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Fig. 1.

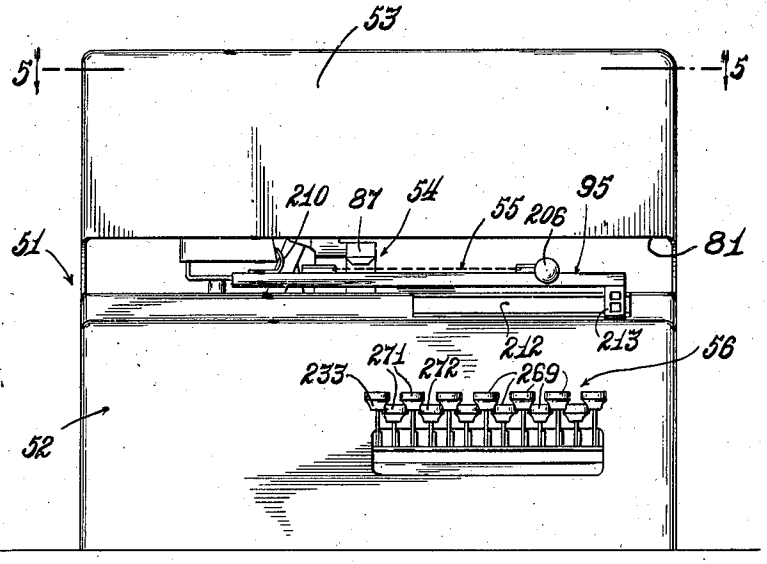


Fig. 2.

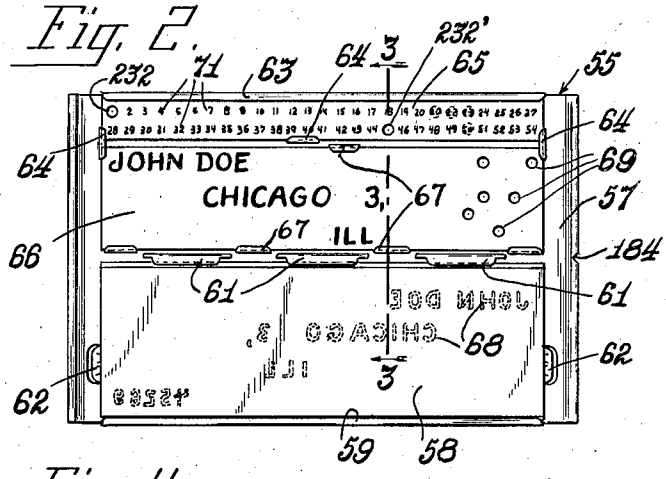


Fig. 3.

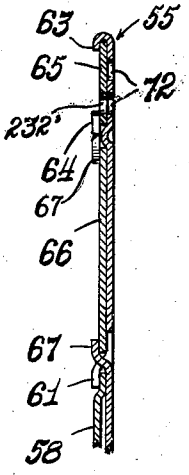
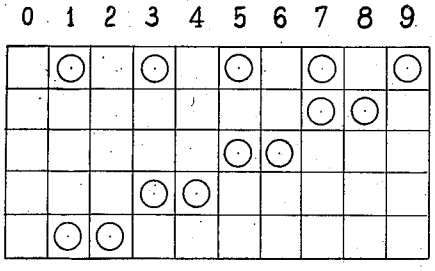


Fig. 4.



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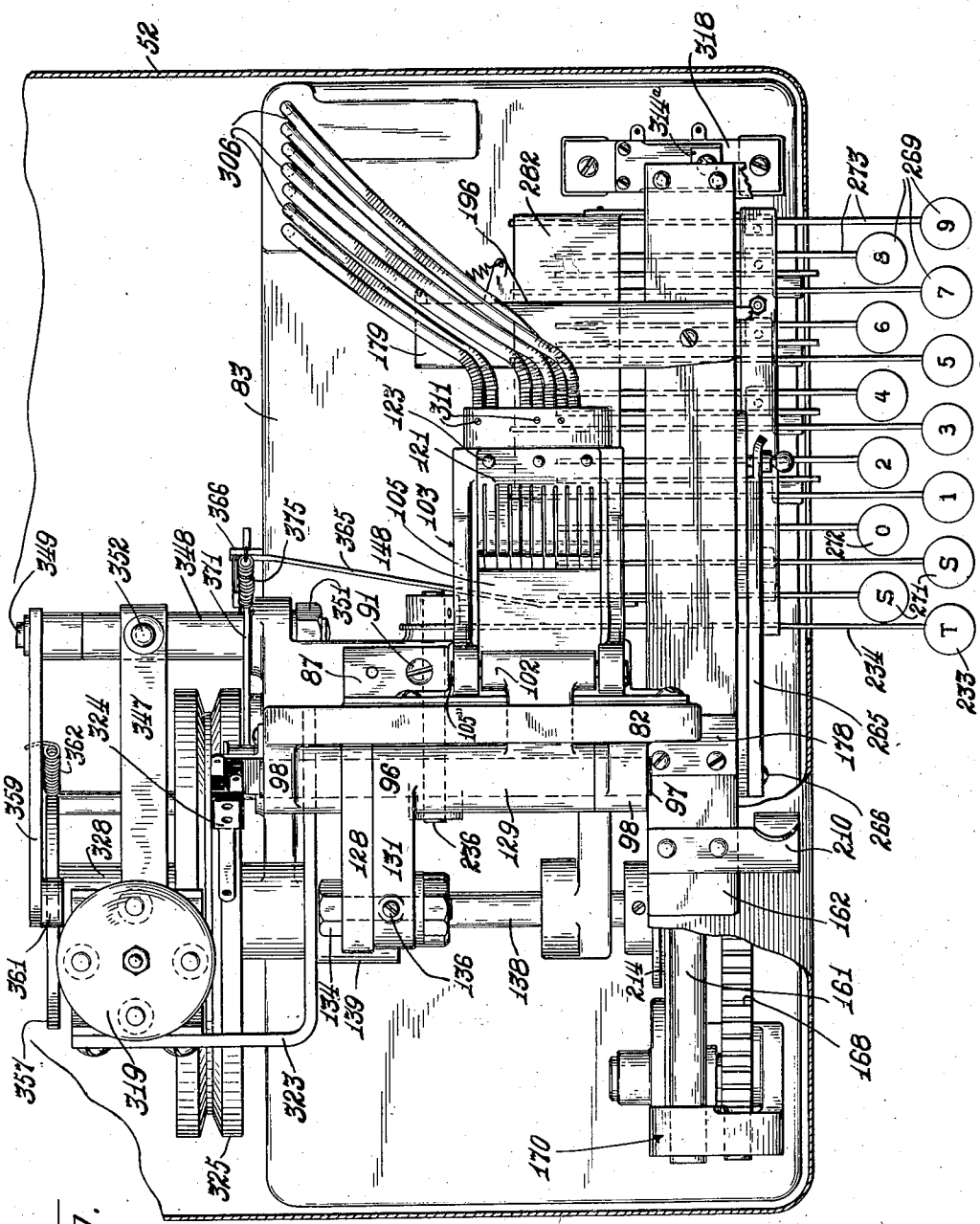

FIG. 5.

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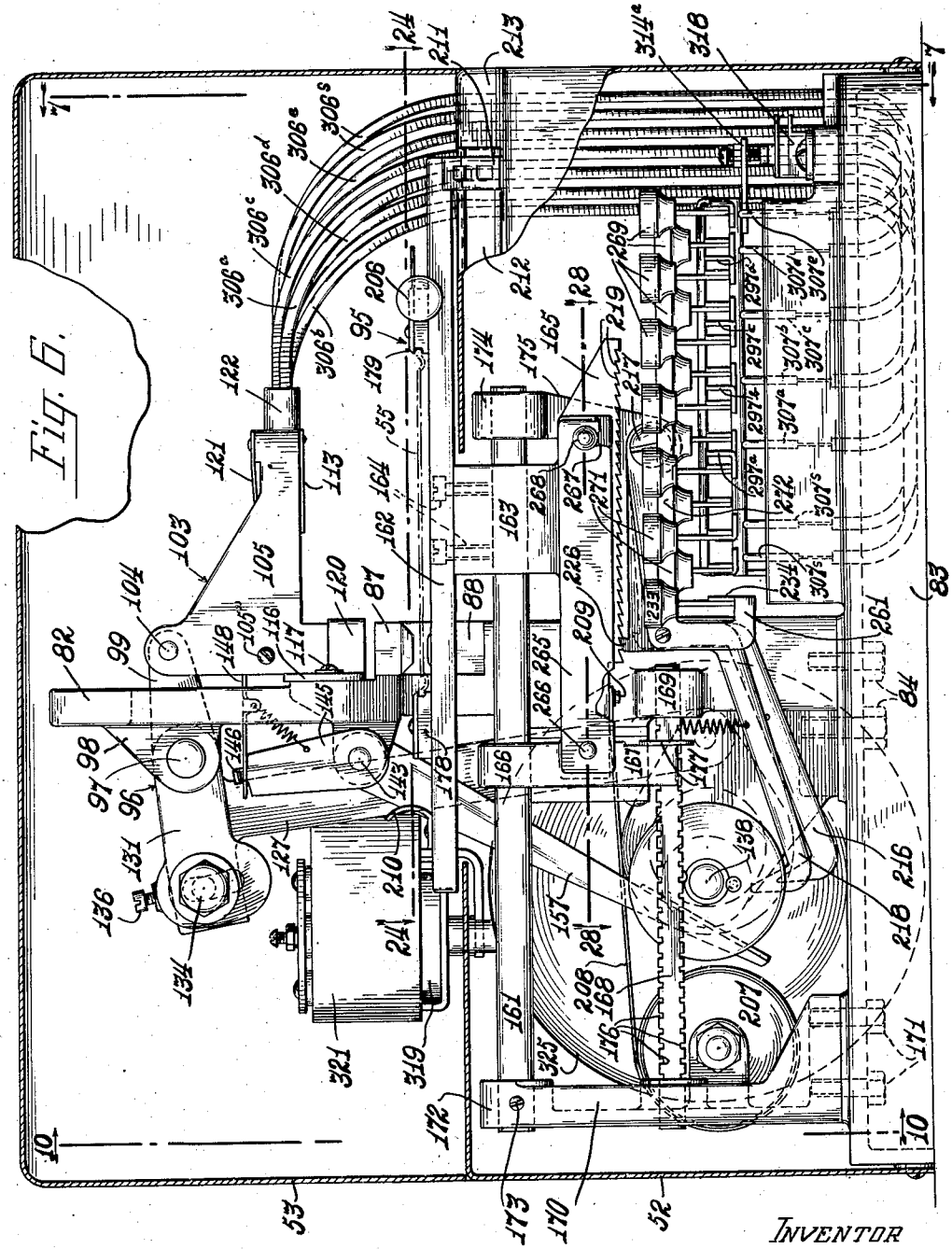

Fig. 6.

