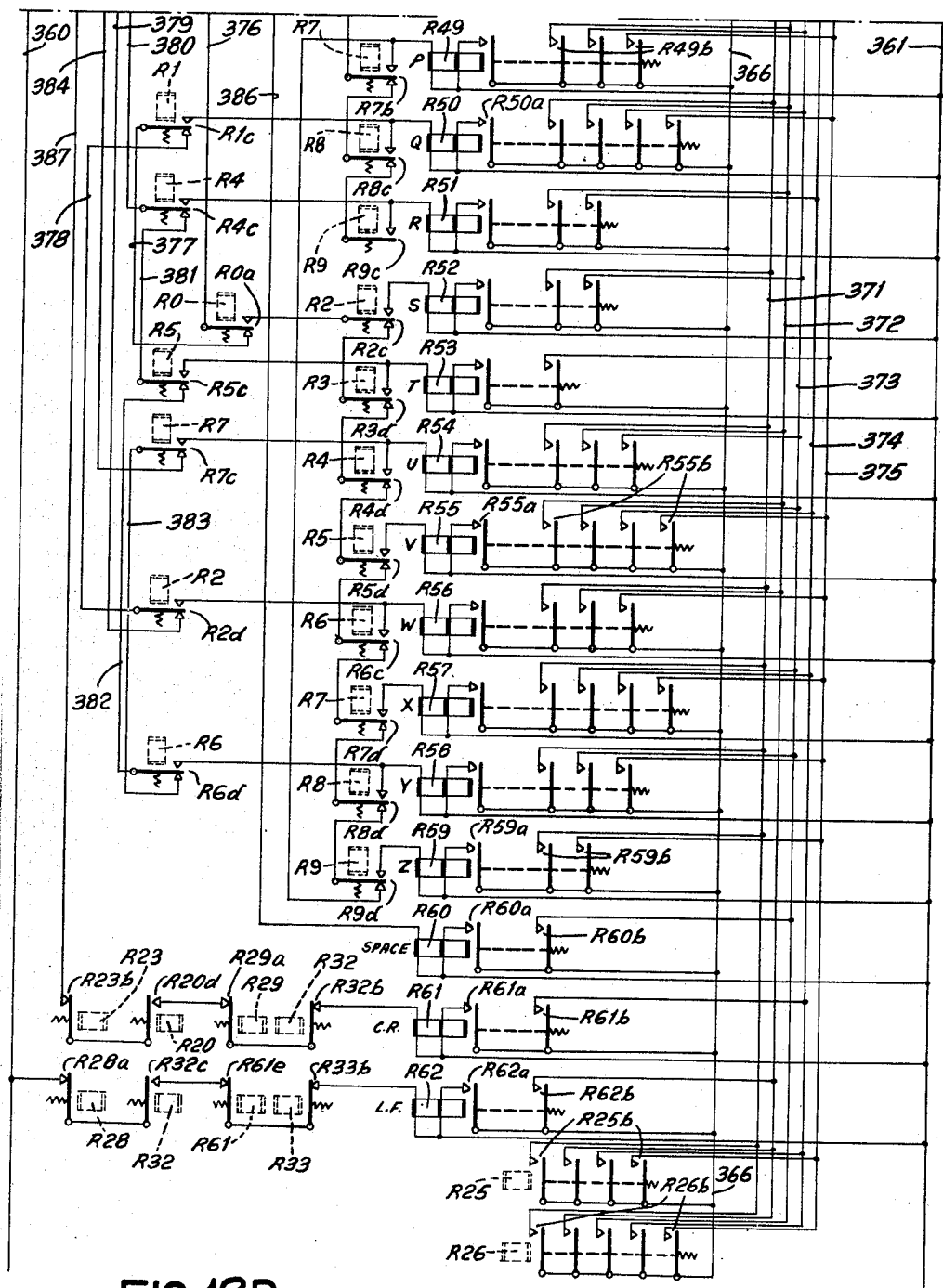
E. J. RABENDA

2,362,027

COMMUNICATION APPARATUS

Filed Nov. 13, 1943

9 Sheets-Sheet 9



INVENTOR
EDWARD J. RABENDA

BY

W. M. Wilson
ATTORNEY.

UNITED STATES PATENT OFFICE

2,362,027

COMMUNICATION APPARATUS

Edward J. Rabenda, Binghamton, N. Y., assignor
to International Business Machines Corporation,
New York, N. Y., a corporation of New
York

Application November 13, 1943, Serial No. 510,156

1 Claim. (Cl. 164—115)

This invention relates to apparatus used in the telegraphic transmission of data stored in statistical code on record cards, and is concerned particularly with a feature of such apparatus, which becomes important when the data is translated into a telegraphic code recorded on a tape, the tape being used to control a high speed telegraph transmitter, for transmission to a page printer at the receiving station.

Whenever a page printer is used, the problem arises of providing time for the carriage return, during which no signals to be recorded are sent. In the use of some printers this time is provided for by inserting in the sequence of telegraphic code signals, between the carriage return signal and the next signal representing a character to be recorded, one or more signals which may operate some part of the printer, but without affecting the carriage position and without operating the recording elements of the printing mechanism. For this purpose, it is customary to use a line feed signal and a key signal, which does not space the carriage or cause a character to be printed. The key signal is added for delay where the rate of transmission is high, to insure the return of the carriage to its first column position, before the first character code signal is received. (The term "first column position" means the position in which the first character may be printed for any particular job, which is not necessarily the extreme limit position to which the carriage can be moved.)

The present invention is an improvement on the apparatus disclosed in the Mills and Rabenda Patent 2,346,268, issued April 11, 1944. The apparatus disclosed in said application senses the columns of a record card in sequence and converts the statistical code characters into a sequence of telegraphic code characters. The telegraphic code employed is of the kind which divides the characters into two classes, namely, alphabetical and numerical, and uses identical code signals for each alphabetical character and a numerical character paired therewith. The term "numerical", as used here, includes the digits "0" and "1" to "9," and also punctuation marks and Tab. and monetary symbols. The class significance of the signals is indicated by inserting a key code signal before each sequence of characters of like class. The record card sensing mechanism determines automatically whether a particular statistical code character is an alphabetical or numerical character and, if there is a change from one class of character to the other, causes a key signal to be inserted on the tape,

indicating the class of the character signal to follow. The key signals are designated, respectively, "Letters" and "Figures."

