Nov. 2, 1965 J. E. HICKERSON 3,215,244

PUNCHING AND PRINTING APPARATUS INCLUDING STORAGE MEANS

Filed June 26, 1963 4 Sheets-Sheet 1

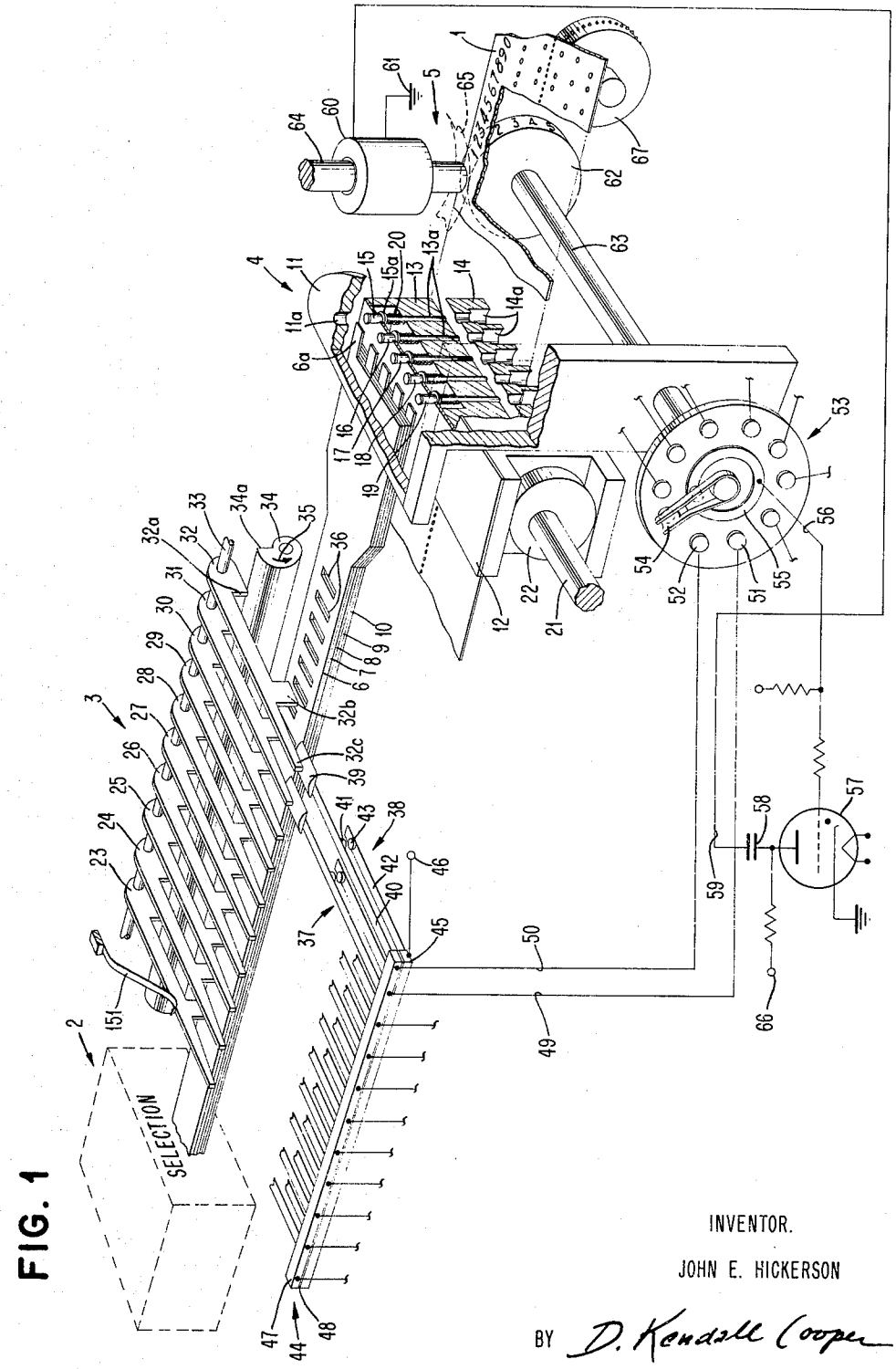

FIG. 1

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PUNCHING AND PRINTING APPARATUS INCLUDING STORAGE MEANS

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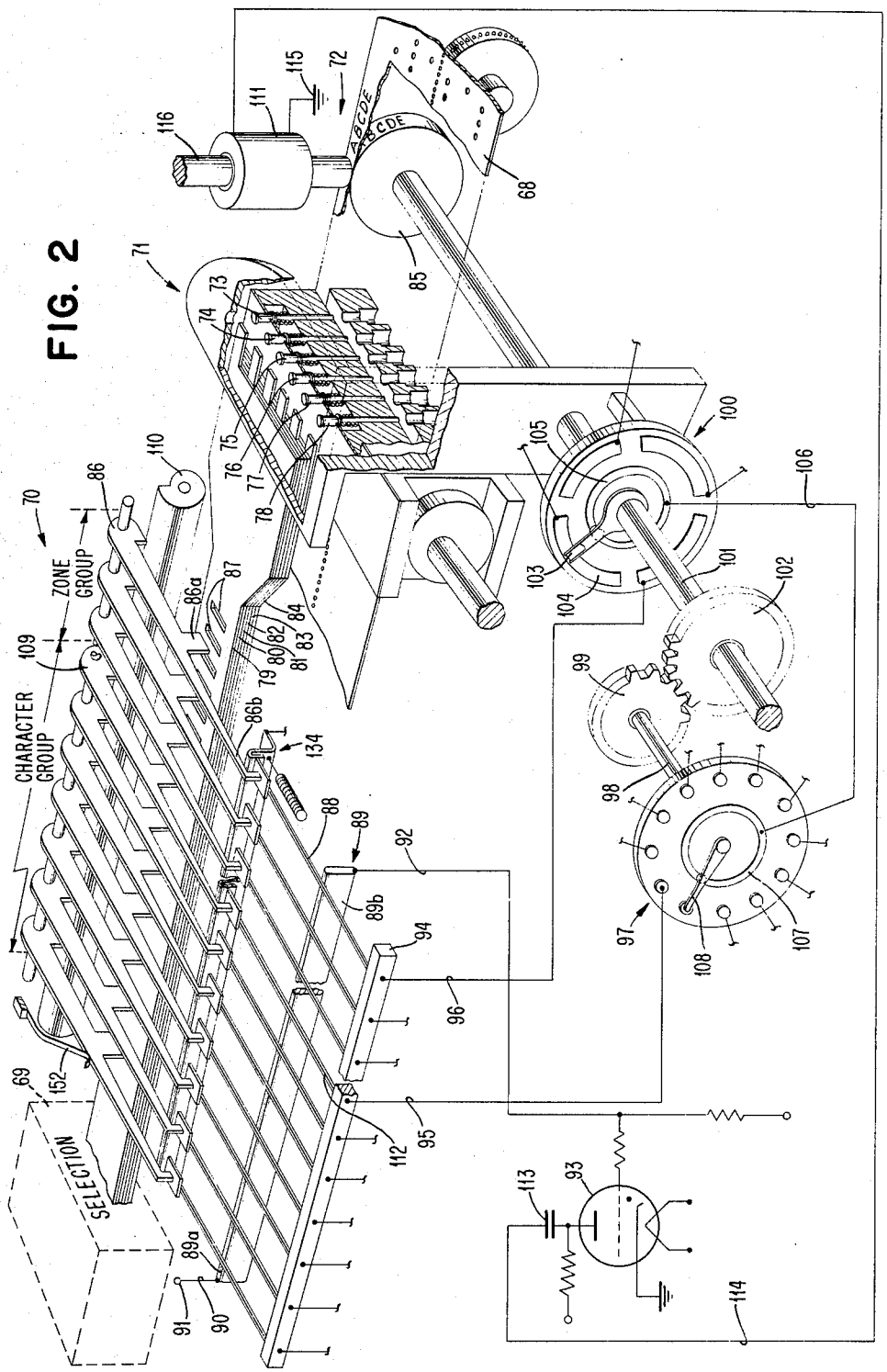
FIG. 2