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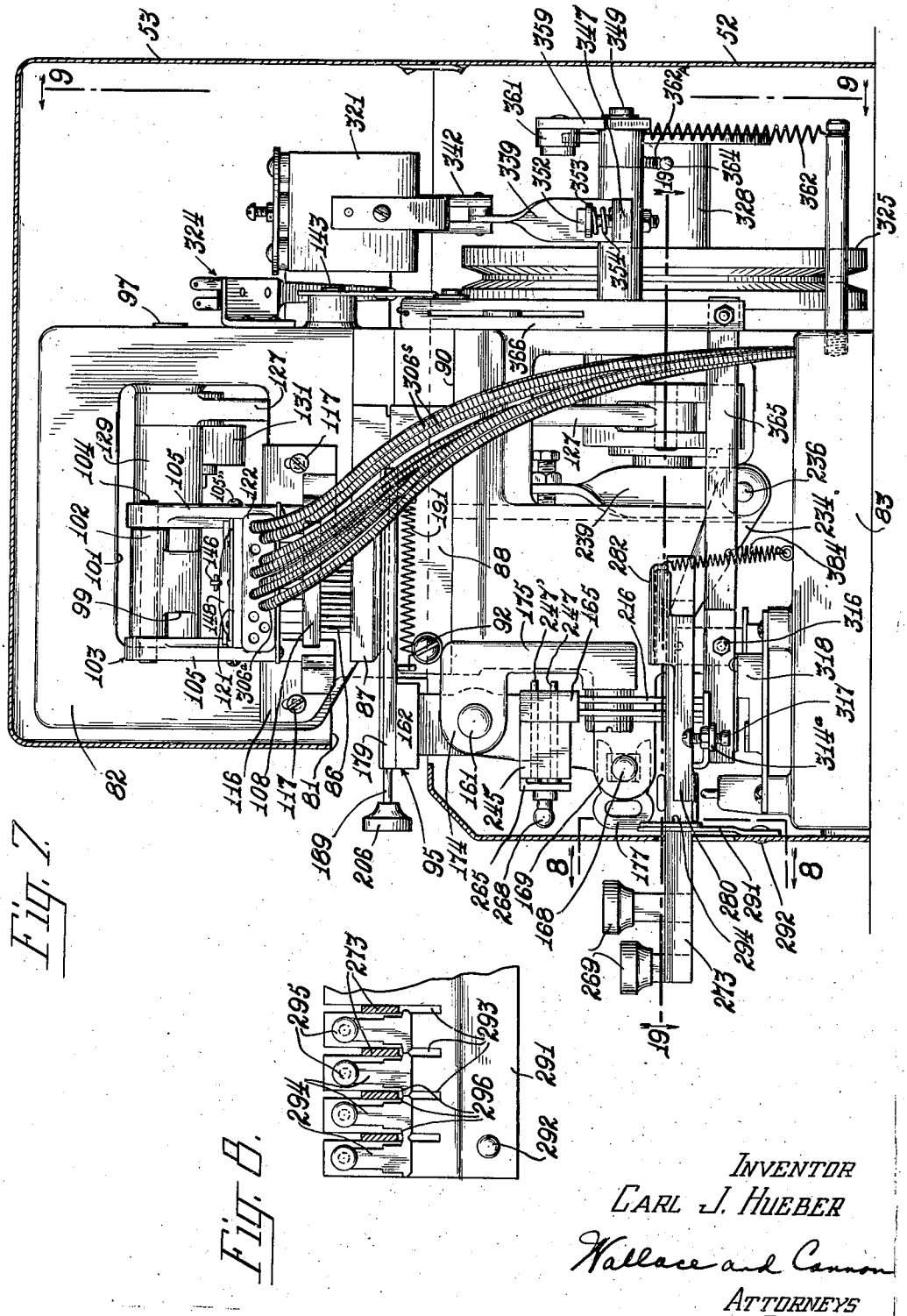

FIG. 7.

FIG. 8.

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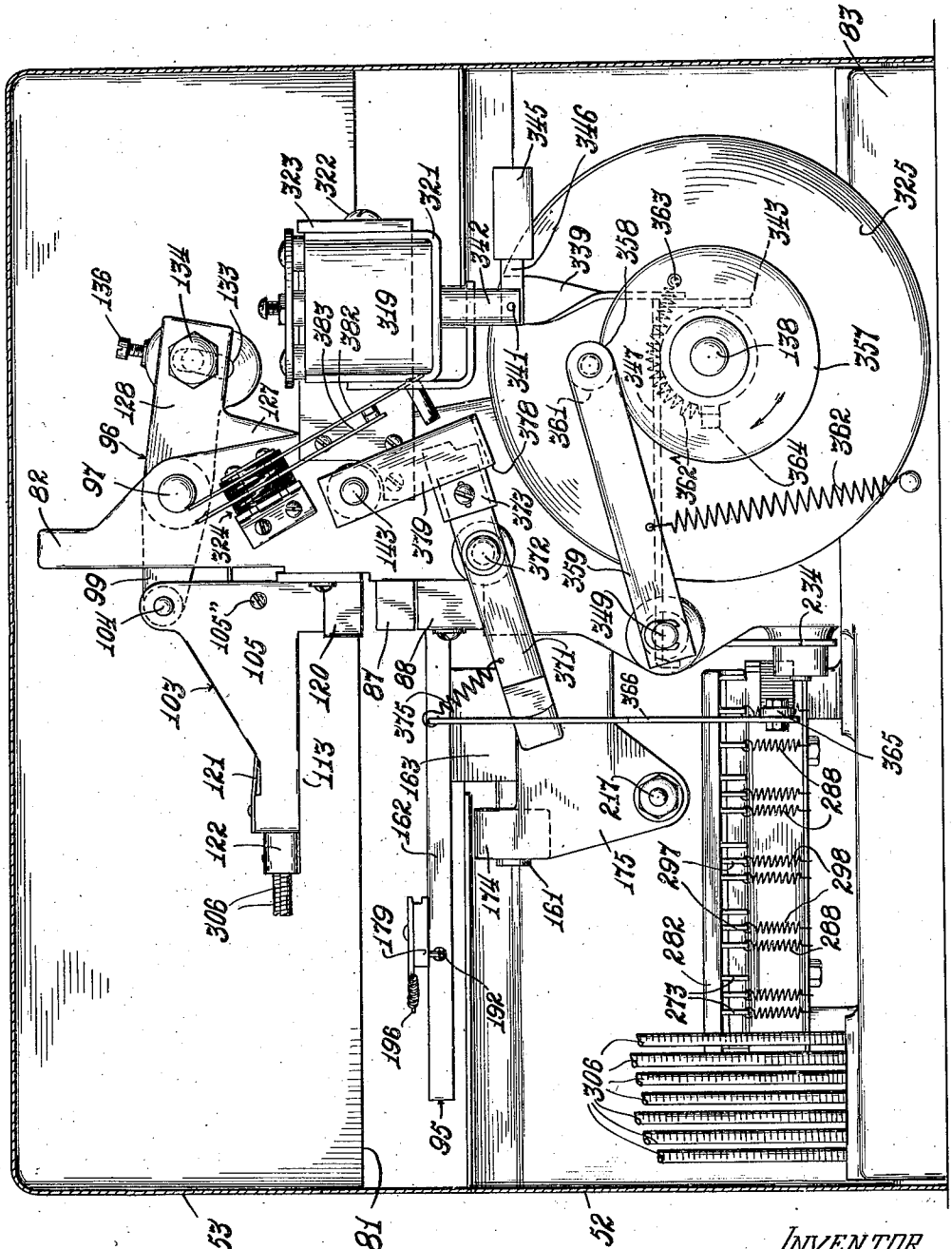

Fig. 9.

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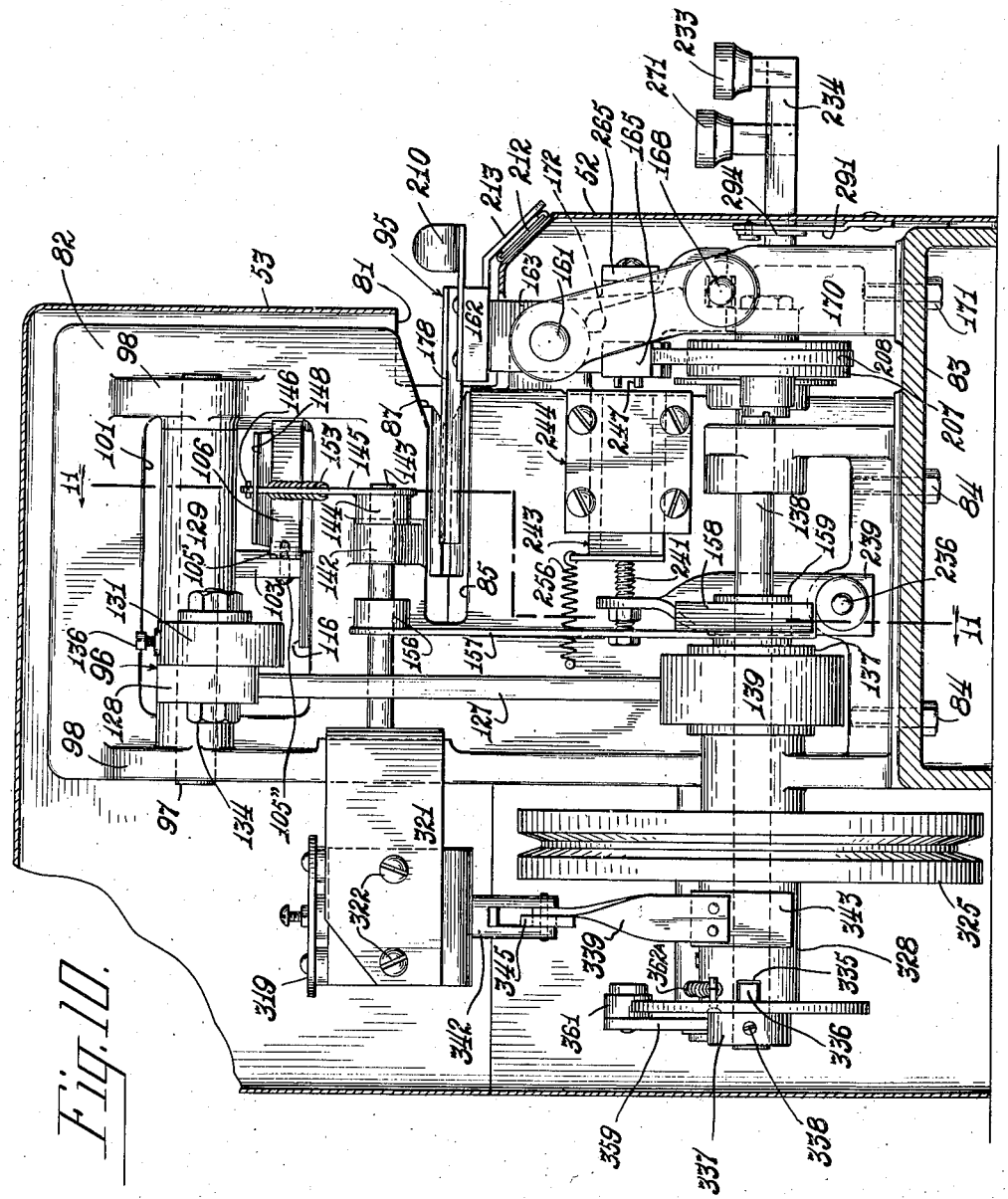

Fig. 10.

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Fig. 11.