In the operation of this type of apparatus, each record card controls the printing of one line by the receiving page printer. A "carriage return" signal, a "line feed" signal, and a key code signal are punched in the tape, between the last character on one card and the first character on the next. The punching of the key signal is done automatically, as the record sensing unit senses the character code in the first column sensed on a card. It may happen, however, that the first column sensed is blank. In this case, with the machine as disclosed in said application, a "space" signal would be inserted at the beginning of the new sequence on the tape, not preceded by a key code signal. Where the rate of transmission is high, this space signal might be received at the receiving station before the return of the carriage of the printer to first column position and thus be lost. As a result, the code character sensed in the second column of the control record would be printed in the first column of the receiving printer. In statistical work, the vertical alignment is important and loss of the "space" signal is undesirable. It is the object of the present invention to provide the additional moment of time required for return of the printer carriage to first column position, prior to the reception of a "space" signal resulting from the sensing of a blank column in the first column sensed on the record card.

The following description and accompanying drawings disclose one embodiment of the invention, by way of example, illustrating the principle of the invention and the best mode which has been contemplated of applying that principle.

In the drawings:

Fig. 1 is an outline plan view of a record sensing unit and a tape perforating unit interconnected for operation in accordance with the invention.

Fig. 2 is an elevational view, with parts in section, of a portion of the carriage return mechanism of the record sensing unit.

Fig. 3 is a vertical sectional view through the reading section of the card sensing unit.

Fig. 4 is a front elevation view, with parts in section, of a portion of the card sensing unit, showing the card ejecting mechanism.

Fig. 5 is a face view of a portion of a control record card showing the statistical alphabet code.

Fig. 6 is a similar view of a portion of a tape, showing the five position telegraphic code.

Fig. 7 is a rear elevational view, with parts in section, of a portion of the record sensing unit, showing the escapement mechanism.

Fig. 8 is a face view of portions of two record cards showing an example of statistical records, which will be referred to in explaining the operation of the improved apparatus.

Fig. 9 is a similar view of the corresponding telegraphic tape.

Fig. 10 is a timing diagram of certain contacts of the tape perforating unit.

Fig. 11 is an expanded perspective view of the tape perforating unit.

Figs. 12A-12D are four parts of a wiring diagram of the apparatus. These parts are to be arranged in vertical sequence.

In the illustrative embodiment of the invention shown in the drawings the telegraphic code sequence, into which the statistical code data from the original records is translated, is recorded on a tape, which can then be handled in the usual way in a tape controlled transmitter. The high speed transmission under tape control may result in premature transmission of a "space" signal at the beginning of a new sequence, when the first column sensed, of the record card, is blank. The present invention provides the necessary delay.

Record cards CD1 and CD2 (Fig. 8) having columns of alphabetical and numerical data recorded thereon, in a statistical alphabetic code (Fig. 5), are presented to the sensing station of a record sensing unit (Fig. 1), by means of a reciprocable card carriage comprising a pusher 13 (Fig. 3) and guide 14. The individual columns of data are fed, step by step, to the group of sensing brushes 12. There is a sensing brush 12 for each index point position of the card and these brushes are connected to individual translating relays of the group RR, RX, R0, R1-R9 (see Fig. 12A), which relays are controlled selectively in accordance with the sensed data designations on the record cards. A plurality of control relays R10-R13 are connected to certain ones of the translating relays so as to be controlled selectively, in accordance with the data sensed on the cards.

The individual translating relays are provided with groups of translating contacts (see Figs. 12C and 12D) connected in cascaded relationship, which contacts, in turn, are connected to the individual distributing relays R34-R60. A distributing relay is provided for each character code designation to be recorded, and has its associated "b" contacts connected in various combinations to the common conductors 371-375, the latter including the related tape punch control magnets 232 (Fig. 12B). The said translating and distributing relays 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 in different code combinations, thereby causing the code designating perforations representing the data sensed on the record cards to be punched in telegraphic code in the telegraphic tape 200 (Fig. 9).

In order to distinguish the code designations recorded in the telegraphic tape as alphabetical or numerical, a plurality of supervisory circuits are provided, which circuits are selectively controlled by the said control relays. The said supervisory circuits include the relays R25 and R26 (Fig. 12B), which relays are conditioned selectively in order to supervise the tape punching op-

erations. Whenever, alphabetical characters are sensed on the record cards, relay R25 is conditioned to cause the punch to record a "letters" key code signal preceding the telegraphic code designations representing the alphabetical characters, and whenever, numerical characters are sensed the relay R26 is conditioned to cause the punch to record a "figures" key code signal preceding the numerical character code designations. A single key code signal preceding a group of successive code designations representing characters of the same group is sufficient; it is not necessary to precede every character code designation by a key code signal.

A chain of timing relays R21-R23 are provided and arranged to be operated progressively for controlling the energization of the selected distributing relay circuit, and the energization of the spacing or escape magnet 40 of the card sensing unit. These mentioned circuits are energized at predetermined times, during each cycle of operation, so that continuous operations of the card sensing and tape punching units can be effected at high speed. Control relay R24, energized simultaneously with relay R22, normally provides for continuous operation of the punch unit, by energizing the tape punch control magnet 300, each cycle, before the armature of the latter becomes effective to latch the punch unit in an inoperative position.

The tape punch unit normally requires one cycle of operation for recording each character code signal. 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 punch unit requires two cycles of operation, the said key signal being recorded during the first cycle, and the said character code signal during the second cycle.