PUNCHING AND PRINTING APPARATUS INCLUDING STORAGE MEANS

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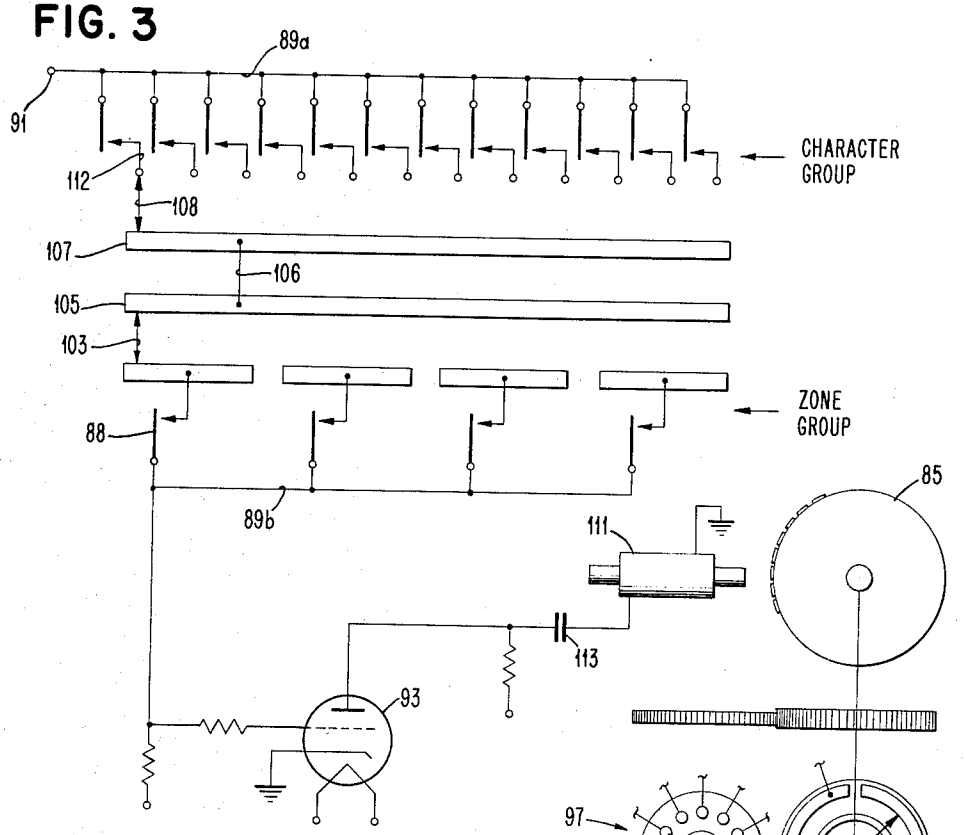
FIG. 3