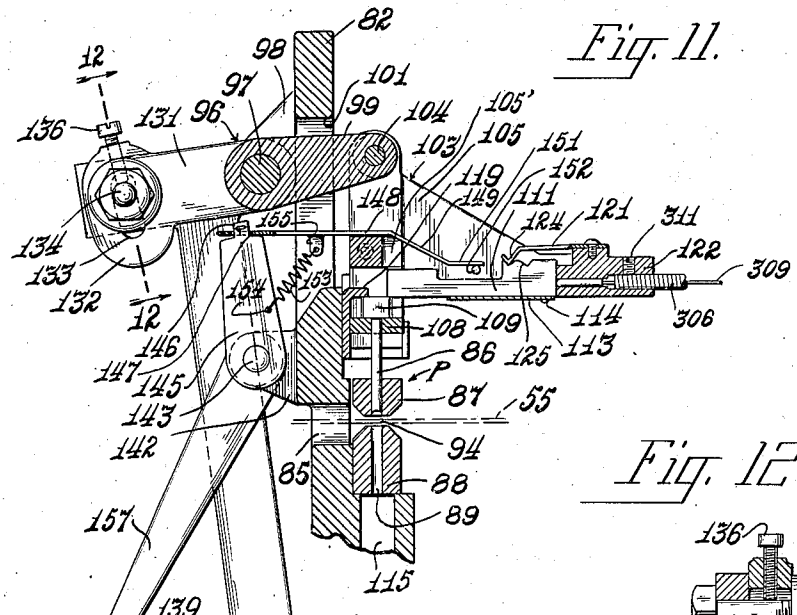


Fig. 12.

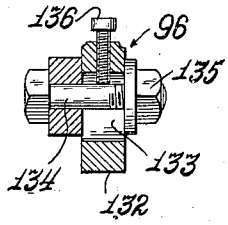
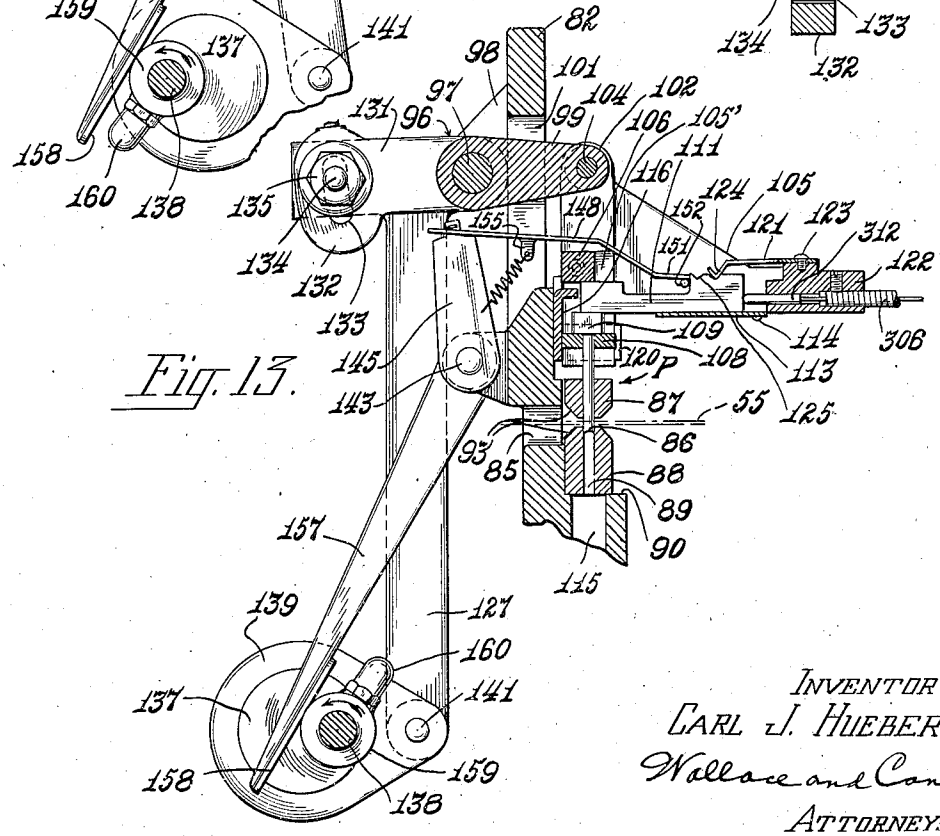


Fig. 13.



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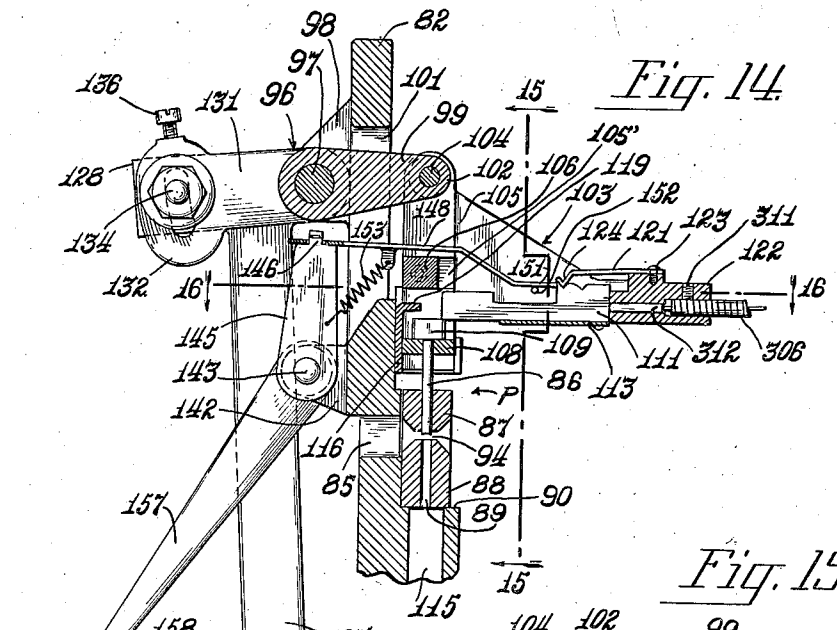

Fig. 14.

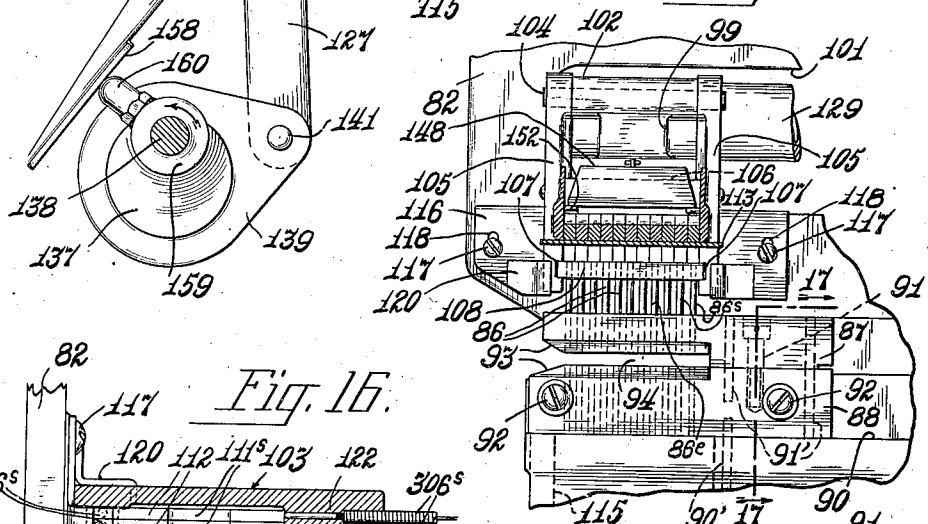

Fig. 15.

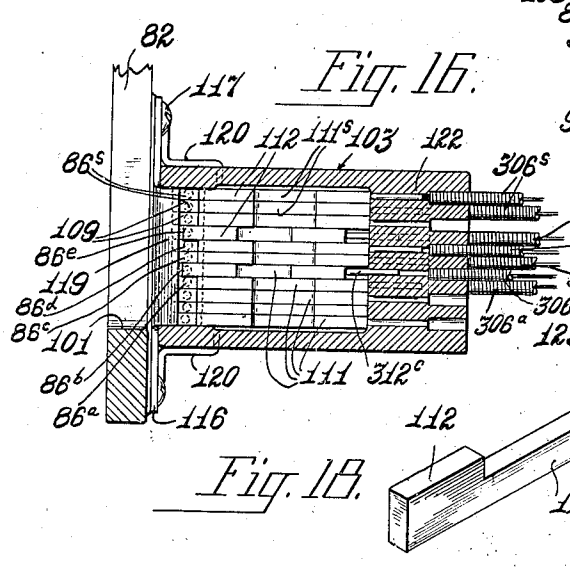

Fig. 16.

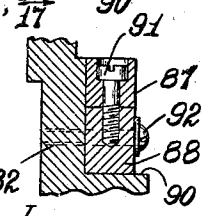

Fig. 17.

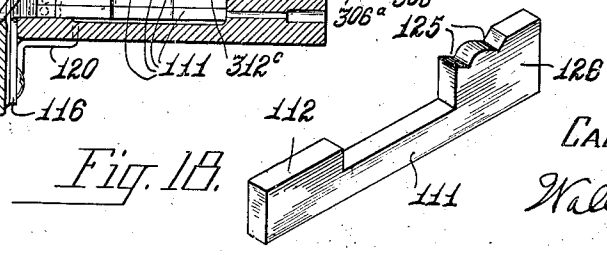

Fig. 18.

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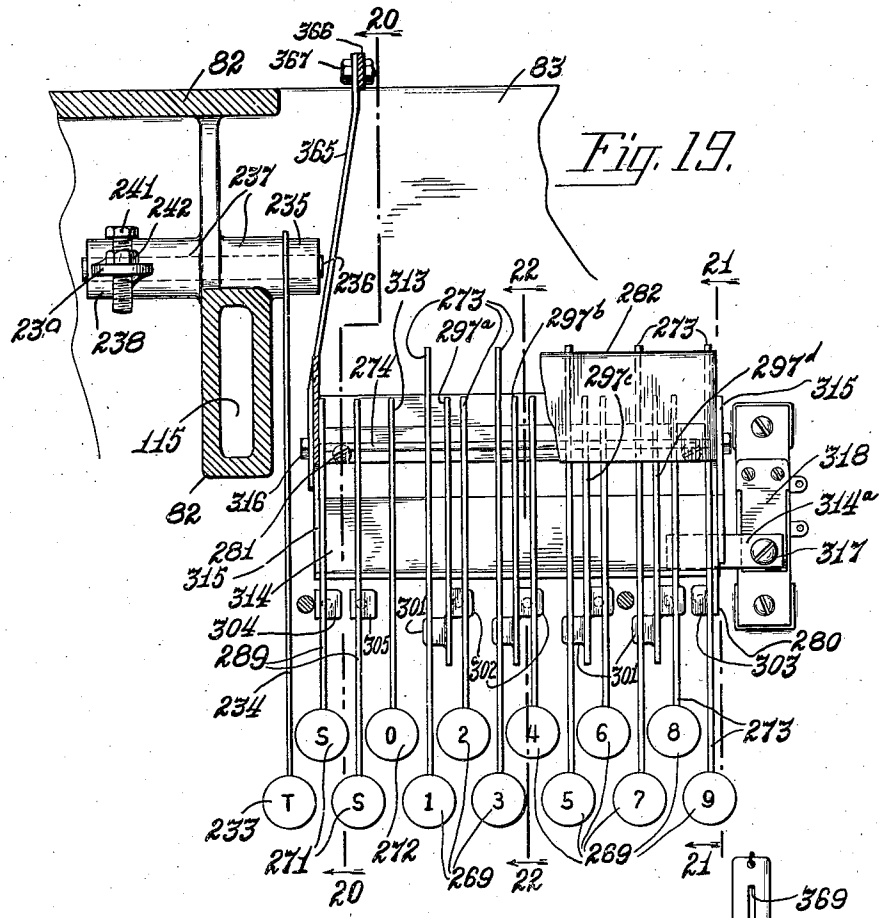

Fig. 19.