Whenever a blank column is detected in the record card, the said timing relays R21-R23 and control relay R24 condition certain circuits, including distributing relay R60, whereby the punch unit is controlled to record automatically a "space" signal in the telegraphic tape 200, and the record card sensing unit is controlled so as to feed the next column of the card to the sensing brushes 12 to be analyzed. However, if a blank occurs in the first column sensed, the perforation of the "space" signal is preceded by the perforation of a "figures" key code signal, in accordance with the present invention.

During card ejecting operations, the distributing relays R61 and R62 are automatically controlled successively for controlling the punch unit so as to record a "carriage return" signal in the tape followed by a "line feed" signal.

Control record

Referring now to Fig. 5, the control record is shown to comprise a well known tabulating machine record card, generally designated CD, of a type commonly used in electric tabulating systems. Differentially positioned control representations, such as perforations 9, are used to represent the various characters composing the data. The perforations are differentially positioned in various columns of the record card, and by the differential positioning thereof different significations are imparted thereto. 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 column.

The alphabetical statistical code shown in Fig. 5 is 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. 5 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 in 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 columns 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 CD to be sensed or analyzed are placed in a magazine designated 10, from which they are advanced singly toward the left, by means of a picker 11, to present their first column to a card sensing position above the sensing brushes designated 12 (also see Fig. 3). 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. 3) and bar 16 has a gear 18 (see Fig. 2) meshing with its upper edge, both gears being rigidly 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 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 Schaaff 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. 2) coupled to a stub shaft 23 (see Fig. 3), to which is secured a worm 24 in mesh with a worm wheel 24a secured to 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 this gear is mounted a disk 27 (Fig. 2). 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. 2

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 rotate counterclockwise to drive the rack bar 16 toward the left. The clutching mechanism is constructed, as explained in greater detail in the patent to Lake et al., No. 1,914,263, dated June 13, 1933, 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 uncouples the parts, whereby they may automatically return to the position shown in Fig. 2 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 explained in the said Patent 1,772,186, 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 21.

Also integral with the armature 31 of the trip magnet 32 is an arm 34 (see Fig. 3), the free end of which is adapted to bear upon the center blade of pairs of contacts 35 and 36, herein called latch contacts, to open the former and close the latter when magnet 32 is energized. The contacts are 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. 3), 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 41a in a clockwise direction and, through a screw 42 secured to an arm 43a projecting from a rockably mounted rod 43, will rock the rod 43 counterclockwise (in Fig. 3) 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. 7). Arm 46 is provided with a laterally extending pin 46a 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 45a 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. 7. The detail structure of this dog and rack arrangement is well known and

need not be further described; 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 equal to the width of one of the columns of the card.

Automatic card ejecting means.—The machine is provided with mechanism for automatically ejecting 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. 4, with its jaws 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. 4. 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 rock the same to initiate 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 brushes. 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 on 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 15 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. 5, 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 auto-

matic 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. 3. 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 upward, from the position shown in Fig. 3, to engage 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 can 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 adapted, when attracted by the magnet, to open a pair of contacts 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. 7 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. 7 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 open contacts 149 during the period that the dog is raised. In Fig. 3 there is shown a card lever 157 lying in the path of the record card as it passes from the magazine to the sensing position. When a card is fed from the magazine, the card lever is rocked to close a pair of suitably disposed contacts 156.

The record sensing unit may have the usual release mechanism 65, 66, 67, 68 controlled by release key 64, which may be operated by release magnet 60. The release mechanism operates upon the usual skip bar interposer 51 (see also Fig. 7), to lift the stepping dog 47 above the rack bar 15 and allow the carriage 13, 14 to move all the way to the left (Fig. 3), to operate the last column contacts 145 and thus initiate the card ejection and carriage restoring operations. The interposer 51 can also operate in conjunction with the skip bar 50, under control of skip magnet 56 (Fig. 1) to skip certain columns of the card, but this mechanism will not be described since the present invention is not concerned with it.

Telegraphic tape

Referring now to Fig. 6, a tape 200 is shown provided with successive transverse rows of code perforations 201 arranged in accordance with the well known five unit telegraphic code, usually referred to as the Baudot or teletype code, and a sixth perforation 202, which serves as a feed hole. In a five unit code, only thirty-two possible combinations are available, and, as mentioned hereinabove, for this reason, it is necessary to employ the same code combinations to represent alphabetical characters and numerical and other characters.

In order to distinguish the alphabetical characters from the other remaining characters, for telegraphic transmission purposes, a sequence of alphabetical signals is always preceded by a "letters shift" signal and a sequence of the other remaining character signals is preceded by a "figures shift" signal.

Tape perforating unit

Fig. 11 shows, in semi-diagrammatic form, a perforating apparatus for perforating the tape. A full disclosure of this perforator appears in the Mills and Rabenda Patent 2,346,268, supra. It comprises individual punch elements 210, one for each of the five units of the telegraphic code and one for punching the feed hole 202. There is a die block 211 for the punch elements and individual springs 213 normally hold the latter retracted. Each punch element has a recess 216 into which is inserted one end of a rockable punch lever 217 having an oval shaped opening 218. An individual punch lever is provided for each punch element. An elongated cam or eccentric 219 on a shaft 220 is disposed within the oval shaped openings of the punch levers, to support and actuate said levers. Normally, during the rotation of the eccentric, the punch levers move downward and upward about their pivotal connections with the punch elements 210. Under these conditions the free right ends of the punch levers are rocked idly downward and upward.

A plurality of latch members 227, one for each punch lever, are pivotally supported by a shaft 228, in cooperative relation to their respective punch levers. The downwardly extending arms 227A of the latches have latching shoulders 230 to engage under the right ends of their punch levers 217. All of the latches, except the one pertaining to the feed hole punch, have arms 227D extending to the right and three of them, in alternate positions, also have leftwardly extending arms 227B. The latter arms are biased upward by individual springs 234, while the arms 227D of the other three latches are biased downward by springs 234 anchored to a stationary pin 236. The springs 234 urge the latches in clockwise direction, but, with the exception of the latch pertaining to the feed hole punch, the latches are normally held in retracted position, with the hooks 230 out of the path of the punch levers, by their rightwardly extending arms 227D, the ends of which are detained in recesses 233 of related armatures 231 pertaining to tape punch selector magnets 232, only two of which are shown in the drawings. Upon energization of the individual magnets 232, the related armatures 231 are attracted and release their respective latches, permitting them to swing under the influence of springs 234, to engage their shoulders 230 under the free ends of the corresponding punch levers 217.