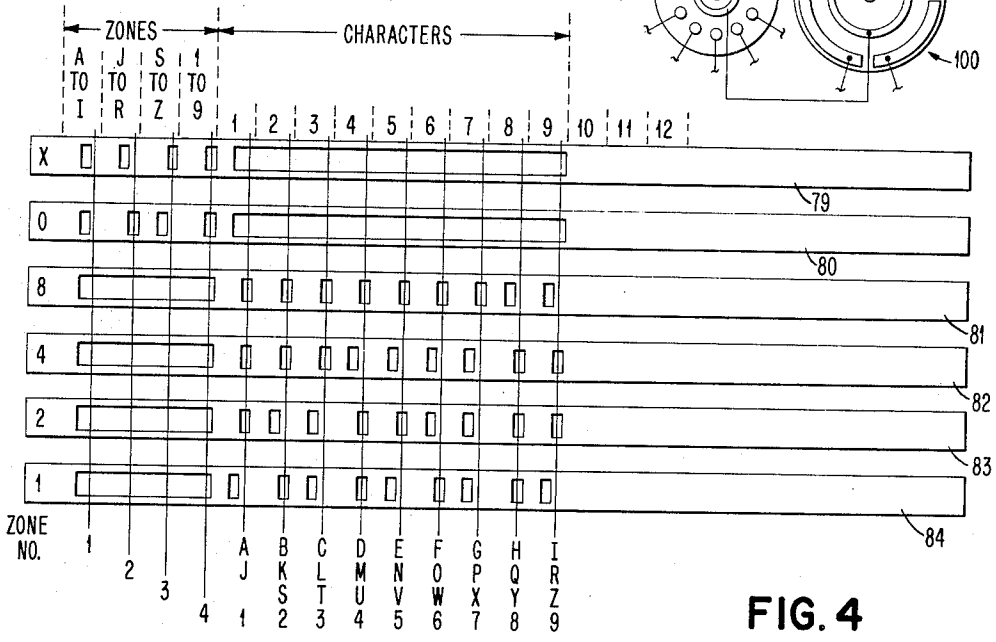


FIG. 4

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FIG. 5

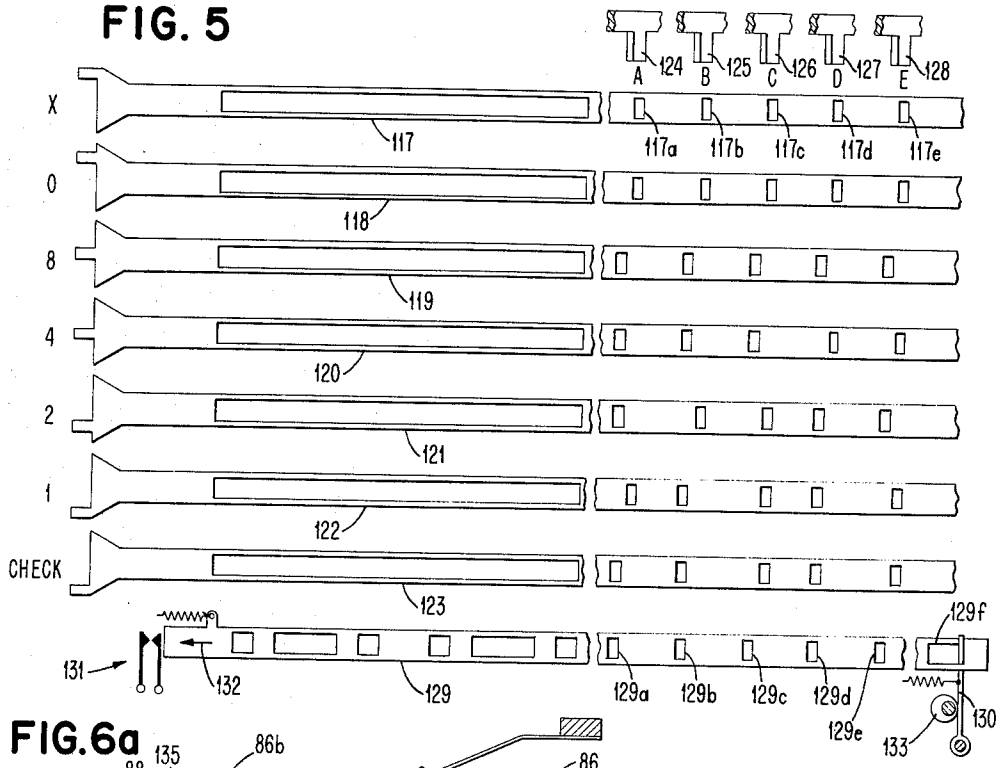


FIG. 6a

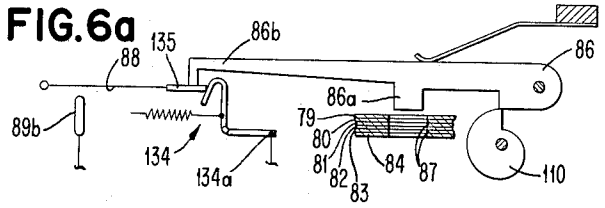


FIG. 6b

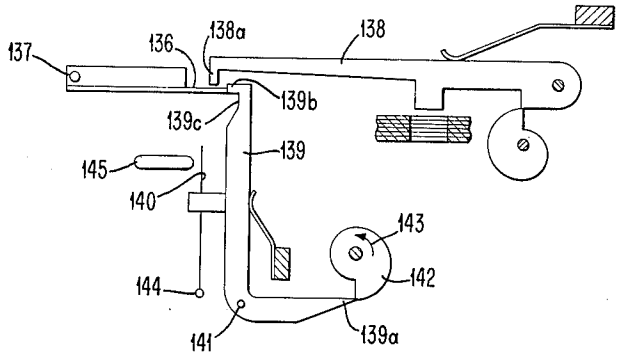
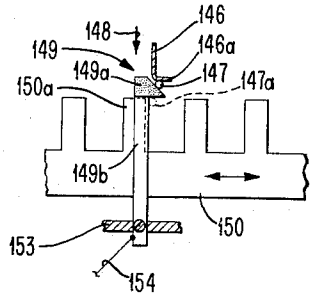


FIG. 6c



United States Patent Office 3,215,244 Patented Nov. 2, 1965

3,215,244

PUNCHING AND PRINTING APPARATUS INCLUDING STORAGE MEANS

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Filed June 26, 1963, Ser. No. 290,823
8 Claims. (Cl. 197—1.5)

This invention relates to punching apparatus, and more particularly to apparatus of this general type which has means for printing information concurrently with punching operations.

The invention has particular usefulness in connection with mechanisms of the type disclosed in U.S. Patent Nos. 2,978,086, 3,044,690, and 3,050,241 to J. E. Hickerson. These mechanisms are intended primarily to perform the function of punching storage media, such as a paper tape, and are generally characterized by the provision of groups of thin metallic strips that are selectively movable from inactive positions to active positions in order to establish conditions in the mechanisms for punching perforations in the paper tape according to a desired code. The aforementioned patents disclose various types of setup and selection mechanisms, as well as auxiliary mechanisms. In U.S. Patent No. 2,978,086, for example, a simple and inexpensive keyboard for a key operated machine is provided which has a number of thin interposer strips or tapes that are movable longitudinally from inactive positions to active positions in response to the actuation of a key. The strips are arranged side by side and are provided at different points along their lengths with openings through which stop pins may be inserted. The openings at each point are aligned with each other at their ends adjacent the active positions so that a released pin may pass through all of the strips. Some of the openings at each point may be only large enough to receive the pin which then operates to hold strips having such openings against movement. Other openings at each point may be long enough to permit movement of strips to their active positions after a stop pin has been inserted through them. Each of the stop pins is normally latched in a position free of the strips, and a key element is provided for freeing each pin so it may be moved through aligned openings at one of the points. The strips are yieldingly urged toward their active positions after one of the stop pins is released, and those strips which move since they have long openings receiving the released pin, are representative of the character assigned to the key which is actuated for releasing the stop pin. Movement of strips to their active positions may result in the closing of contacts for effecting the operation of mechanisms to print the character, to punch holes representative of the character, or to perform some other useful function. If desired, the strips may be connected to some other operating mechanism mechanically instead of by electrical circuits.

U.S. Patent No. 3,044,690 concerns a mechanism which operates in response to the code produced by one machine and converts it to a code which is readable by another machine. The mechanism includes two groups of slides, the number of slides in one group being equal to the number of index points at which holes may be punched in a tape to represent any character to be read, and the number of slides in the other groups being equal to the number of points at which holes are to be punched in a new tape according to a different code. The slides of both groups have openings which are aligned at some one of a plurality of points when the slides of the first group are moved in response to the sensing of a character in the tape being read. A pin then moves through the aligned openings and limits movement of the second group of slides to effect punching of holes in the new tape according to a different code. Movement of slides in the second group may effect some other function, such as printing, as disclosed in the aforementioned U.S. Patent No. 2,978,086.

The mechanism disclosed in U.S. Patent 3,050,241 includes means which operate automatically to punch shift codes when needed. This mechanism includes two slides, one moving on the first actuation of a key for typing Letters to cause the punching of a "Letter" shift code, and the other moving on the first actuation of a key for Figures or Special Characters to cause the punching of a "Figure" shift code. The punching of the shift code, in each case, takes place simultaneously with the punching of the code for the character of the key actuated.

Many other mechanisms have been proposed in the prior art for the punching of paper tape or similar media, in addition to those disclosed in the aforementioned patents. In fact, many mechanisms have also been proposed for accomplishing the function of printing concurrently with a recording operation. However, except for the mechanisms disclosed in the previously mentioned patents, prior art punching mechanisms have generally been characterized by their complexity, and further that the relative mass of the moving elements in the mechanism have not lent themselves to high speed operation.

Accordingly, it is an object of the invention to provide means for printing on a paper tape or similar media concurrently with its punching.

Another object of the invention is to provide printing means that are operable with a high speed punching mechanism and wherein the printing of information takes place essentially "in flight."

A further object of the invention is to provide a mechanism wherein printing of information is performed in a selective manner either prior to, concurrently with, or subsequent to punching of the same information.

A further object of the invention is to provide mechanism for the preparation of paper tape wherein printing of information takes place in the same relative position on the tape as the punching of information.

A still further object of the invention is to provide a printing mechanism which is operable in conjunction with a punching mechanism to print information on a paper tape in space that is presently not used for other purposes.

Still another object of the invention is to provide a printing mechanism in conjunction with a punching mechanism which is operable to print a character that has been punched in order to supply a visual check that the punching has been performed correctly.

A still further object of the invention is to provide a punching and printing mechanism which has associated parity checking and error indicating means for supplying an indication that punching and printing have in fact been performed correctly.

In accordance with a preferred embodiment of the invention, a mechanism for printing on a paper tape or similar medium is provided which is selectively set up under the control of the same mechanism that establishes the selection for punching in the tape.

In an alternative embodiment, a printing mechanism for printing a plurality of characters on a paper tape or similar medium is selectively set up under control of a group of elements which is considerably less in number than the number of characters to be printed.

In other embodiments of the invention, simplified auxiliary means are provided for checking the correct set up for both punching and printing of information and for indicating an error in the event of improper setup.