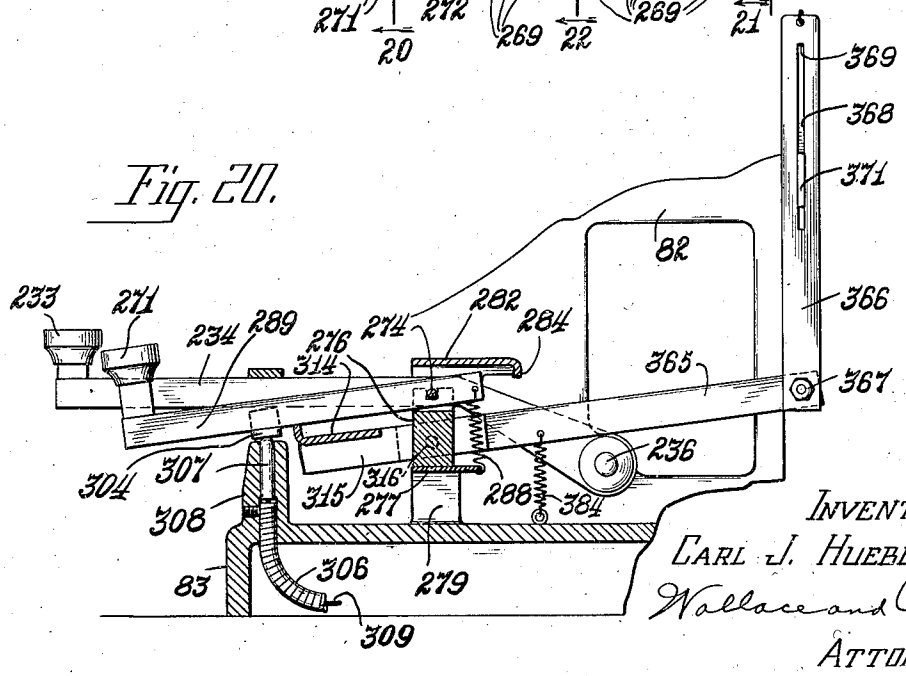

Fig. 20.

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Fig. 21.

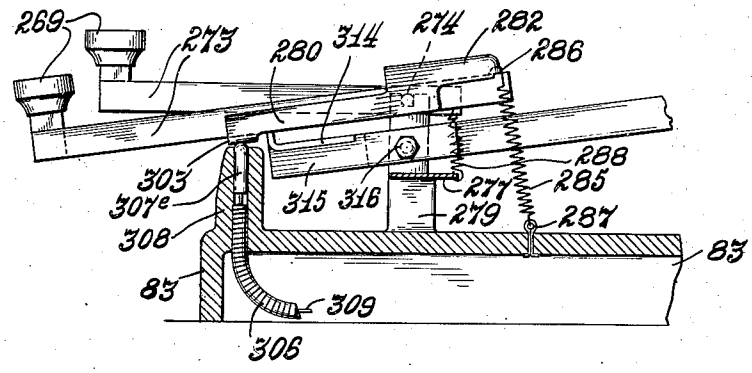

Fig. 22.

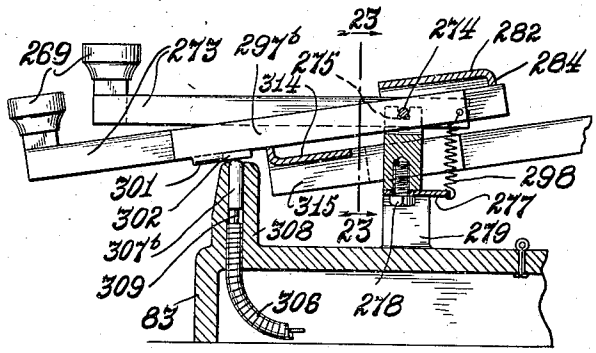

Fig. 23.

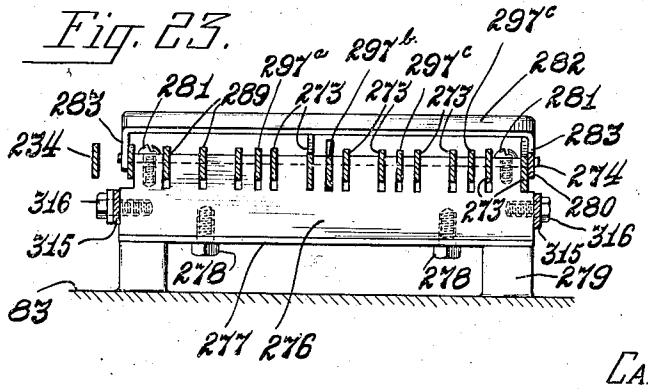

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Fig. 24.

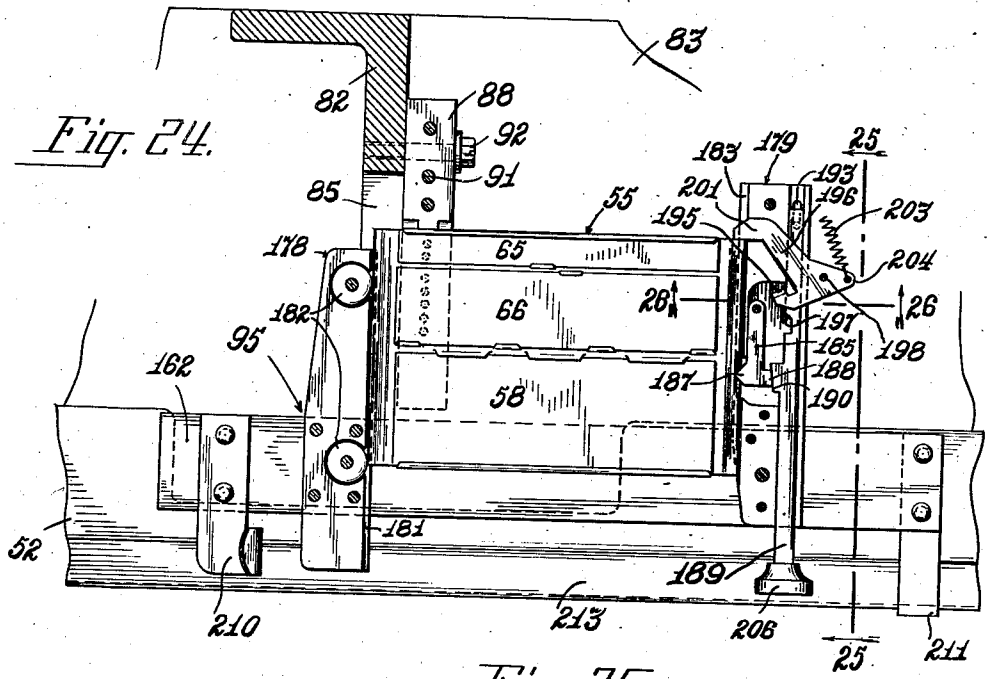
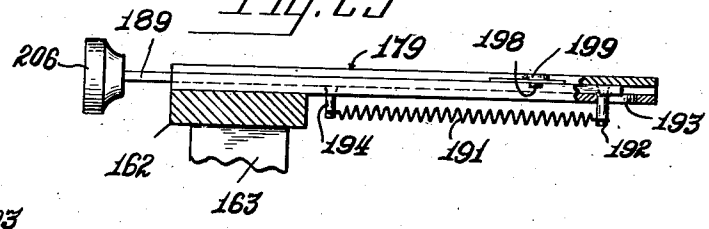


Fig. 25



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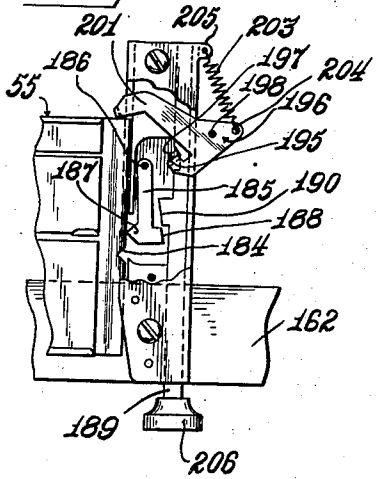

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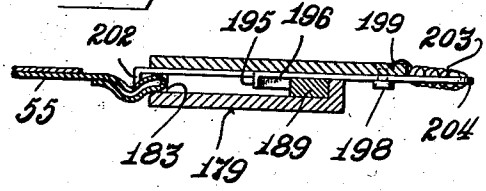

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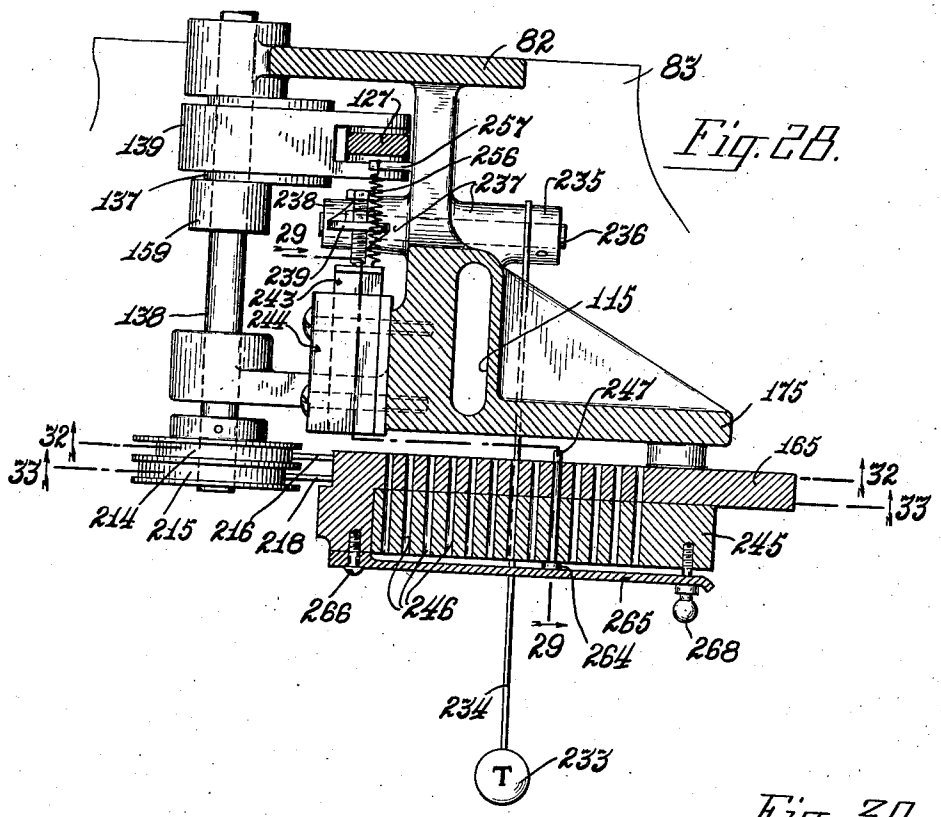

Fig. 28.

Fig. 29.

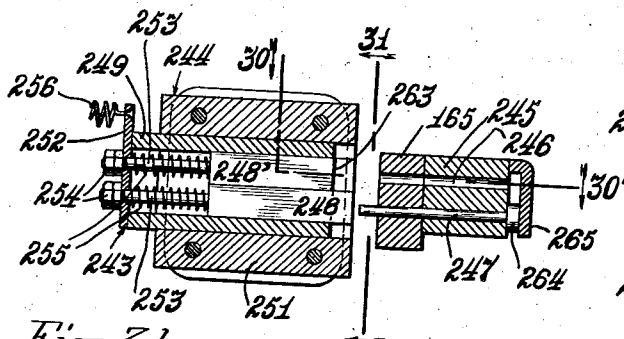

Fig. 30.