The shaft 220 is operated in a start-stop manner, by means to be described presently, the latch levers 227 which are to be engaged being released at the start of each cycle, when the right ends of the punch levers are in their uppermost positions, or approaching their uppermost positions. Thus, upon latching of a punch lever 217 the following rotation of the eccentric 219 rocks the punch lever counterclockwise about its pivotal connection with the latch lever, forcing the related punch element 210 through the telegraphic tape 200. A restoring bail (not shown) is provided to restore the latch levers 227 at the end of each punch cycle and a locking bail 238 may also be provided to lock the latch levers in effective or ineffective position through the punch cycle.

Means are provided for intermittently advancing the tape 200 near the end of each cycle of rotation of the shaft 220. The tape is fed from a supply reel (not shown) through a tape feeler mechanism such as shown in the above mentioned copending application. The feeler mechanism operates the tape contacts 317 shown on the circuit diagram (Fig. 12A), to indicate exhaustion of the tape supply. The tape is fed between the die block 211 and the punch elements 210 and over a sprocket wheel 261. The sprocket wheel 261 has a series of teeth 264 to engage the feed holes 202. The feed holes are punched by a punch element 210, the punch lever 217 of which is constantly latched by a stationary latch lever 221 having no latching arm 227D, so that a feed hole is punched on each revolution of the shaft 220. The shaft 267 of the sprocket wheel 261 has secured thereto a ratchet wheel 268, which is advanced step by step by a pawl 269 pivotally mounted on a cam follower arm 270. A spring 272 anchored to a fixed part and hooked into the pawl 269 urges the pawl against the ratchet 268 and pulls the arm 270 to the right so that a roller 270a thereon bears against a cam 271 on shaft 220. Near the end of each cycle of shaft 220 the high point of cam 271 moves the cam follower arm 270 and pawl 269 to the left to advance the ratchet wheel 268 and the sprocket wheel 261 one step. Thus, the tape 200 is fed to present the next position thereon to the punch elements. When the high part of the cam 271 passes, the pawl 269 is retracted to engage the next tooth of the ratchet wheel 268.

The start-stop operations of the shaft 220 are controlled by a one revolution clutch 290, which is shown only in outline in Fig. 11, but may be constructed in the manner fully disclosed in United States Patent 2,206,646, issued to Schneider on July 2, 1940. The clutch is controlled by a dog lift lever 293, which, when stopped by a detent 294, disconnects the shaft 220 from a constantly driven shaft 298 driven by motor 301 through a worm and wheel gearing 302. The detent 294 also determines the stationary angular position of the shaft 220. Detent 294 is part of a rocker arm 295 pivoted at 294a and biased counterclockwise by a spring 296. The arm 295 has a bent over portion 299 which acts as an armature to a clutch magnet 300. When the magnet is energized, the detent 294 is retracted from the dog lift lever 293 and the clutch engages. The shaft 220 is rotated until the magnet 300 is deenergized, dropping the detent 294 into the path of dog lift lever 293. The engagement of the detent with the dog lift lever disengages the clutch and stops shaft 220 in a fixed angular position.

A pair of normally open bail contacts 311 are operated by a pivoted bail lever 315, which is rocked by the upwardly extending arm 227c of any released latch lever 227, to close the contacts 311. The contacts 311 are employed, at certain times, for controlling the energizations of the clutch magnet 300. The time of closure of contacts 311 is shown in the timing diagram, Fig. 10.

Two additional pairs of contacts, C1 and C2, are operated cyclically by related cams 309 secured to shaft 220. The functions of these cam controlled contacts will be explained later. Their timing is shown in Fig. 10.

Operation

Referring now to Figs. 12A to 12D, arranged in vertical sequence, the operation of the described units will be explained in connection with the circuit diagram. In this description it will be assumed that the first two cards are punched as shown, in part, in Fig. 8. Card CD1 is punched in columns 1—10 to represent "John Jones" and in columns 18—20 to represent 123. Card CD2 is punched in columns 2—10 to represent "Sam Jones," column 1 being blank, to represent a space. Thus, when card CD2 is fed into sensing position, a space will be sensed in the first column, which might lead to an error in the printing, as explained above. The manner in which the apparatus described herein operates to avoid this kind of error will be pointed out in the following description.

It will be assumed that the card sensing unit is conditioned so that the first column of the record card CD1 is under the sensing brushes 12 and that the telegraphic tape 200 is properly positioned in the punch unit. For these assumed conditions the tape controlled contacts 317 (Fig. 12A), the card lever contacts 156, the latch contacts 35, and the floating cam contacts 149 (Fig. 12A) are closed. The closure of card lever contacts 156 completes a circuit from conductor 360 (connected to one terminal of the power supply) through contacts 35, wire 362, said contacts 156, relay R17, to conductor 361 (connected to the other terminal of the power supply) energizing said relay. Contacts 17b complete a holding circuit for relay R17, through the latch contacts 35, while contacts R17a complete a circuit from line wire 360 through latch contacts 35, wire 362, normally closed contacts R18a, said contacts R17a, brush magnet 92, to line wire 361, energizing said magnet. Brush magnet contacts 95 open, deenergizing relay R14 and allowing contacts R14c (Fig. 12A) to close.

Start.—Upon depression of the start key (Fig. 12A), closure of contacts 350 establishes a circuit from conductor 360 through the said start contacts 350, coil of relay R20 to conductor 361 thus energizing said relay. A holding circuit for this relay is completed immediately from conductor 360 through the tape controlled contacts 317, contacts 351 of the stop key, contacts R20b, and coil of relay R20 to conductor 361.