In still another embodiment of the invention, auxiliary

storage means are provided for storing the setup of the printing selection mechanism which is operable during one cycle, for example, in order that the selection mechanism can be set up for a subsequent character and printing of the previous character can take place in a following cycle.

The foregoing and other objects, features, and advantages of the invention will be more apparent from the following more particular description of the preferred embodiments of the invention as illustrated in the accompanying drawings.

In the drawings:

FIG. 1 represents a punching and printing mechanism according to the invention which has setup means for performing the printing of information belonging to a basic group of data, such as numeric information.

FIG. 2 represents punching and printing apparatus which is similar to that in FIG. 1, with the exception that a setup mechanism is provided for printing a plurality of characters, such as numeric and alphabetic characters, or special characters. The number of setup mechanisms required is considerably less than the number of characters to be printed.

FIG. 3 is a simplified schematic of the circuitry and circuit elements involved in the mechanism in FIG. 2.

FIG. 4 illustrates typical code setup arrangements for certain of the slide elements in FIG. 2.

FIG. 5 illustrates certain of the elements belonging to the mechanism of FIG. 2, and other mechanism operable therewith for checking that punching and printing set up have been properly performed.

FIGS. 6*a*, 6*b* and 6*c* represent various storage mechanisms for use in connection with the mechanisms of FIGS. 1 and 2.

FIG. 1 shows a mechanism that is selectively operable for punching and printing information in a five channel paper tape **1**. The mechanism of FIG. 1 generally resembles those punching mechanisms disclosed in the aforementioned Hickerson patents and includes a number of primary areas of interest. These are a selection station **2**, a sensing station **3**, a punching station **4**, and a printing station **5**. The printing station **5** may or may not be in alignment with the punching station, as desired. In the embodiment shown in FIG. 1, the printing station **5** is assumed to be displaced one punching position subsequent to the punching station **4**. The distance between the two stations has been somewhat exaggerated for clarity. As will be brought out in subsequent discussion, the arrangement of the punching station with respect to the printing station is quite flexible.

The mechanism of FIG. 1 includes a selection station having mechanism that is generally indicated as lying within the confines of a dashed box **2**. The selection mechanism is not shown in detail, but might take a number of forms as fully described in detail in the Hickerson patents. For example, in one case, it may include key actuated set up mechanisms, while in another case electromagnetically actuated mechanisms can be provided. In the alternative, as disclosed in one of the Hickerson patents, the selection mechanism might include elements that are positioned in such a manner as to read another paper tape having perforations therein arranged according to one code format with the ultimate objective of perforating paper tape **1** with perforations according to another code format.

The Hickerson mechanisms disclosed in the three U.S. patents noted above are characterized by the provision of coded setup tape, slides, or strips, such as strips **6–10**. In FIG. 1, five such strips are provided. Each of the strips **6–10** has a projecting end portion, such as portion **6***a* on strip **6**, which extend into the punching station **4**. The punching station generally comprises a plate **11**, a plate **12**, a stripper block **13** and a die plate **14** that are arranged with respect to one another in a predetermined aligned manner. Block **13** has a series of openings **13***a* into which are fitted punch pins **15–19**. Each punch pin

has a collar, such as collar **15***a*. The pins are assembled with respect to block **13** and plate **12** in such a manner, that the collar of each pin **15–19** is maintained in abutment against plate **12**. Pressure for this purpose is supplied by means of individual springs, such as spring **20**. Each projecting portion, such as portion **6***a* on strip **6**, is associated with a different one of the punch pins. As described in the Hickerson patents, the pins **15–19** are conditioned for perforating the tape **1** by moving the associated strips **6–10** in a selective manner so that the projections extending from the strips are positioned above or are not positioned above the related pin. If a projection, such as projection **6***a*, is positioned above its associated pin, such as pin **15**, the pin will be in condition for punching a perforation in tape **1** as will shortly be described. Arranged opposite each pin **15–19** are openings **14***a* in the die plate **14**.

Following the setup of the strips **6–10** with respect to their related pins **15–19**, a shaft **21** is actuated in such a manner that eccentric cam **22** is rotated. The rotation of cam **22** results in the upward movement of block **13** and associated die plate **14**. Wherever a portion of any strip **6–10** is projecting over its related punch pin, that pin will be held in the position generally shown in FIG. 1, as the assembly moves upward. Any pin that is held by its associated strip will be forced through the tape **1** into the related opening **14***a* and perform the punching of a perforation in the associated channel in tape **1**. The various driving mechanisms and selection mechanisms for performing the punching operation are fully described in the Hickerson patents.

Those pins that do not have portions of their associated strips moved into position above them will move upwardly with the assembly and pass into related openings such as openings **11***a*.

Following the perforation of tape **1** with a particular character, the corresponding character is printed on tape **1**. Each character printed is preferably in line with the same column in tape **1** in which the character was punched. The printing operation will now be described. It is assumed in the embodiment of FIG. 1, that it is desired only to print one of the numeric digits 0–9 on tape **1**.

Positioned to the left of the punching station **4** is a sensing station **3**. Sensing station **3** includes a number of sensing pins **23–32** which correspond in number to the number of numeric digits 0–9 to be printed. In this case, since ten numeric digits are to be printed, ten sensing pins **23–32** and related sensing elements are provided. Each sensing pin **23–32** is similar to the other sensing pin, and each is formed with a particular configuration. Each sensing pin is freely mounted for rotation on a shaft **33**. Each sensing pin **23–32** has a flat spring member associated therewith, such as spring member **151**, that is associated with sensing pin **23**. The spring members tend to urge their associated sensing pins downward. Extending under the group of sensing pins is a sensing cam **34** which has a high lobe with a sharp cut off at **34***a*. Each sensing pin **23–32** has a portion, such as portion **32***a* on pin **32**, which normally rests on the high step portion **34***a* of cam **34**. It will be noted that a slight rotation of cam **34** in the direction indicated by arrow **35** will result in all sensing pins **23–32** dropping off the high step **34***a* of cam **34**. Each sensing pin **23–32** has a downwardly extending portion, such as portion **32***b* on sensing pin **32** and a finger like extension, such as extension **32***c* on sensing pin **32**, which are positioned in a particular manner with respect to the strips **6–10**.

Intermediate the selection mechanism **2** and the punching station **4**, strips **6–10** having a plurality of openings **36** that are arranged in a particular predetermined pattern that is comparable to that shown in FIG. 4. These openings are arranged in a plurality of sets particularly related to and indicative of the code permutations employed, and each set having predetermined configurations or portions for collectively indicating the relative posi-

tions of the strips with respect to one another, as described in the Hickerson patents. Positioned under each extension of the sensing pins 23–32 is an associated contact assembly, like assembly 37 for sensing pin 31, and assembly 38 for sensing pin 32. Contact 38 has a shoe portion 39 that is positioned directly under finger 32c.