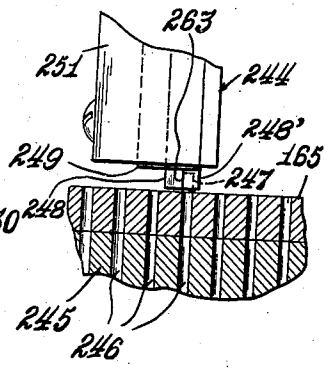

Fig. 31.

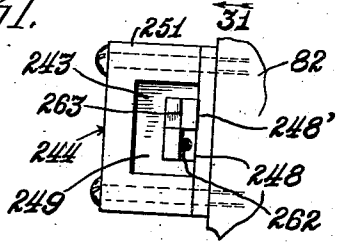

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Fig. 32.

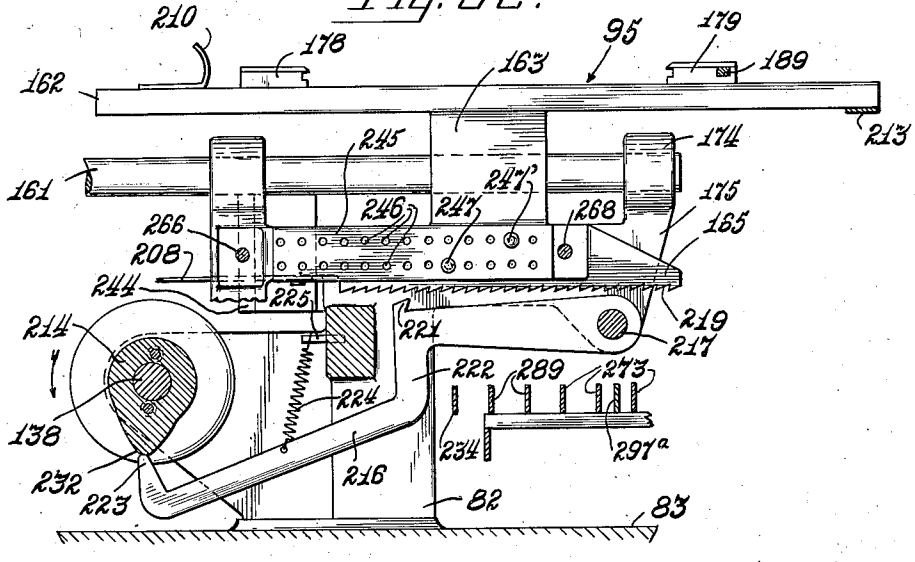

Fig. 33.

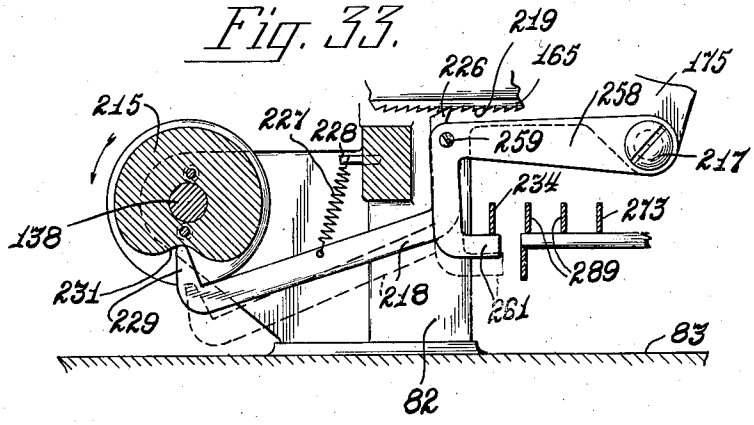

Fig. 34.

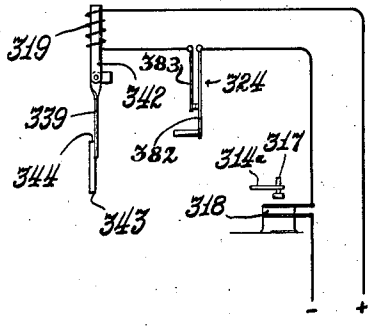

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Fig. 35.

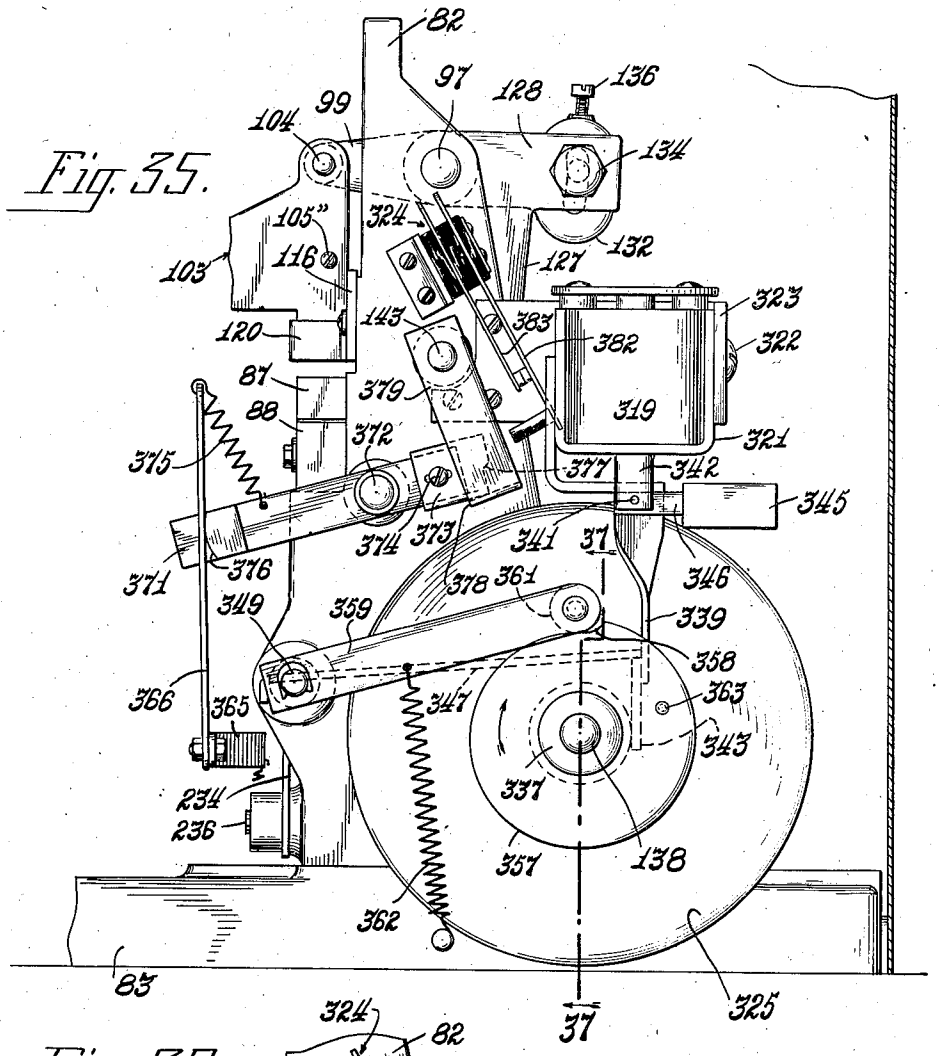
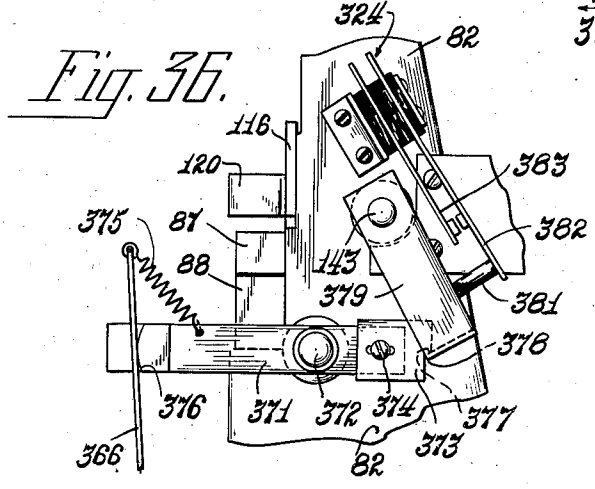


Fig. 36.



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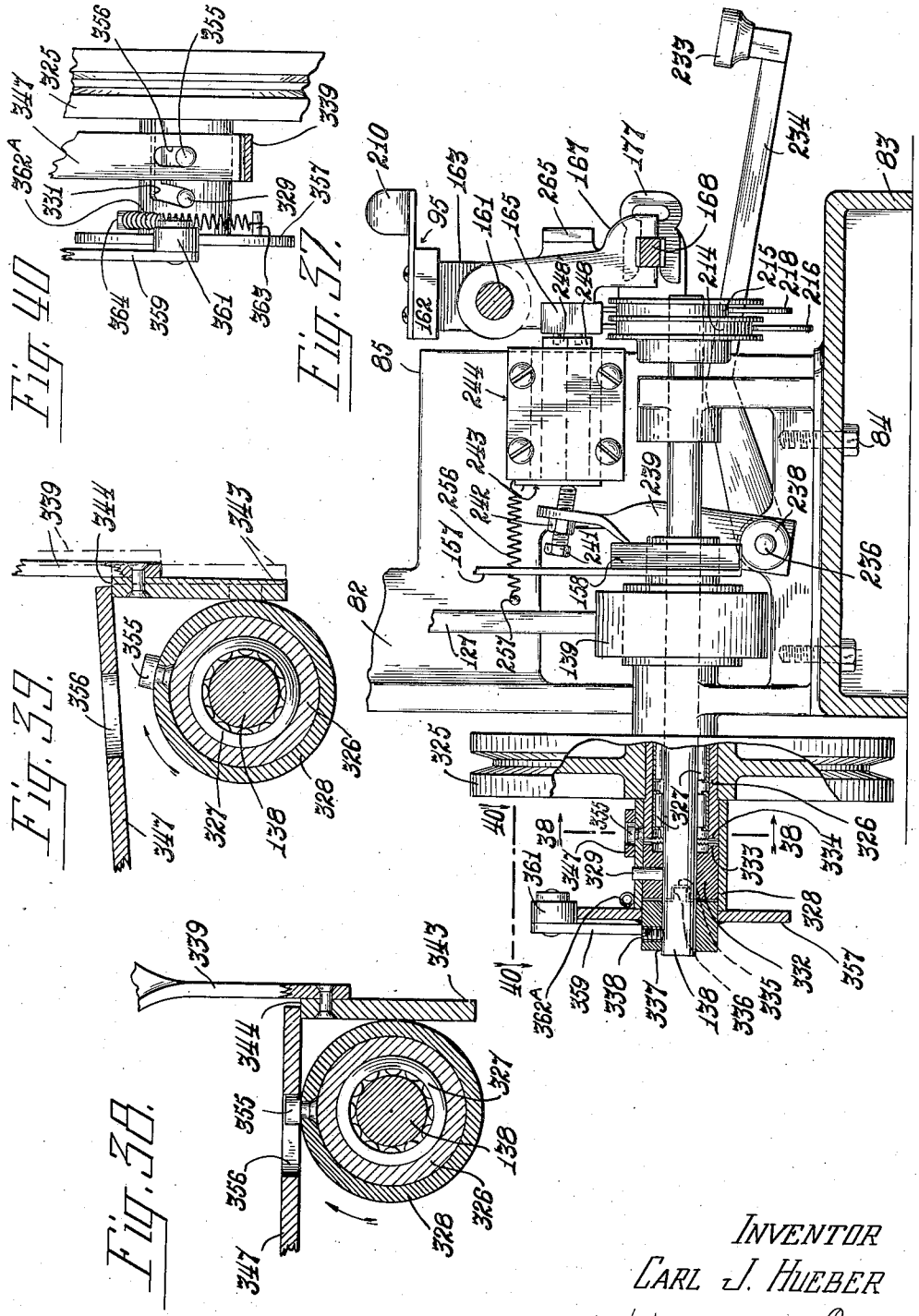