Due to closure of contacts R20c (Fig. 12A), a circuit is completed from conductor 360 through the normally closed latch contacts 35, floating cam contacts 149, conductors 363 and 364, normally closed contacts R14c, said contacts R20c, and coil of relay R21 to conductor 361, energizing this relay. Closure of contacts R21a completes a circuit from said conductor 362 through contacts R21a, and coils of relays R22 and R24 to conductor 361, energizing said relays. Closure

of contacts R22a then completes a circuit from said conductor 362 through said contacts R22a to coil of relay R23 and conductor 361, energizing said relay.

The chain of relays R21—R23 are energized successively, each under control of the preceding relay in the chain, and constitute timing relays, the operations of which are adjusted so as to enable key signal punching cycles to be inserted where they are called for. The relay R20, energized simultaneously with the relay R22, becomes effective, after the first punch cycle of each tape run (each record card controls one tape run), to hold the punch clutch magnet energized through the end of each revolution of the punch shaft. This allows the punch to run continuously and quietly, without being stopped at the end of each revolution. Unless the stop contacts 351 or tape controlled contacts 317 are opened, relay R20 is maintained energized continuously and through the agency of contacts R20c, permits a circuit to be completed to the first relay R21 of the chain of timing relays each time the floating cam contacts 149 and latch contacts 35 close at the beginning of a tape run and each time the contacts 149 close during a tape run.

Alphabetical data.—The energization of brush magnet 92, as previously mentioned, brought the brushes 12 up against column one of the card CD1. Since this column is punched in the X and 1 index point positions, to represent the latter J, circuits are completed from conductor 360 through contacts 35 and 149, contact roll 91, brushes 12 sensing the X and 1 perforations, coils of translating relay RX and control relay R11, also translating relay R1, control relay R13, and normally closed contacts R10a and R12a to line wire 361, energizing all of said relays. The following changes are thereby caused, in the condition of the relay contacts in the supervisory circuits (Fig. 12B): Contacts R11a transfer, contacts R11b open; contacts R13a transfer and R13b close. These changes take place before the start key is pressed.

When contacts R21b close, upon energization of relay R21, in the manner described above, a "letters" supervisory circuit is established from conductor 360 through latch contacts 35, floating cam contacts 149, conductors 363 and 364, closed contacts R21b, normally closed contacts R10b, said transferred contacts R11a and closed contacts R13b, normally closed contacts R31a, and the pick-up coil of the "letters" control relay R26, to conductor 361, energizing said relay. A holding circuit is established from conductor 360 through normally closed cam contacts C1, conductor 365, contacts R26a and holding coil of said relay R26 to conductor 361. This holding circuit is broken when cam contacts C1 open. Relay R20 is connected in parallel with the holding coil of relay R26 and is energized so long as cam contacts C1 are closed. Contacts R28a, included in the pickup circuit for relay R62 (Fig. 12D), are opened and prevent energization of this "line feed" distributing relay, while the said cam contacts C1 are closed.

The energizing circuit for distributing relays R34—R60 extends from line wire 360 through cam contacts C1, contacts 23a (when closed), normally closed contacts R25c and R26c, contacts R21c (when closed), wire 369, and the interconnected contacts of translating relays RR, RX, RO and R1—R9 (Figs. 12C and 12D), the pickup coil of one of the group of distributing relays R34—R66,

to line wire 361. But, in the example, the relay R26 is energized concurrently with the relay R22, hence prior to relay R23; thus contacts R26c open before contacts R23a close and prevent the distributing magnet selected by the contacts of the translating magnets from being energized when contacts R23a close. Opening of contacts R26c also prevents a circuit from being completed to the escape magnet 40 via conductor 368. Opening of contacts R26d prevents a holding circuit from being established for relay R30, while closure of contacts R26e partially completes a circuit to a "letters" supervisory relay R31. Closure of contacts R26b (Fig. 12D) completes circuits to the "1," "2," "3," "4," and "5" tape punch magnets 232, which can be traced as follows: conductor 360, normally closed cam contacts C1, conductor 366, said "b" contacts of relay R26, conductors 371, 372, 373, 374, and 375, to the said connected tape punch magnets 232 and conductor 361, energizing said magnets.

It will be recalled, that upon energization of any one of the magnets 232, the bail contacts 311 are closed, due to the tripping of the related latch lever or levers 227. Closure of contacts 311 permits the following circuit to be established: conductor 360, normally closed cam contacts C1, said contacts 311, the coils of the tape punch clutch magnet 300 and relay R29 to conductor 361, energizing the said magnet and relay. Energization of the said clutch magnet causes the punch eccentric to be set in motion for actuating the punch elements, thereby effecting the punching of the "letters" key code signal in the first transverse row of the telegraphic tape 200, as indicated in Fig. 9.

The opened contacts R29a (Fig. 12D), included in the pickup circuit of distributing relay R61, prevent energization of this "carriage return" distributing relay, while the tape punch clutch magnet 300 is energized. During the punching cycle, cam contacts C2 are closed (see Fig. 10) to complete a circuit to relay R31 as follows: conductor 360, cam contacts C1, said cam contacts C2, contacts R26e and the pickup coil of relay R31 to conductor 361, energizing said relay. A holding circuit for this relay can be traced from line wire 360, through latch contacts 35, conductor 362 to normally closed contacts R25d, contacts R31b, the holding coil of relay R31 to conductor 361. Now, contacts R31a are opened to break the traced pickup circuit for relay R26. In this manner, repeated energizations of relay R26, and punching of the "letters" key code signal are prevented.