Contact assembly 38 further comprises an upper contact strap 40 having a contact button 41 and a lower contact strap 42 having a contact button 43. Only contact assemblies 37 and 38 are shown in their entirety, it being understood that the balance of the contact assemblies are similarly constructed. All contact assemblies extend from a contact mounting assembly 44. Assembly 44 has a lower common bus bar 45 which is connected to a source of potential at terminal 46. Bus bar 45 is insulated from an upper contact mounting portion 47 by means of an insulation strip 48. The lower contact straps in each contact assembly are connected to the common bus bar 45. The upper contact straps in each contact assembly are mounted in the upper portion 47 of assembly 44, but are electrically insulated from one another. Each upper contact strap is connected to an associated wire connection such as connections 49 and 50 for the upper straps of contact assemblies 37 and 38. The various wire connections, such as 49 and 50, are connected to individual segments, such as segments 51 and 52, of a commutator assembly 53. Commutator 53 in this case, has ten segments altogether, again corresponding in number to the number of characters to be printed. Commutator 53 has a wiper arm 54 and a wiper ring 55. As is well known, rotation of wiper arm 54 will result in the electrical connection of each segment like segments 51 and 52 with the ring 55 in a successive manner. Connected to ring 55 is a wire connection 56 which is directed to the grid of a thyratron tube 57. Tube 57 has a capacitor 58 associated therewith. The side of capacitor 58 opposite to the plate of thyratron 57 is connected by means of a wire connection 59 to a solenoid 60 and finally to ground at 61.

Printing station 5 includes solenoid 60 as well as a print wheel 62 which has numeric characters embossed around its periphery. It will be noted that print wheel 62 is mounted to a shaft 63 on which commutator 53 is also mounted. Therefore, print wheel 62 rotates in synchronism with commutator 53. The embossed characters on print wheel 62 are arranged at radial positions which correspond with the radial positions of related segments on commutator 53.

Solenoid 60 has a plunger 64, the lower extremity of which is positioned normally above the top surface of tape 1. Positioned in between the lower extremity of plunger 64 and the top surface of tape 1 is an inked ribbon 65 that is indicated in dashed outline. Ribbon 65 might easily be positioned underneath the tape 1 in order to effect printing on the lower side of tape 1. It may be preferred to eliminate ribbon 65 altogether by providing a carboned layer in tape 1.

The operation of the printing portion of the apparatus in FIG. 1 is as follows. Strips 6–10 are positioned in order to set up punching, as previously described. It may be that the apparatus in FIG. 1 is capable of punching alphabetic as well as numeric information according to the well known five channel tape format. However, since it is assumed that printing of numeric characters only is required in the embodiment shown in FIG. 1, the printing mechanism will be actuated only when a numeric character is perforated in tape 1. Openings 36 in strips 6–10 are arranged in such a manner that whenever the strips 6–10 are set up for the punching of a numeric character, the openings 36 associated with the character selected will be aligned to permit a projection on a particular sensing pin, such as projection 32b on sensing pin 32, to pass all the way through the bundle of strips 6–10 when cam 34 is rotated. Only that sensing pin 23–32 that is associated with the character selected will pass through openings 36 in the manner described. The other openings 36 in strips 6–10 will be out of alignment so that no other sensing pin 23–32 can pass through the entire bundle of strips 6–10.

When any of the sensing pins 23–32 has passed through the strips 6–10, the weight of that sensing pin as reflected by its extension, such as extension 32c on pin 32 against the shoe of its related contact, such as shoe 39, will cause the closure of the associated contact assembly, such as assembly 38.

Selective closure of the contact assemblies in this manner results in the routing of the potential from terminal 46 to one of the lines, such as lines 49 and 50.

If the potential is supplied to line 50, for example, because of the closure of the related contact assembly 38, the potential from terminal 46 will be applied to the corresponding segment 52 on commutator 53.

Ordinarily, thyratron 57 is maintained in an off condition and capacitor 58 is charged by a potential from a terminal 66. In FIG. 1, it will be assumed that the commutator drive shaft 63 is continuously rotating thereby continuously rotating the print wheel 62 and the commutator assembly 53. As soon as the wiper 54 comes in contact with the segment 52 connected to line 50, the potential from terminal 46 will be directed through the wiper 54 to ring 55 and connection 56 and will fire the thyratron 57. The firing of thyratron 57 results in an immediate discharge of capacitor 58 through solenoid 60 to ground at 61. Since the characters on print wheel 62 are positioned radially in a correlated manner with respect to the segments on commutator 53, and since print wheel 62 is mounted on shaft 63 for synchronous rotation with commutator assembly 53, the numeric character corresponding to the character that has just been punched will be positioned under the plunger 64 when the solenoid 60 is energized. This will result in the printing of the proper character on the paper tape 1.

As previously noted, the printing station 5 can be arranged in line with the punching station 4, rather than displaced from it, as shown in FIG. 1. If this is the case, then printing will be performed about the same time that punching takes place. Following punching and printing, tape 1 is stepped one position for the punching and printing of the next character by means of a feed mechanism, as represented by a feed wheel 67. When the printing station 5 is positioned past the punching station 4 as shown in FIG. 1, tape 1 is preferably first punched as described, and then stepped into the printing station 5 in order that the printing operation can be performed. The sequence of operations in this case is punching, stepping and printing. As another alternative, it is apparent that printing station 5 can be positioned ahead of punching station 4. The sequence of operations in that case would be printing, stepping, punching.

It is apparent that the commutator assembly 53 and the various elements involved can be arranged in such a manner that a slight delay adequate to perform the printing operation following the stepping operation can be provided. If the printing station 5 is positioned one column removed from the punching station 4, a delay of this kind will still permit printing to take place in the column in which the associated character has been punched.

As will be described subsequently in connection with FIGS. 6a, 6b and 6c, additional means may be supplied with the apparatus of FIG. 1 for storing the step up of the sensing pins 23–32 in a simplified and efficient manner for later use.

Reference is now made to FIG. 2. The apparatus of FIG. 2 is generally comparable to that in FIG. 1, with the exception that provision is made for the punching and printing of a large number of characters on a tape 68. Tape 68 has six code channels, rather than five code channels as in tape 1, FIG. 1. The punching mechanism in FIG. 2, like that in FIG. 1, is generally based on the

mechanisms disclosed in the aforementioned Hickerson patents.

Only those elements in FIG. 2 which are additional to or are significantly different from the elements in FIG. 1 will be described in detail.

The apparatus in FIG. 2, like that in FIG. 1, has a selection mechanism **69**, a sensing station **70**, a punching station **71**, and a printing station **72**. The punching station **71** has six punch pins **73–78** and six respectively associated code strips **79–84**.

Print station **72** has a print wheel **85** which is assumed to have 48 embossed characters positioned at regular intervals about its periphery. These characters are arranged in four groups of 12 characters each. It is assumed that they include the conventional numeric characters 0–9, the alphabetic characters A–Z, and certain other special characters, as required.

In accordance with the embodiment in FIG. 2, the selection of any one of the 48 characters on print wheel **85** is accomplished with a number of selection elements that is considerably less in number than the total number of characters to be printed.