Fig. 40

Fig. 37

Fig. 39

Fig. 38

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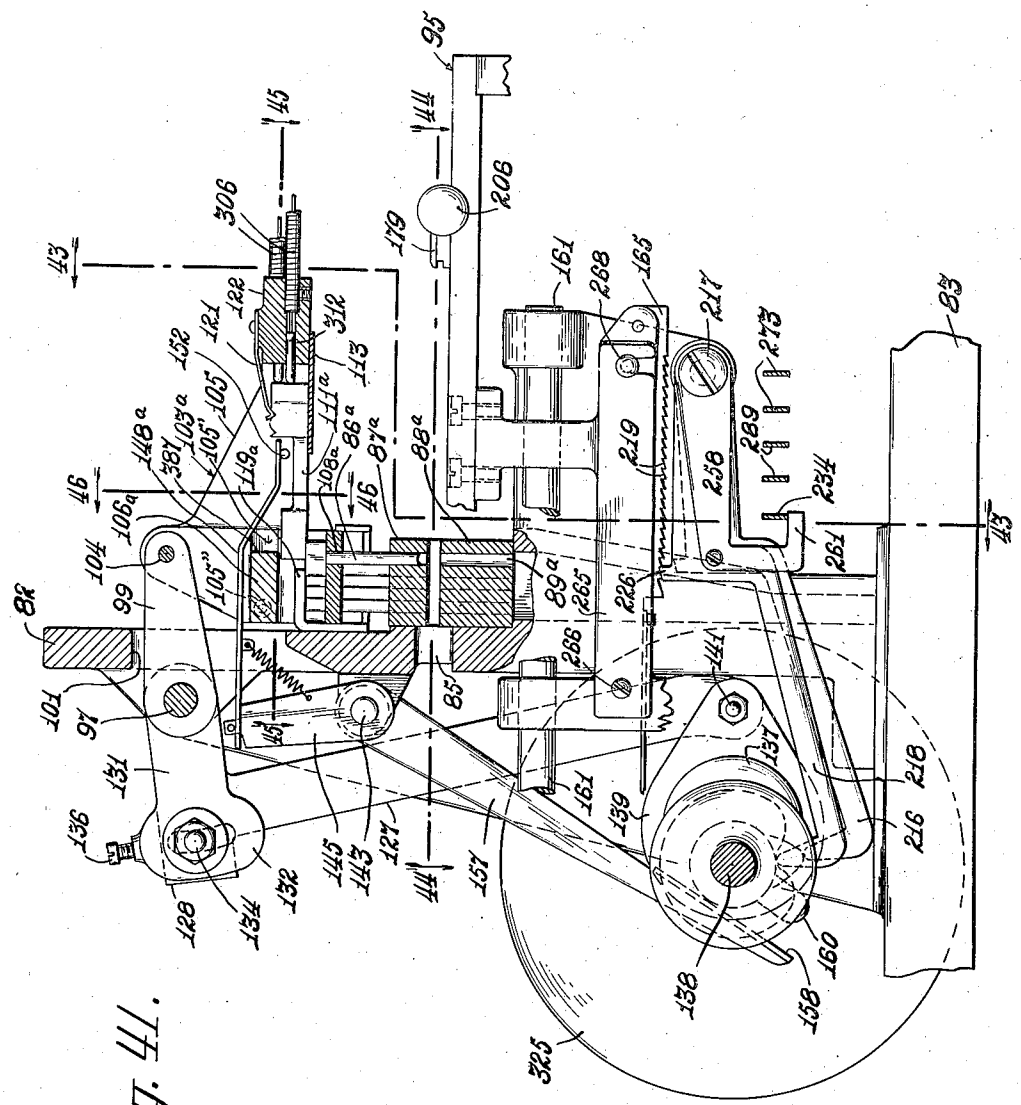

Fig. 41.

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Fig. 42.

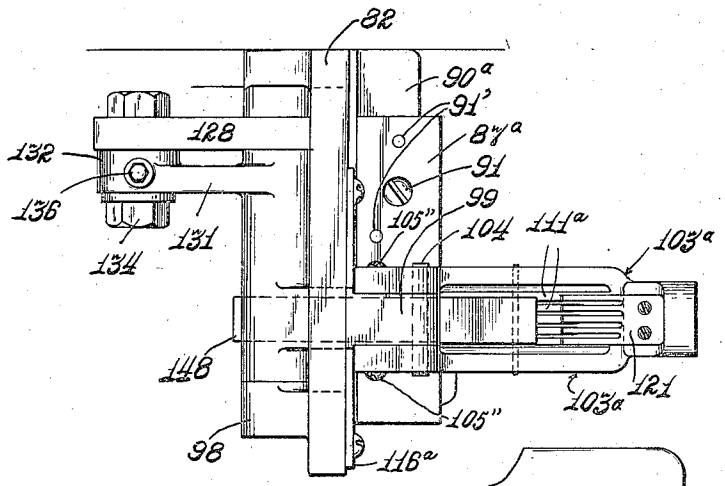

Fig. 43.

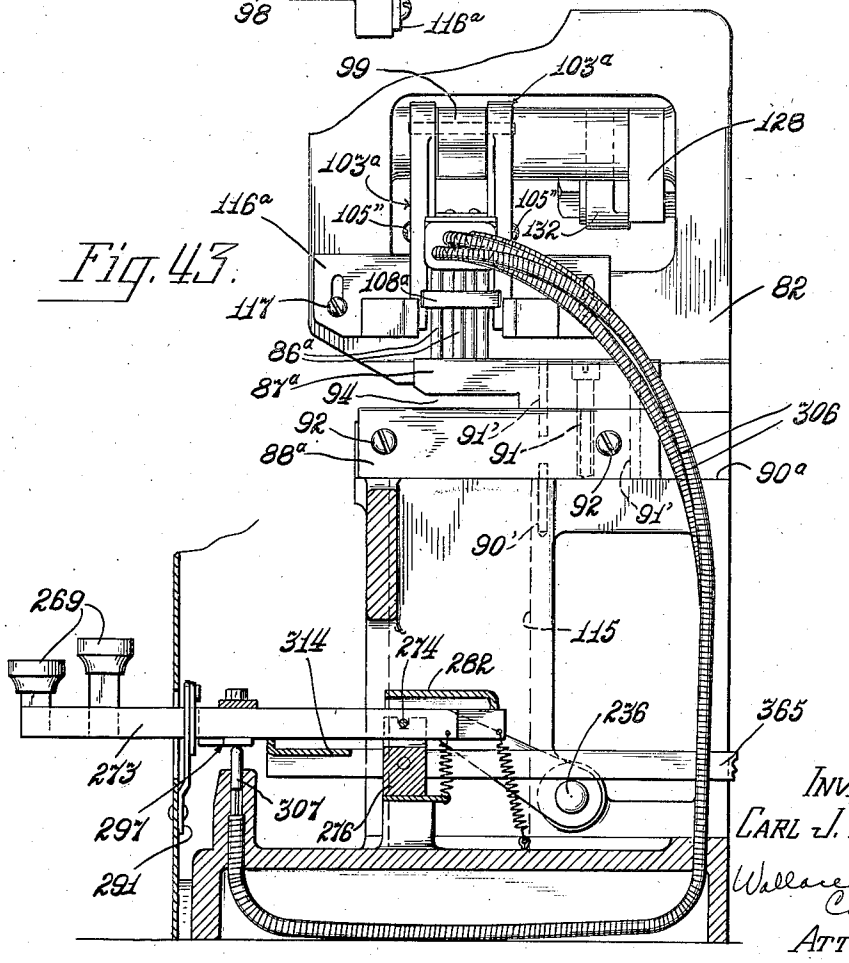

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Fig. 44.

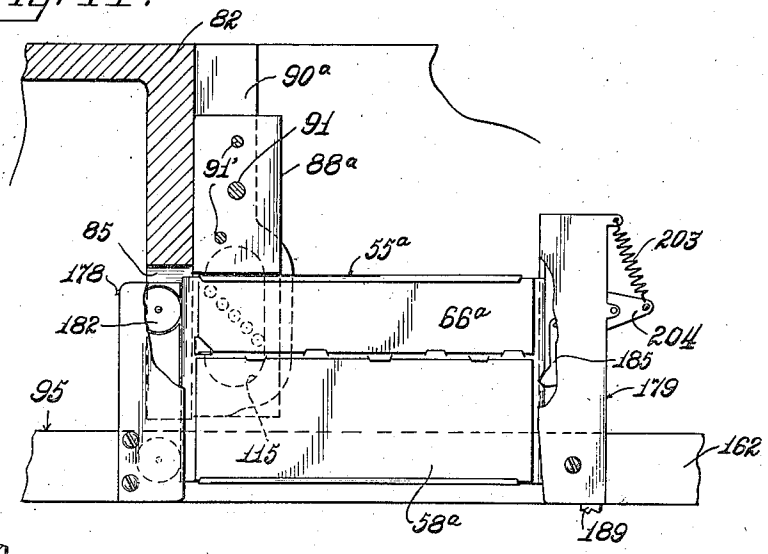


Fig. 45.

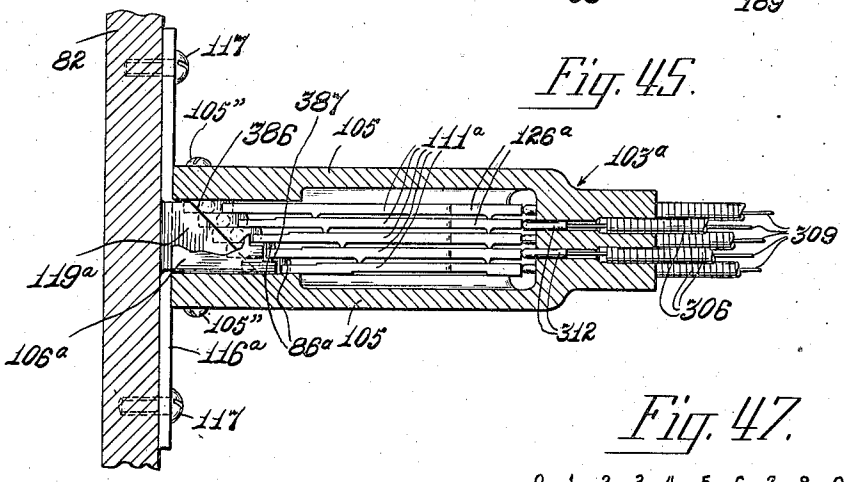


Fig. 47.