Another circuit is completed, upon closure of cam contacts C2 which can be traced from conductor 360, said cam contacts C1 and C2, conductor 367, pickup coil of relay R19 and conductor 361, energizing this relay. A holding circuit is established immediately from conductor 360 through tape controlled contacts 317, stop contacts 351, contacts R20a, R14b, R19a, the holding coil of relay R19 to conductor 361. Closure of contacts R19b now establishes a circuit, shunting the said bail contacts 311, which can be traced from conductor 360, cam contacts C1, said contacts R19b, R24a (now closed), clutch magnet 300 and relay R29 to conductor 361.

Upon the opening of cam contacts C1 and C2, which occurs approximately at the same time in the punch cycle (see Fig. 10), the holding circuit for relay R26 is opened to cause this relay to be deenergized. It is to be noted that the "letters" supervisory relay R31 remains energized, and is

maintained so until the "figures" supervisory circuit to relay R25 is energized (contacts R25d are included in the traced holding circuit for relay R31). Also, the "letters" supervisory circuit cannot be energized again to pick up relay R26 until the said relay R31 is deenergized.

It has been pointed out, that the described circuits for relay R26 are established before the circuit to the last relay R23 of the timing chain, so that circuits cannot be established to the escape magnet 40 (via conductor 368), and translating contacts and distributing relays (via conductor 369). In view of the fact, that the escape magnet 40 is not energized during this first punch cycle, the said translating relays RX and R1 and control relays R11 and R13 remain energized. Also, since the floating cam contacts are not opened, at this time, the chain of timing relays R21—R23, and control relay R24 remain energized.

Now, upon closure of cam contacts C1, near the end of the first punch cycle, a circuit can be traced from conductor 360 through the said cam contacts C1, closed contacts R19b and R24a to the clutch magnet 300 and relay R29, to energize the said magnet and relay. In this manner, another punch cycle is initiated immediately, without awaiting the closure of bail contacts 311.

Another circuit can be traced from the said conductor 360 and cam contacts C1 through the series connected contacts R23a (now closed), R25c and R26c (normally closed), and R21c (now closed), conductor 369, normally closed contacts RRa, conductor 370, transferred contacts RXc, transferred contacts R1b to the pickup coil of distributing relay R43 and conductor 361, energizing this relay. A holding circuit is established immediately through the associated "a" contacts as follows: conductor 360, cam contacts C1, conductor 366, contacts R43a, holding coil of relay R43 to conductor 361. The traced holding circuit for relay R43 applies to all of the holding circuits for the distributing relays of the group R34—R62, by means of the related "a" contacts and holding coils, and therefore need not be traced in detail hereinafter.

Circuits are also completed from the said conductor 366 through the "b" distributing relay contacts, namely R34b, to conductors 371, 372, and 374, and the connected "1," "2," and "4" tape punch magnets 232, energizing the said magnets. Hereinafter, these circuits traced to the punch magnets will be referred to as the punch magnet circuits completed through the "b" distributing relay contacts, since all the "b" contacts of relays R34—R62 are connected in varying combinations to the said conductors 371—375 and "1" to "5" punch magnets, respectively. In this manner, during the rotation of the punch eccentric, the code designating perforations representing the letter "J" are punched in the second transverse row of the telegraphic tape 200, as indicated in Fig. 9.

Before the said cam contacts C1 are opened during this second mentioned punch cycle, a circuit is also completed from conductor 360, cam contacts C1, the said series connected contacts R23a, R25c, R26c, conductor 368 to the escape magnet 40 and pickup coil of relay R16 to conductor 361, energizing the said magnet and relay. Contacts R16a (Fig. 12A) closing at this time exercise no controlling functions. The purpose of these contacts will be understood as the description progresses. The energization of the said escape magnet causes the card carriage to be advanced, one step, and present the next column

of the card to the sensing station, in the manner set forth hereinbefore. It will be remembered that the floating cam contacts 149 are opened each time the escape mechanism of the card carriage is operated.

Upon opening of the cam contacts C1, the holding circuit for the selected distributing relay is broken, thus restoring the distributing relay and associated contacts to normal. The circuits traced to the translating relay contacts and escape magnet are also broken, upon opening of cam contacts C1. Opening of the floating cam contacts 149 causes the said translating relays RX and R1 and control relays R11 and R13 to be deenergized. The circuit to the first relay R21 of the chain of timing relays R21—R23 is also broken at this time, by the opening of contacts 149, causing relay R21 to be deenergized, and in turn, causing relays R22, R23, and R24 to be deenergized.

Now, upon presentation of the second card column to the sensing station, and upon closure of the floating cam contacts 149, RX and R6 translating relays and R11 and R13 control relays are energized. The control relay contacts in the supervisory circuits are conditioned the same as for the first card column, but since contacts R21a are now open, when the floating cam contacts close, energizing relay R21, the resulting closure of contacts R21b does not energize relay R26. When relay R21 is energized relays R22 and R24, and then relay R23, are picked up in succession, as described hereinabove. Upon closure of contacts R24a the clutch magnet 300 is energized to initiate the third punch cycle, in the course of which the tape is perforated with a telegraphic code signal representing the character "0," in the same manner as before.

The advantages and functions of the described chain of timing relays should now be apparent. The chains R21, R22, R23 insure that before an impulse is transmitted through the translating relay contacts to the selected distributing relay, and through conductor 368 to the escape magnet, by the closure of contacts R23a, the supervisory circuits to the pickup coils of the "letters" and "figures" relays R25 and R26 will have been tested for a change from one class of character to another. If a change has occurred the relay R25 or R26 will be energized concurrently with relay R22 and contacts R25c or R26c will be opened before contacts R23a close. Thus the punching of the character code signal and the energization of the escape magnet will be deferred till the next punch cycle. The function of relay R24 is to make the operation of the punch faster and more quiet. Once the relay R19 has been energized, which occurs in the first punch cycle, the contacts R24a establish a circuit to reenergize the clutch magnet 300 when the contacts C1 close. Thus the punch shaft 220 rotates continuously, so long as relay R19 remains energized (which may be for one full tape run) and is not stopped at the end of each revolution, to be released by closure of the bail contacts.