This may be observed by referring to the sensing station **70** wherein a number of sensing pins like the pins **23–32** in FIG. 1, are provided. In order to select each of the 48 characters on print wheel **85**, it has been found necessary to provide only 16 sensing pins at sensing station **70**. For reasons of simplicity, not all of the sensing pins are shown in FIG. 2, but a sufficient representative number is shown to illustrate the operation of the embodiment. The 16 sensing pins at station **70** are divided into two groups. These are the "Character" group which includes 12 sensing pins, and the "Zone" group which includes 4 sensing pins. Each sensing pin, such as pin **86**, has a downwardly extending portion such as portion **86***a*, and a finger like extension, such as extension **86***b*. The downwardly extending portions of all sensing pins are arranged to cooperate with openings **87** in the slides **79–84** as described for the embodiment in FIG. 1. The openings **87** are arranged in a plurality of groups (two), each group including a plurality of sets of openings indicative of the coded permutations employed, and each set having predetermined configurations or portions for collectively indicating the relative positions of the slides **79–84**. Like the sensing pins in FIG. 1, each sensing pin in FIG. 2 has a flat spring member for maintaining tension in a downward direction, such as spring member **152**. Each sensing pin has an associated contact strap, such as strap **88**, which under certain conditions is actuated by a sensing pin extension, such as extension **86***b*. Positioned underneath the contact straps is a common contact bar **89**. Contact bar **89** has a first section **89***a* and a second section **89***b* that are electrically insulated from one another. Section **89***a* is associated with the character sensing pins and contacts and is connected by a wire connection **90** to a source of potential **91**. Section **89***b* is associated with the Zone sensing pins and contacts and is connected at one extremity by a wire connection **92** to the grid of thyratron tube **93**. Each of the contact straps is supported by a mounting assembly **94**, and each has associated therewith a wire connection such as connections **95** and **96**. Wire connection **95** is representative of a group of connections that are associated with the "Character" group of sensing pins and their related contacts. Each wire in this group, such as wire **95**, is connected to an individual one of twelve segments on a commutator assembly **97** that is mounted on a shaft **98**. Shaft **98** has a gear **99** mounted thereon.

Wire connection **96** is representative of a group of connections that are associated with the "Zone" group of sensing pins and their related contacts. Each wire in this group, such as wire **96**, is connected to an individual one of four segments on a commutator **100**. Commutator **100** is mounted on a shaft **101** which has a gear **102** associated therewith. Gear **102** is meshed with gear **99**. Shaft **101** also supports print wheel **85**. The ratios of the gears **99** and **102** are chosen so that commutator **97** makes four revolutions during each revolution of commutator **100**, that is, a four to one ratio.

Commutator **100** has a wiper **103** which extends outwardly from its center for contact with each of its segments, such as segment **104**. Wiper **103** is also in contact with a wiper ring **105**. As drive shaft **101** rotates, wiper **103** comes into contact in succession with the various segments on commutator **100**. Each segment on commutator **100**, therefore, is electrically connected in succession to the common ring **105**. Ring **105** is connected by a wire **106** to a wiper ring **107** that is associated with commutator **97**. Also associated with commutator **97** is a wiper **108** which is rotated by the driving of shaft **98** through gears **99** and **102**. As wiper **108** rotates, each of the segments on commutator **97** is connected in turn to the common wiper ring **107**. It will be recalled that due to the ratio of gears **99** and **102**, wiper **108** will make a complete revolution of all segments on commutator **97** during the interval of time in which wiper **103** moves from one end to the other of one of the segments on commutator **100**.

FIG. 3 is a simplified schematic of the embodiment in FIG. 2. Both FIGS 2 and 3 will be referred to in the discussion of operation of the embodiment in FIG. 2. Before discussing the operation, reference is first made to FIG. 4.

FIG. 4 shows representative configurations for the openings **87** in the six slides **79–84** in order to set up punching and printing of as many as 48 characters. The openings are divided into a Zone group and a Character group. The Zone group has four sets of openings A to I, J to R, S to Z and 1 to 9. The Character openings are arranged into nine related sets designated **1–9**. However, an additional three sets can be provided in the columns designated **10**, **11** and **12** in order to provide the complete complement of 12 character sets.

Slides **79–84** in FIG. 4 are respectively designated X, O, **8**, **4**, **2**, and **1**.

In order to set up a character on print wheel **85** for printing purposes, it is necessary that a single sensing pin, such as pin **86**, pass completely through a set of openings in the Zone group in the slides **79–84** and that another sensing pin, such as pin **109**, pass through a set of openings in the Character group in the slides **79–84**.

The openings in the strips **79–84**, FIG. 4, are arranged in such a manner that only one sensing pin in the Zone group will pass completely through the strips **79–84**.

Following the selection of slides **79–84** by the selection mechanism **69**, the sensing pin cam **110** is rotated in a manner similar to that for the embodiment in FIG. 1, and the sensing pins are permitted to drop downwardly toward the slides **79–84**. As a result of this action, two sensing pins will pass through the slides, **79–84** and the contacts associated with the two sensing pins involved will be moved downwardly into contact with the contact bar **89**.

In order to observe the operation of the embodiment in FIG. 2, a typical circuit path will be followed for energizing solenoid **111**, which corresponds to solenoid **94** in FIG. 1. It will be assumed that sensing pins **109** and **86** have passed through strips **79–84** following selection, and that their respectively associated contacts **112** and **88** have been moved into contact with the related sections **89***a* and **89***b* of contact bar **89**. The circuit path begins at terminal **91**, and continues through the common contact bar section **89***a* to the character sensing contact **112** and from there over connection **95** to the related segment on commutator **97**. The path continues through wiper **108**, wiper ring **107**, wire **106**, wiper ring **105**, and wiper **103** to one of the segments, such as segment **104**, on commutator **100**. It will be recalled that there are four zones in the embodiment illustrated. Zone contact **88** is now closed. Contact **88** is connected by wire **96** to one of the

four segments on commutator **100**. As wiper **108** rotates past the individual segments on commutator **97**, each segment will be connected in turn to ring **107** on commutator **97**. The potential from terminal **91** through contact **112** will be made available to each segment on commutator **100**. However, a continuous circuit path will not be completed until wiper **103** reaches the zone segment on commutator **100** which corresponds to the zone contact **88** that has been closed. When wiper **103** has reached the selected zone segment on commutator **100**, a circuit is completed over the wire connection **96** to the selected zone contact **88** through section **89***b* of contact bar **89** and by way of connection **92** to the grid of thyratron **93**.

The thyratron portion of the circuit in FIG. 2 operates in a manner that is comparable to that for the thyratron circuit in FIG. 1. Normally, thyratron **93** is de-conditioned, and thereby non-conductive. When thyratron **93** is in this condition, capacitor **113** accumulates a charge. As soon as the circuit is completed through the path just traced from terminal **91**, thyratron **93** will fire, and capacitor **113** will be discharged through the solenoid **111** by way of the connection **114** to ground at **115**.

As a consequence of a firing of thyratron **93** and the discharge of capacitor **113**, the solenoid **111** will be energized, and plunger **116** will be rapidly displaced toward the print wheel **85**. Since print wheel **85** is mounted on the same shaft **101** on which commutator **100** is mounted, and since the commutator **100** is synchronized with a one to four ratio with commutator **97**, the firing of solenoid **111** and movement of plunger **116** will result in the printing of a character on tape **68** which corresponds to the character that was selected for punching in the tape at punching station **71**.

Referring now to FIG. 5, additional mechanism is disclosed for checking that the set up of strips **79–84** was performed correctly. If desired, the tape **68** in FIG. 2 could be supplied with an additional channel for the perforation of a check bit if necessary in each character code group.

In this case, seven strips would be supplied in the apparatus of FIG. 2 rather than six, as shown. In FIG. 5, seven such strips **117–123** are respectively designated X, O, **8**, **4**, **2**, **1** and Check. Each strip has an additional set of five openings as at **117***a*–**117***e* which belong to individual groups designated A, B, C, D, and E. Associated with each of the groups A, B, C, D and E are sensing pins **124–128**. These sensing pins have projections that are adapted to pass through the openings in the strips **117–123**. Associated with the seven strips **117–123** in FIG. 5 is an auxiliary error-indicating strip **129** which also has five openings designated **129***a*–**129***e* that are essentially aligned with the five groups A, B, C, D and E. Strip **129** is normally maintained to the right in FIG. 5 by means of a pawl **130** which engages an opening **129***f* in strip **129**. At the left extremity of strip **129** is a contact pair **131** which is arranged in such a manner that it may be closed if strip **129** is moved to the left as indicated by arrow **132**.