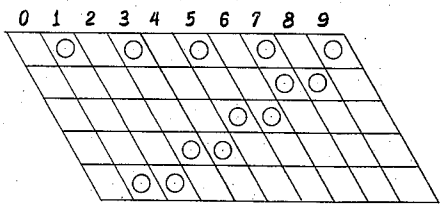
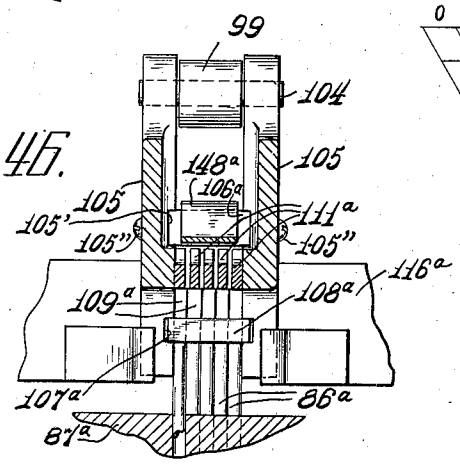


Fig. 46.



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Patented Mar. 26, 1946 2,397,112

UNITED STATES PATENT OFFICE

2,397,112

PUNCHING APPARATUS

Carl J. Hueber, Euclid, Ohio, assignor to Addressograph-Multigraph Corporation, Wilmington, Del., a corporation of Delaware

Application June 30, 1944, Serial No. 543,015

34 Claims. (Cl. 164—113)

The invention relates to improvements in machines for the preparation of control devices of the kind adapted for use in accounting machines, computing machines, variable printing machines, or the like.

Control devices adapted for uses of this character generally include cards or control areas wherein coded representations of the desired control data are provided by suitable physical deformation, such as perforating, of the cards in accordance with a selected positional code. Such control devices are usually passed sequentially to the machine to be controlled so that each control device effects the predetermined operation of the machine in accordance with the coded control data carried thereby. In many instances, the control device may be employed to carry coded representations of letters or words; while in other instances the coded data carried by the control device represent numerical control data. When the coded representations represent numerical data, this data may be used in various ways, as for example, to set up the represented numerical data as one of the factors to be employed in a computing operation of a computing machine.

Control devices of this general character may be in the form of so-called Hollerith or Powers cards or may be formed as a part of a printing and control device of the general character illustrated and claimed in Gollwitzer Patent No. 2,132,412. In control devices of the general character disclosed in that patent, the control data holes or perforations are formed on but a predetermined portion of the complete device, other or remaining portions or areas of the device being employed to carry a printing plate and an index or name-address visual caption card, the printing plate bearing embossed printing characters to be utilized in a printing machine while the caption or index card bears an impression from the printing plate, and the coded representations of various control data or index data may be formed in such predetermined portion of the complete device with the machine of the present invention.

In the preparation of devices of this general character, the data representing perforations are formed upon a series of control devices in succession, such data being taken from a suitable list. The preparation of the control devices involves the reading of the desired data pertaining to a particular control device from the list, and the formation of coded physical representations of the control data upon the control device. An important object of the present invention is, therefore, to facilitate the formation of such data on control devices and the like and a related object is to provide a machine embodying structural characteristics particularly intended to facilitate the formation of coded index or selecting and control data upon control devices of the general character above described.

Another object is to enable a machine for forming the desired control data and index data on control devices of this general character to be so constructed that the inherent operating cycle of the machine is such as to promote efficient and accurate operations by the operator.

The present invention includes an arrangement of punch elements selectively operable to produce perforations representative of the desired data in the control and in the index, or selector, areas of control devices. Obviously, repeated use of these punch elements necessitates occasional grinding of such elements so as to insure the formation of clean cut perforations in the control device because, should such perforations be irregular or be improperly formed, the accuracy of a machine, such as a computing machine, in which the control devices are subsequently used, may be seriously impaired. It is, therefore, another object of the present invention to enable the elements of the punching means to be removed easily and quickly as a unit for sharpening or other repair without dismantling the machine or any substantial portion thereof, as has been the customary requirement of earlier machines of this general character, and to enable the punch assembly to be easily and quickly remounted and adjusted as a unit to insure proper performance of the required perforating operations.

Punching machines of a kind intended for use in producing perforations in an index area or a control area of control devices upon selective manipulation of control keys frequently involve a complicated mechanical organization of a kind which is costly to manufacture and assemble, and because of its numerous operating parts, such machines are in many instances subject to possible break-downs due to improper adjustment of the inter-connected parts. It is, therefore, another object of the present invention to provide a punching machine of this character wherein a simple organization of elements is employed to transmit motion from the control keys directly to means controlling selection of the punch or punches.

Still another object of the invention is to pro-

vide a new and improved punching machine of the kind exemplified herein and in which machine operation is instituted upon selective manipulation of a selected key thereon and wherein means are set automatically each time a key is actuated to initiate machine operation, to prevent continued operation of the machine after it has completed a cycle of operation even though the key initially actuated to start said cycle of operation is retained in a machine-operating position; and a related object is to so construct such a machine that an operated selecting key must be returned to its normal position before another cycle of machine operation may be instituted.

Another object of the invention is to provide a machine of the aforesaid character that is operative not only to produce coded representations of digits on a control area in a control device but also to produce representations of coded identifying or classification data to identify items or devices having certain characteristics in common.

Another feature of the present invention is to provide a punching machine of the kind exemplified herein and which has reciprocable punches freely guided in a punch block for positive movement downwardly to effect a punching operation only when a selector element is positioned thereabove, and having means to insure proper positioning of all of said punches at the completion of a cycle of machine operation so as to enable movement of such selector elements as are selected preparatory to instituting another operating cycle and thereby cause punching operation of any of said punches in an efficient and accurate manner.

It will be manifest that in a machine such as that to which the present invention pertains, wherein a plurality of operative mechanisms are provided and whose various operations are interrelated in the course of a cycle of machine operation, it is essential that the time of operation of the various mechanism be closely controlled so as to insure proper operation of the various mechanisms and also to enable operation of the various mechanisms so as to enable accurate performance of the machine. Hence, it is another object of the invention to provide a machine of the kind having various mechanisms operable in timed relation to one another upon actuation of control means through operation of a selected operating element.

As has been stated hereinabove, control means on control devices may be conveniently represented by perforations and to this end a punching mechanism is provided for producing such perforations, and hence additional objects of this invention are to provide novel mechanism for producing control and selector perforations in control devices and the like; to enable such a punching mechanism to be key controlled; to prevent actuation of keys in the key board while one of such keys is in an operative position; to insure against undesirable repeated operation of the punch means; to enable selection and operation of punches of the punching means in a simple and expeditious manner; to positively return the punch operating arrangement to inoperative positions after a punching operation; and to provide a punching mechanism of simple and economical construction and efficient and positive operation.

Other objects of the invention are to employ a one-revolution clutch structure for controlling the operation of various operating mechanisms which is accurately and positively controlled by the employment of novel electrical controls; to initiate operation of such controls by switches controlled by operation of certain of the operating mechanisms; and to arrange the control switches so as to make their operation to effect actuation of the clutch inter-dependent upon proper operation of the means controlling operation of the machine.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings, which by way of illustration show preferred embodiments and principles thereof of what I now considered to be the best mode in which I have contemplated applying these principles. Other embodiments of the invention utilizing the same or equivalent principles may be made by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

Fig. 1 is a front elevational view of a machine embodying features of the invention;

Fig. 2 is a front elevational view of a control device which is adapted to be formed through the use of the machine of the present invention;

Fig. 3 is an enlarged sectional detail view taken on line 3—3 of Fig. 2;

Fig. 4 is a view illustrating the five element positional code which is employed in the present machine for representation of numerical data;

Fig. 5 is a plan sectional view of the machine of the present invention, as taken substantially on line 5—5 of Fig. 1, to show the internal elements thereof;

Fig. 6 is a front elevational view of the machine showing the housing in section so as to expose the mechanism contained therein;

Fig. 7 is an end elevational view of the machine taken partially in section as viewed on line 7—7 of Fig. 6;

Fig. 8 is a fragmentary sectional detail view taken on line 8—8 of Fig. 7;

Fig. 9 is a rear elevational view of the machine as taken partially in section on line 9—9 of Fig. 7;

Fig. 10 is an end elevational view of the machine taken partially in section on line 10—10 of Fig. 6;

Fig. 11 is a sectional detail view taken on line 11—11 of Fig. 10;

Fig. 12 is a sectional detail view taken on line 12—12 of Fig. 11;

Fig. 13 is a view similar to Fig. 11, showing parts of the mechanism in an operationally adjusted position;

Fig. 14 is a sectional detail view similar to Figs. 11 and 13, showing the parts in a different position as attained during machine operation;

Fig. 15 is a vertical sectional detail view taken on line 15—15 of Fig. 14;

Fig. 16 is a horizontal sectional detail view taken substantially on line 16—16 of Fig. 14;

Fig. 17 is a sectional detail view taken on line 17—17 of Fig. 15;

Fig. 18 is a detail perspective view of one of the selector or interposer bars;

Fig. 19 is a horizontal sectional detail view taken substantially on line 19—19 of Fig. 7;

Fig. 20 is a vertical sectional detail view taken on line 20—20 of Fig. 19;

Fig. 21 is a vertical sectional detail view similar

to Fig. 20 showing other parts of the key mechanism in an actuated position and taken on line 21—21 of Fig. 19;

Fig. 22 is a vertical sectional detail view of the key mechanism taken on line 22—22 of Fig. 19;

Fig. 23 is a sectional detail view taken on line 23—23 of Fig. 22;

Fig. 24 is a horizontal sectional detail view of the carriage upon which the work such as a control device is mounted during the perforating operation, the view being taken on line 24—24 of Fig. 6, and a control device being shown in position on the carriage;

Fig. 25 is a sectional detail view taken on line 25—25 of Fig. 24;

Fig. 26 is a sectional detail view taken on line 26—26 of Fig. 24;

Fig. 27 is a fragmentary detail view of a portion of the mechanism shown in Fig. 24, but showing the parts in a control device releasing position;

Fig. 28 is a horizontal sectional detail view of the carriage tabulating mechanism taken substantially on line 28—28 of Fig. 6;

Fig. 29 is a sectional detail view taken on line 29—29 of Fig. 28;

Fig. 30 is a sectional detail view taken on line 30—30 of Fig. 29;

Fig. 31 is a detail view taken on line 31—31 of Fig. 29;

Fig. 32 is a vertical sectional view taken substantially on line 32—32 of Fig. 28;

Fig. 33 is a sectional detail view taken on line 33—33 of Fig. 28;

Fig. 34 is a wiring diagram showing the interlock control circuit to prevent machine actuation beyond one cycle of operation;

Fig. 35 is a fragmentary rear elevational view of the machine substantially like that shown in Fig. 9, but showing the parts thereof in a different position assumed during machine operation;

Fig. 36 is a fragmentary elevational detail view of the safety switch illustrated in Fig. 35, but showing it locked in an open or circuit interrupting position;

Fig. 37 is a sectional detail view taken on line 37—37 of Fig. 35 showing parts of the mechanism in elevation;

Fig. 38 is a sectional detail view taken on line 38—38 of Fig. 37, showing the clutch locked in its disengaged position;

Fig. 39 is a sectional detail view like Fig. 38 but showing the clutch engaged and in the early portion of its one-revolution operation;

Fig. 40 is a fragmentary elevational view of the clutch mechanism, viewed substantially along line 40—40 of Fig. 37;

Fig. 41 is a fragmentary front elevational view of the mechanism of a machine similar to the disclosure of Fig. 6 but showing a modified form of construction of various of the parts thereof, some of which are shown in section;

Fig. 42 is a top plan view of what may be termed the standard and punch cradle operating mechanism of the structure shown in Fig. 41;

Fig. 43 is a vertical sectional detail view taken substantially on line 43—43 of Fig. 41;

Fig. 44 is a detail sectional view taken on line 44—44 of Fig. 41;

Fig. 45 is a horizontal sectional detail view taken on line 45—45 of Fig. 41;

Fig. 46 is a vertical sectional detail view taken on line 46—46 of Fig. 41; and

Fig. 47 is a view illustrating a five element angular positional code which is employed in the operation of the machine illustrated in Figs. 41 to 47 inclusive.