The sensing of columns 3 to 10 of the card CD1 and punching in the tape of equivalent telegraphic code signals continues in the same manner as described for columns 1 and 2. When the blank in column 5 is sensed none of the translating relays is energized. When the contacts 23a close an impulse is transmitted through the cascade of translating relay contacts in their normal position, to the "space" relay R60, energizing this

relay and causing a "space" signal to be punched in the tape.

Numerical data.—Now assume that the sensing of the card has progressed to column 78 and that the last preceding character was an alphabetical character. When the floating cam contacts 149 close, upon arrival of the card CD1 in column 78 sensing position, circuits are completed from conductor 360 through latch contacts 35, said contacts 149, contact roll 91, brushes 12 sensing the "1" perforation, translating relay R1, and control relay to conductor 361, thus energizing the said translating and control relays. Also, upon closure of the said floating cam contacts, the chain of timing relays R21—R23 and relay R25 are energized, as described in detail hereinabove. In addition thereto, the "figures" supervisory circuit is completed to energize the "figures" control relay R25 as follows: said floating cam contacts 149, conductors 363 and 364, contacts R21b now closed, normally closed contacts R10b, R12b, R11b, transferred contacts R19c and R19a, normally closed contacts R30a to the pickup coil of said relay R25 and conductor 361, energizing this "figures" control relay. A holding circuit is established therefor, through closed cam contacts C1, contacts R25a and holding coil of relay R25. Contacts R25c are opened to prevent energization of the escape magnet 40 and the distributing relay whose pickup circuit was partially prepared by the translating relay R1. Contacts R25d are opened causing the "letters" supervisory relay R31 to be deenergized. Contacts R25b are closed causing the "1," "2," "4" and "5" punch magnets 232 to be energized. The tape punch clutch magnet 300 is energized as before, through contacts C1, R19b, and R24a, thereby causing the latched punch levers to punch the "figures" key code signal in the telegraphic tape 200, as indicated in Fig. 9.

Upon closure of cam contacts C2, during this punch cycle, a circuit can now be completed to the "figures" supervisory relay R30 as follows: conductor 360, cam contacts C1 and C2, contacts R25e to the pickup coil of relay R30 and conductor 361, energizing this "figures" supervisory relay. A holding circuit is established from conductor 362 through contacts R26d, R30b, and the holding coil of the said relay R30 to conductor 361. This holding circuit is maintained continuously so that the "figures" supervisory relay is held energized until the "letters" control relay R26 becomes energized. Opening of contacts R30a causes deenergization of the "figures" supervisory circuit including relay R25.

Since the escape magnet is not energized during this punch cycle, the said floating cam contacts remain closed, thus maintaining the said translating and control relays energized. The punch clutch magnet is energized upon closure of cam contacts C1 for initiating the next punch cycle.

During this next punch cycle, the following circuit is completed: from conductor 360 through cam contacts C1, the series connected contacts R23a, R25c, R26c, and R21c, conductor 369, normally closed contacts R19a, R19c, and R10a, transferred contacts R1c to the pickup coil of distributing relay R50 and conductor 361, energizing this relay. The usual distributing relay holding circuit through contacts R50a is established. Through the "b" contacts of relay R50, the "1," "2," "3," and "5" punch magnets 232 are energized, thus causing the code signal representing the numerical character "1" to be punched in the

next transverse row of the telegraphic tape 200, as indicated in Fig. 9.

During this punch cycle, the circuit to the escape magnet 40 is also established through the series connected contacts R23a, R25c, and R26c, and conductor 368, energizing said magnet, and subsequently causing the next or 79th column of the card to be presented to the sensing station.

Carriage return and line feed signals.—The sensing of columns 79 and 80 and punching in the tape of telegraphic code signals representing the characters "2" and "3" follows. During the sensing of the 80th column, the escape magnet 40 is energized as before. It will be remembered that the pickup coil of relay R16 (Fig. 12A) is included in the escape magnet circuit, and is energized concurrently with the escape magnet; however, as mentioned, this relay is not effective to exercise any controlling functions during the normal sensing and punching cycles.

Now, upon energization of relay R16, with the card in the last column position, the closed last column contacts 145 permit a holding circuit for relay R16 to be established as follows: conductor 360, said last column contacts 145 and contacts R16a, the holding coil of relay R16, and conductor 361. Relay R18, being connected in parallel with the holding coil of relay R16, is also energized, upon closure of the last column contacts. Contacts R18a are opened to deenergize the brush magnet 92, which magnet, in turn, causes the related contacts 95 to be closed. Closure of contacts 95 effects energization of relay R14, and in turn, deenergization of relay R19, due to the opening of contacts R14b. Opening of contacts R14c prevents any energization of the chain of timing relays R21—R23, and relay R24.

Upon closure of contacts R16a and the last column contacts, a circuit is also completed from conductor 360 through these contacts, via conductor 387, contacts R23b, R20d (now closed), R29a and R32b (normally closed), pickup coil of distributing relay R61 and conductor 361, energizing this relay. The usual distributing relay holding circuit is established through contacts R61a. The "4" punch magnet 232 is energized due to closure of the contacts R61b. Upon energization of the said punch magnet, as mentioned hereinabove, contacts 311 of the punch unit are closed and, since contacts R19b and R24a are open at this time, complete the circuit to the clutch magnet 300 and relay R29. Energization of relay R29 causes contacts R29a to open the described pickup circuit for distributing relay R61. In this manner, the code perforation for the "carriage return" signal is punched in the telegraphic tape, as indicated in Fig. 9.

During this punch cycle, upon closure of cam contacts C2, a circuit is completed from the said cam contacts through contacts R61c to the pickup coil of relay R32 and conductor 361, energizing this relay. A holding circuit is established from conductor 360, last column contacts 145, conductor 390, contacts R32a, to the holding coil of relay R32 and conductor 361. This holding circuit is maintained until the last column contacts 145 are opened. Contacts R32b in the pickup circuit of distributing relay R61 are opened, assuring that energization of this relay cannot occur again at this period.