During each cycle of punching and printing, the strips **113–123** are moved from their inactive positions to their active positions as described in connection with strips **79–84**, FIG. 2. As shown in FIG. 5, movement of this sort would be from right to left. In order to have a correct indication that strips **117–123** have been properly set up, the openings in the strips in the groups A, B, C, D and E are arranged in such a manner that at least one of the pins **124–128** should pass completely through all of the strips **117–123** during each cycle.

The arrangement in FIG. 5 is such that an even parity is the desired parity. This means that if an odd number of strips **117–122** have been selected, then the check strip **123** will also be selected in order to make the total number of strips selected even. If an even number of strips **117–122** is selected, then the check strip **123** remains in its normal position, since an even number has already been selected.

In any case, a proper selection of the strips **117–122**, and the check strip **123**, will result in the passage of at least one of the sensing pins **124–128** all the way through the strips **117–123** and into engagement with one of the apertures **129***a*–**129***e* in strip **129**. At a later time in the cycle following the set up of the strips **117–123**, strip **129** is released by rotation of cam **133** and movement of pawl **130** to the left. If the strips have been properly set up, one sensing pin **124–128** will be in engagement with the error indicating strip **129**, thereby preventing movement of strip **129** to the left at this time. Contacts **131** will remain open. If on the other hand, the strips have not been set up properly or any malfunction occurs to prevent proper movement of the sensing pins, no sensing pin **124–128** will be in an engagement with the error indicating strip **129**, and it will be free to move to the left when released by pawl **130**. Movement of error indicating strip **129** to the left will result in closure of the contacts **131**. These contacts can be included in a circuit for actuating a relay, an audible signal, or other error indicating means.

Referring again to FIG. 2, a latching arrangement generally indicated at **134** is provided for retaining those contacts which have been transferred by their related sensing pin, such as pins **86** and **109**, and have been selected. This serves as a temporary storage means, and permits the restoration of the sensing pins while maintaining the set up of the contacts, such as contacts **88** and **112**, in order to perform the printing operation. An obvious advantage occurs as a result of the provision of latching means **134**, since each sensing pin can now be restored upward to its normal position, and set up of the interposer strips **79–84** can occur prior to the time that printing takes place. This may be early in the following cycle. One reason for doing this, as noted above, is that the tape **68** can be stepped one columnar position in order that the character printed will be in alignment with its related perforations in the tape **68**.

A number of storage arrangements, including storage means **134**, are illustrated in FIGS. 6*a*, 6*b* and 6*c*.

The storage arrangement in FIG. 6*a* is generally like that shown in FIG. 2. FIG. 6*a* includes a sensing pin **86** having a projection **86***a* and a contact actuating finger **86***b*. Projection **86***a* is positioned in proximity to the bundle of strips **79–84** for passage through openings **87** therein. A sensing pin cam **110** then performs the same function as that shown in FIG. 2. When sensing pin cam **110** is rotated out of the way of sensing pin **86**, projection **86***a* is assumed to be able to pass through openings **87** in the strips **79–84**. If this takes place, finger **86***b* will move contact **88** downwardly, and a shoe portion **135** underneath finger **86***b* will be latched under latch bail **134**. Bail **134** may be split into individual sections one for each sensing pin if timing conditions make this desirable. Contact **88** comes into electrical contact with the common contact bar **89***b* as before. Subsequently, after printing of the character takes place, latch bail **134** can be pulled downwardly at point **134***a*, thereby releasing contact **88** in preparation for a subsequent setup operation.

FIG. 6*b* shows a similar arrangement for storing the set-up of the sensing pin contacts. In FIG. 6*b*, an element **136** is pivotally mounted at **137** for movement downward in response to the downward movement of finger **138***a* on a sensing pin **138**. When it is moved downwardly, element **136** becomes latched under bail **139** which has an associated wire contact **140** and which is pivotally mounted at **141**. Each sensing pin would have a similar latch bail and associated contact. Bail **139** is normally held out of engagement with element **136** by means of a latch bail cam **142**. In order to latch element **136** in its downward position, latch bail cam **142** is rotated in a direction indicated by arrow **143** so that the arm **139***a* of latch bail **139** drops off the high step of cam **142**. When bail **139** is released by cam **142**, it will remain in its normal posi-

tion or move to the left depending upon whether or not the projection **139***b* comes in contact with the element **136**. If element **136** has been moved downwardly by finger **138***a*, the end of element **136** will be in a position to move into the recess **139***c*, thereby permitting latch bail **139** to move to the left. Any latch bail, like bail **139**, that moves to the left carries its associated wire contact, like contact **140**, to the left also. If bail **139** moved to the left, contact **140** will complete an electrical circuit from the terminal **144** to the common contact bar **145**. The various latch bails are subsequently restored when cam **142** moves around and the arms corresponding to arm **139***a* are raised by the high lobe on cam **142**.

Another alternative arrangement for storing the setup of the sensing pins is illustrated in FIG. 6*c*. A sensing pin **146** has a tab portion **146***a*. The tab portion **146***a* is engaged with a movable wire contact member **147** that rests against an insulated portion **149***a* of a latch member **149**. Tension is maintained on contact member **147** in such a manner, that when sensing pin **146** moves downwardly as indicated by arrow **148**, contact **147** will be moved downwardly and to the left into engagement with a circuit conducting portion **149***b* of latch element **149**. Latch element **149** is fixedly mounted to a support member **153**. Any sensing pins like pin **146** that are moved downwardly will therefore cause their associated wire contacts, like contact **147**, to be latched into a stored condition, as at **147***a*. Contact **147**, in each case, can function to complete circuits for setting up the printing operation as previously described. Connection into the circuit of FIG. 2 can be made by means of a wire connection **154**. At a later time, each contact is moved to the right and out from under its associated latch by means of a restore bail **150**. Contact **147**, for example, is unlatched from latch element **149** by the movement to the right of lug **150***a* on bail **150**.

From the foregoing description, it is apparent that novel apparatus for perforating and printing on a storage media at high speeds has been provided. The apparatus is arranged in such a manner that printing can take place simultaneously with punching, prior to punching, or following punching, as desired. In adidtion, simplified storage arrangements are provided for storing setup conditions of the apparatus. In an expanded form, the apparatus performs the printing selection function with a minimum amount of hardware that is considerably less than that normally required for selecting and causing the printing of a like number of characters. In addition, other facilities are provided in the apparatus, if desired, in order to perform redundancy checking and error indication functions.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. Cyclically operable apparatus for punching and printing information in a storage media comprising:
- a sensing station;
- a punching station, said station including a plurality of selectively actuatable elements for perforating said media according to predetermined code configurations;
- a plurality of selectively actuatable punch interposer strips, said strips extending through said sensing station to said punching station and each said punch interposer strip being associated with a particular one of said punch elements for controlling its actuation;
- means for selectively actuating said interposer strips in order to thereby set up said punch elements for punching a particular character code configuration in said media;
- means at said sensing station for sensing the actuation configuration of said interposer strips;
- a printing station, said station including a print wheel and associated selectively actuatable solenoid means for printing individual characters on said media;
- means controlled by said sensing means for selectively actuating said solenoid means in order to print on said media a character which corresponds to the character selected for punching;
- and common drive means for synchronously actuating said sensing means, said punching elements, said solenoid actuating means, and said print wheel during a single cycle of operation.