Contacts R32c in the distributing relay R62 pickup circuit are closed, thus permitting a circuit to be completed from conductor 360, contacts R28a, R32c, R61c (now closed), and R33b to the pickup coil of distributing relay R62 and

conductor 361. This circuit is established before cam contacts C1 are closed to energize relay R28, which energization occurs each punch cycle to open the pickup circuit of relay R62. The usual holding circuit for this distributing relay is established through contacts R62a, upon closure of the cam contact C1, and, by means of contacts R62b, the "2" punch magnet 232 is energized. Upon energization of the said punch magnet, contacts 311 are closed to energize the punch clutch magnet, and cause the code designating perforations for the "line feed" signal to be punched in the telegraphic tape, as indicated in Fig. 9.

Upon closure of cam contacts C2, a circuit is completed from these contacts through contacts R62c to the pickup coil of relay R33, energizing this relay. A holding circuit is established from the last column contacts 145, via conductor 390, contacts R33a, and holding coil of relay R33. Contacts R33b, in the pickup circuit for distributing relay R62, are opened to prevent further energization of this circuit.

In the instant case, the "carriage return" and "line feed" signals are punched successively in the telegraphic tape 200, during the period the record card is ejected. The eject magnet 79 is energized, upon closure of the last column contacts 145 and contacts R16a, since this magnet is also connected in parallel with the holding coil of relay R16.

As described hereinabove, upon completion of the card ejecting operation, the auto-start contacts 84 are closed to energize the trip magnet 32 (contacts 145 being closed at this time). It will be 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 from latch contacts 36 to the drive motor 281 of the card sensing unit (contacts R14a being closed at this time), 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.

Upon opening of the last column contacts 145, the described holding circuits for relays R32 and R33 are broken, and these relays are restored to normal. Relays R18 and R16 are also deenergized at this time, as well as eject magnet 79 and trip magnet 32. The spring of latch contacts 35 deenergizes relay R17. When the next card closes the card lever contacts 156 a pickup circuit for relay R17 is prepared, which will be completed when the latch contacts transfer back to normal position, at the end of the feed of the card from the hopper. At this time latch contacts 36 open, deenergizing the motor 281. The closure of latch contacts 35 causes the energization of the brush magnet 92. Contacts 95 open, deenergizing relay R14, so that its contacts R14a, R14b, and R14c return to normal condition.

Sensing a blank in column 1.—In the chosen example, the card CD2 has a blank in column 1. Thus, when the floating cam contacts 149 close, upon the arrival of the card CD2 in column 1 sensing position, none of the sensing brushes 12 finds a perforation and, consequently, the translating relays RR, RX, RO, R1—9, and the control relays R10—R13, all remain deenergized. However, a circuit is completed through the floating cam contacts 149, wire 364, and contacts R14c and R20c, through relay R21 to line wire 361, energizing said relay. When contacts R21b close a circuit is completed through line wire 364, said

contacts R21b, normally closed contacts R10b, R12b and R11b, contacts R19c in the normal position (relay R19 has not yet been energized in this tape run) normally closed contacts R30a, relay R25, to line wire 361, energizing this "figures" supervisory relay. It has been explained before how, upon energization of relay R25, a "figures" key code signal is punched in the tape, as the circuits to the distributing relays and the escape magnet are opened, by contacts R25c, to defer for one cycle the punching of the tape under control of a distributing relay and the escape-ment of the carriage to the next column.

Upon closure of contacts C2 in the punch cycle which punches the "figures" key code signal in the tape, the relay R19 is energized through the circuit previously traced. The contacts R19a immediately close and hold the relay R19, while the contacts R19b prepare the circuit which is to energize the tape punch clutch magnet 300 during the normal operation. When contacts C1 close near the end of this first punch cycle, a circuit is completed through contacts R23a, now closed, R25c, R26c, R21c, wire 369, contacts RRa, RXc, ROa, R1c, wire 378, contacts R2d, wire 379, contacts R3b, wire 380, contacts R4c, wire 381, contacts R5c, wire 382, contacts R6d, wire 383, contacts R7c, wire 384, contacts R8b, wire 385, contacts R9b, wire 386, and relay R60 to line wire 361, energizing this "space" distributing relay. The contacts R60a close to hold the "space" relay and the contacts R60b close to establish a circuit from contacts C1 through wire 366, said contacts R61b, wire 373, and the number 3 tape punch magnet 232. The "space" signal is thus punched in the tape. The escape magnet is energized concurrently with the distributing relay R60 and the card CD2 escapes to the next column. The sensing and punching then proceeds in the manner previously described.

By the means last described a key code signal, for delaying purposes, is punched in the tape, even when the first column sensed, in a card, is a blank. Thus the "space" signal representing this column does not become lost and the agreement in form of the printed tabulation and the control record is preserved.

While there have been shown and described

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

What is claimed is:

In apparatus for converting records in a statistical code having a separate code designation for each character, into records in a telegraphic code having code designations of alternatively alphabetical or numerical class significance, as determined by associated key signals, the statistical code records being on separate cards whereon the code designations of different characters are placed in different columns and "spaces" are denoted by blank columns; record card reading means comprising card holding means and card sensing means relatively reciprocable to cause the columns of a record card to be sensed in sequence; telegraphic code recording means including a group of code elements operable singly and in various combinations to record the telegraphic code signals; translating means controlled by said reading means to operate said code elements selectively, to record in telegraphic code the characters read from said record cards; supervisory means controlled by said sensing means and differently responsive to the sensing on the record cards of characters of the two different classes; designating means adapted to control said code elements, said designating means being controlled by said supervisory means to cause said code elements to record either of two different key signals, depending upon the class of character sensed; said supervisory means including auxiliary means to render the same responsive to the sensing of a blank column, to cause said designating means to control said code elements so as to record a key signal; and means to render said auxiliary means effective only when said sensing means senses a particular column, other than the last column, of the record cards.

EDWARD J. RABENDA.