2. Apparatus for punching and printing information in a storage media comprising:
- a sensing station;
- a punching station, said station including a plurality of selectively actuatable elements for perforating said media according to predetermined code configurations;
- a plurality of selectively actuatable punch selection elements, said elements extending through said sensing station to said punching station and each said punch selection element being associated with a particular one of said punch elements for controlling its actuation;
- means for selectively actuating said punch selection elements in order to thereby set up said punch elements for punching a particular character code configuration in said media;
- a printing station, said station including a print wheel and associated actuatable means for printing individual characters on said media;
- a plurality of sensing elements and respectively associated electrical contacts at said sensing station for sensing the actuation configuration of said punch selection elements and for representing said configuration by contact closures, said elements corresponding in number to the total number of characters available for printing on said print wheel;
- a commutator, said commutator having a plurality of segments corresponding in number to the number of said sensing elements, each said segment being respectively associated with a particular one of said sensing means, and said commutator further having a wiper element for contacting each of said segments in succession;
- circuit means for interconnecting each of said sensing contact with a particular segment on said commutator and for supplying an electrical potential through any closed sensing contact;
- and circuit means responsive to an impulse from said commutator for actuating said print wheel actuatable means in order to print on said media a character which corresponds to the character selected for punching.

3. Cyclically operable apparatus for punching and printing a storage media, comprising:
- a sensing station;
- a punching station, said station including a plurality of elements that are selectively actuatable for perforating said media according to predetermined code configurations;
- punch selection means, said means including selection elements which extend through said sensing station and said punching station for setting up said punching elements according to a particular code configuration, said selection elements having indicative portions thereof arranged in a plurality of groups, each group including a plurality of indicative sets, each set having a predetermined number of portions for collectively indicating the relative positions of said elements with respect to one another;
- printing means, said means including elements actuatable during a cycle of operation for selectively printing

one of a number of characters corresponding to the product of the number of indicative sets in one selection group times the number of indicative sets in another selection group;

a plurality of groups of sensing elements at said sensing station, each said group of elements being respectively associated with a particular indicative portion group and further corresponding in number to the number of indicative sets in said particular group;

and means responsive to indications from individual sensing elements in each of said groups for selectively setting up said printing means to print a particular one of said plurality of characters.

4. Cyclically operable apparatus for punching and printing alphabetic, numeric, and special characters in a storage media, comprising:

a sensing station;

a punching station, said station including a plurality of elements that are selectively actuatable for perforating said media according to predetermined code configurations;

punch selection means, said means including interposer strips which extend through said sensing station and said punching station for setting up said punching elements according to a particular code configuration, said strips having openings therein arranged in a zone group and a character group, including a plurality of indicative opening sets, each set having a predetermined number of openings for collectively indicating the relative positions of said strips with respect to one another;

printing means, said means including elements actuatable during a cycle of operation for selectively printing one of a number of characters corresponding to the product of the number of indicative sets in one selection group times the number of indicative sets in another selection group;

a group of zone sensing elements and a group of character sensing elements at said sensing station, each said group of elements being respectively associated with a particular indicative opening group and further corresponding in number to the number of indicative opening sets in said particular group;

means for moving said sensing elements toward their related opening sets in said strips in order to develop manifestations representative of the character set up by said punch selection means;

and means responsive to indications from individual elements in each of said sensing groups for selectively setting up said printing means to print a particular one of said plurality of characters.

5. Cyclically operable apparatus for punching and printing a storage media, comprising:

a sensing station;

a punching station, said station including a plurality of elements that are selectively actuatable for perforating said media according to predetermined code configurations;

punch selection means, said means including elements which extend through said sensing station and said punching station for setting up said punching elements according to a particular code configuration, said elements having indicative portions thereof arranged in a plurality of groups, each group including a plurality of indicative sets, each set having a predetermined number of portions for collectively indicating the relative positions of said elements with respect to one another;

a plurality of groups of sensing elements and related electrical contacts at said sensing stations, each said group being respectively associated with a particular indicative portion group and including sensing elements corresponding in number to the number of indicative sets in said particular group;

means for moving said sensing elements toward their related portion sets in said strips in order to transfer their associated contacts and thereby manifest the selection set up of said punch selection means;

a first commutator, said commutator having a plurality of segments corresponding in number to the number of sensing elements in one of said groups;

a second commutator, said commutator having a plurality of segments corresponding in number to the number of sensing elements in another of said groups;

means to rotate said commutators in such a manner that said first commutator makes one complete revolution for each segment of said second commutator;

circuit means for interconnecting each of said sensing elements to a respectively associated segment on one of said commutators, and said circuit means further being arranged so that a signal is supplied through an actuated sensing contact in a first group to its associated commutator segment, through a segment on said second commutator and subsequently to an actuated contact in another of said groups;

printing means, said means including elements actuatable during a cycle of operation actuatable elements for selectively printing one of a number of characters corresponding to the product of the number of indicative sets in one selection group times the number of indicative sets in another selection group;

and circuit means responsive to said signal as supplied from an individual contact in said second group for actuating said printing means to print a particular one of said plurality of characters.

6. Apparatus for first punching and subsequently printing a storage media as said media progresses successively through a punching station and a printing station, comprising:

punching means at said punching station, said punching means including a plurality of selectively actuatable elements for perforating said media according to predetermined configurations;

a plurality of selectively actuatable punch interposer strips, each said punch interposer strip being associated with a particular one of said punch elements for controlling its actuation;

storage means associated with said punch interposer strips for retaining the setup of said strips while said media progresses from said punching station to said printing station;

printing means at said printing station, said printing means being selectively actuatable to print a character on said media;

and print selection means operable under control of said storage means for setting up said printing means in order to print a character corresponding to said particular code configuration on said media.

7. Apparatus for punching and printing a storage media, comprising:

a punching station, said punching station including a plurality of selectively actuatable punch elements for perforating said media according to predetermined configurations;

a plurality of selectively actuatable punch interposer strips, each said punch interposer strip being associated with a particular one of said punch elements for controlling its actuation;

a printing station, said printing station including printing means that are selectively actuatable to print a character on said media at said printing station;

means for feeding said media from said punching station to said printing station;

print selection means operable under control of said

punch interposer strips for setting up said printing means in order to print said media according to said particular code configuration;

means for driving said punching elements;

means for driving said printing means;

and common drive means for actuating said punch interposer strips, said print selection means, said punch drive means, said feeding means and said printing drive means in succession during a single cycle of operation.

8. Apparatus for recording coded character configurations and printing related information in a storage media comprising:

a sensing station;

a recording station, said recording station including a plurality of selectively actuatable elements for recording in said media according to predetermined character code configurations;

a recording selection station;

a plurality of selectively actuatable recording selection elements, said elements extending from said recording selection station through said sensing station to said recording station and each said recording selection element being associated with a particular one of said recording elements for controlling its actuation;

means at said recording selection station for selectively actuating said recording selection elements

in order to thereby set up said recording elements for recording a particular character code configuration in said media;

means at said sensing station for sensing the actuation configuration of said recording selection elements;

a printing station, said printing station including selectively actuatable means for printing individual characters on said media;

and means controlled by said sensing means for selectively actuating said printing means in order to print on said media a character which corresponds to the character selected for recording.

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