The machine generally

In the forms chosen for disclosure herein, the invention is embodied in a punching or perforating machine 51 enclosed within a two piece housing comprising lower housing section 52 and an upper housing section 53. The machine has a punching position or station 54 adjacent its front wall, past which a control device 55 is shifted with a step-by-step movement so as to have physical representations of the desired index or selecting data and control of the data formed thereon. The formation of the selecting data and of the control data on the control device 55 is, in the present instance, performed by a punching mechanism, the principal parts of which are arranged at the punching position or station 54 and all of which parts are preferably enclosed within the housing 52—53. Operation of the punching mechanism and of the machine is controlled by means of selective keys contained in a keyboard, as at 56, located on the front side of the housing section 52.

The control device

While the machine of the present invention and the principles involved therein may be applied to the formation of many different types of control devices, the machine of the present invention is particularly adapted and designed for the formation of coded numerical control data, and of selectively positioned classification data useful as identifying means to facilitate automatically performed sorting, selecting and other operations in respect to the control devices 55 as well as control operation in connection with the machines in which such control devices are used. In addition to the control functions of these control devices, they are adapted to be used in printing operations.

The control device 55, for which the present machine 51 is particularly designed and adapted, is illustrated in detail in Figs. 2 and 3 of the drawings and is of the construction somewhat like that shown in United States Patent No. 2,132,412, dated October 11, 1938. The control device 55 herein shown is illustrated and described in my copending application Serial No. 583,050, filed March 16, 1945. The control device 55 is in a functional sense divided into several areas or sections, one of which constitutes a printing means; a second, the index or selecting means or area; and a third, the control means or control area. In the particular form herein disclosed, each device 55 comprises a carrier or frame 57 formed from sheet metal. Means is provided on the lower portion of the frame 57 for removably retaining a metallic printing strip or plate 58 on one face of the frame 57. Such means include a bead 59 formed by reversely curling the lower edge of the frame, and this bead 59 engages the lower edge of the printing plate 58. A plurality of aligned retaining devices 61 are formed on the frame 57 to overlie the upper edge of the plate 58. Yieldable depressible tongues 62 are formed in the frame 57 to releasably engage the end edges of the printing plate 58.

The frame 57 has a reversely bent flange or bead 63 along its upper edge, which cooperates with retaining devices 64 struck from the frame to removably secure an index or selecting card 65 in position along the upper marginal area of the frame 57. The portion of the frame 57 inter-

mediate the printing plate 58 and the selecting card 65 constitutes the control area of the device and is provided with a control card 66 which is retained thereon by retaining devices 67 struck from the body of the frame.

The printing plate 58, prior to its mounting on the frame 57, has printing characters 68 embossed thereon so that the printing of data, such as the name and address indicated may be performed through the use of the printing plate 58. Other data may, of course, be embossed on the printing plate as desired, and such embossing operations may be performed with an embossing machine, such as for example, that illustrated in the patent to Joseph S. Duncan, No. 1,518,904, patented Dec. 9, 1924.

The control area that includes the card 66 is, as previously explained, adapted to have formed thereon mechanical or physical representations of information or data which may serve to control the operation of different types of mechanism. This data may be represented in the control area or card 66 by positional arrangement of holes or perforations 69 therein, as for example, in accordance with the five element columnar code illustrated in Fig. 4 of the drawings.

The index or selecting area that includes the card 65 similarly is adapted to have formed thereon mechanical or physical representations of information or data which may facilitate the sorting, selecting or other similar indexing operations. Accordingly, the index or selector card 65 preferably is imprinted or otherwise impressed, as indicated in Fig. 2, with a series of numerals 71 consecutively arranged, preferably in two rows, and extending longitudinally along the entire length thereof, each of which numerals is representative of a station or index identification, and they, such numbers 71 are spaced apart distances along the length of said card corresponding to the spacing between columnar rows of holes 69 to be performed in the control card 66.

While the frame 57 beneath the index or selecting card 65 may be initially formed as an imperforate metal sheet, like the area of the frame 57 beneath the control card 66, so that index openings must be punched simultaneously through both the card 65 and the frame 57 in the preparation of the index or selecting card, it has been found that the need for adjustment of the punching mechanism is minimized and the useful life of the punches is prolonged by providing openings 72 in the frame 57, as best shown in Fig. 3, at all the possible positions at which openings or holes may be punched in the formation of the required index means. Thus, it will be seen that the area of the frame 57 lying in back of the index or selecting card 65 is provided with two longitudinally extending rows of openings 72, Fig. 3, spaced to correspond to the spacing between the index numbers 71 on the face of the index or selecting card. The use of such holes 72 will minimize the wear on the punches used to perform holes in the card 65.

It should be noted further, that the area of the frame 57 lying beneath the control card 66 also may be provided with rows of holes corresponding to the potential positions of data-representing holes which may be formed in the control card 66 thereby to minimize wear on the punches used to perform such holes. Thus, where the control device is adapted to bear representations of five-order number, five horizontally extending rows of openings (not shown) may be initially formed in the frame 57 during the manufacture thereof so as to provide the openings for the purpose aforesaid, properly positioned to correspond to the coded positions of the control perforations to be formed in the control card 66. Data representations in accordance with this five order arrangement of control perforations may be selectively formed in the control area by the punching mechanism 54 of the machine of this invention, and the selection of the punches in said mechanism is determined in accordance with the code illustrated in Fig. 4.

By referring to Fig. 4, it will be noted that this code provides for five potential positions in each vertical column at which perforations may be made. If a perforation is made in a column in the lowermost of any of such five potential positions indicated, as well as at the uppermost of such positions, then the digit "1" is represented. However, if a perforation is made in such lowermost position and no perforation is made in the uppermost position, the digit "2" is represented. To continue, if perforations are located respectively in the next to the lowest and in the upper position in a column, the digit "3" is represented, but the omission of a perforation at the uppermost position affords a representation of the digit "4." The digit "5" is represented by perforations in the medial position and the uppermost potential position in a given column, but the omission of a perforation at the uppermost position with a perforation at the medial position, affords a representation of the digit "6." Perforations in the next to the uppermost and in the uppermost positions in a single column represent the digit "7," but a perforation in this next to the uppermost position in the absence of a perforation in the uppermost position affords a representation of the digit "8." A perforation in only the uppermost position of a column affords a representation of the digit "9." Only the significant digits are represented by perforations and the absence of a perforation in any particular column denotes "0."

The particular positional and columnar relation of the several characters of the control data on the control card 66 is, of course, predetermined by the construction and relation of the means provided to sense the control area in the machines which with the control devices are to be used. In any event, it is usually desirable that the control data be located in a predetermined tabular or columnar relation on the control area of the control card and that the same sequence of characters be maintained in the control area as is present in the control data represented on the list from which the control data is taken.

As a matter of convenience in checking or verifying the control data after the formation thereof, the control data are preferably arranged so that a worker, while holding the device 55 in a position to read the numbers 71 on the index or selecting card 65, may verify the successive characters of the control data by reading from left to right in the same sequence as these characters normally appear on the list. Accordingly, the right hand character of such control data should be located in a predetermined columnar relation adjacent to the right-hand edge of the control card, as viewed in Fig. 2, such right-hand columnar relation or position constituting the "units" order position in those instances where the control data is numerical in character. With this columnar positioning, the calculating or other machine with which the control device is sub-

sequently used is properly operated and controlled.

As mentioned hereinbefore, the production of the coded perforations in the control device is effected in the present machine at the punching station 54. At this station, punching mechanism is provided to effect selective punching of the control device while said device is fed in a step-by-step movement past the punching station.

The punching mechanism

The punching mechanism D of the present machine which operates upon the control device 55 at the punching station 54, is located within the upper section 53 of the housing with its operative punching elements exposed for operation on the control device closely adjacent to the front wall of said housing. Thus, the housing section 53 is formed with a narrow, horizontally elongated opening 81, Fig. 1, extended across its entire front wall. The punching mechanism is carried upon the upper portion of a standard 82 mounted within the housing 52—53, which frame is secured at its lower end to a machine base 83, as by machine screws 84 which extend upwardly through the base and engage in the standard, as best shown in Fig. 10. The standard 82 is generally platelike in form and is disposed in a vertical plane lying perpendicular to the front of the machine. The standard 82 has a horizontal slot 85 formed therein in substantial alignment with the housing opening 81 so as to extend rearwardly from said opening, so that the slot 85 constitutes a throat into which a control device 55 may extend so as to position the index or selecting area and the control area thereof between male and female elements of punches P (Fig. 11), which are supported, in a manner to be described presently, on the standard 82.

Since the code for which the present machine is adapted contains five characters or elements and the index or selecting card 65 is arranged to have characters or elements formed therein in two rows, only seven of the punches P (Figs. 11 to 16 inclusive) are utilized, and if desired those punches that are not to be used may be eliminated. These punches are disposed in a vertical plane extending from front to rear of the machine and just to the right of the standard 82 as viewed in Fig. 11, and the vertically reciprocable male elements 86 of said punches P are guided for such vertical movement in guide holes in a guide-block 87 secured to a die-block 88 mounted upon the right-hand (Fig. 11) face of the standard 82 in the region of throat 85. The die-block 88 includes complemental female elements or die-openings 89 for the male elements 86.

In order to facilitate and simplify the manufacture, use and upkeep of the punches, the guide-block 87 and the die-block 88 are rigidly but separably related as a part of assembly that may be mounted in or removed from its operative position on the standard 82. Accordingly, the guide-block 87 is secured to the die-block 88 by means such as a machine screw 91 (Fig. 17) which extends through the guide-block 87 and is threaded into the die-block 88, and to accurately relate the two blocks 87 and 88, a pair of dowel pins 91' are extended therebetween parallel to the screw 91. This assembly of the two blocks is rested upon a shoulder 90 formed on the side face of standard 82 and is then removably secured in place by machine screws 92, one of which is located at each end of the die-block 88 so as to insure a firm mounting for the assembly in proper horizontal alignment with the throat 85. The location of the assembly on the shoulder 90 is accurately and easily determined by a relatively short dowel pin 90' disposed on the shoulder 90 in an upstanding relationship as shown in Fig. 15, and this dowel pin or locating pin is arranged to be received within the lower end portion of the bore in which one of the pins 91' is disposed. The portions of the guide-block 87 and die-block 88 that are disposed opposite or beside the throat 85 are formed on their opposed faces to afford a throat 94 extending for a suitable distance inwardly of their forwardly disposed ends so that the throat 94 is disposed in substantial register with the throat 85. The edges of the guide-block 87 and the die-block 88 that define the throat 94 are preferably tapered or beveled as at 93, and the upper face of the die-block 88 is so formed as to lie in a single plane, thereby simplifying and facilitating the grinding of this face when sharpening of the edges of the die openings is 89 required. The control devices 55 are supported at the punching station 54 in the elongated opening 94 and in proper relation to the punches P and are advanced through the required step-by-step movements by means of a carriage 95 (Figs. 1 and 24) which is supported and guided, in a manner to be described presently, for movement along the opening 81 in the machine housing.

The male elements 86 of the punches P are supported and reciprocated in the guide-block 87, as best shown in Figs. 11 to 14, by means including a bell-crank 96 mounted on a pivot 97 carried in bearing lugs 98 which project to the left (as viewed in Fig. 11) from the standard 82. The bellcrank 96 has an arm 99 projecting to the right in Fig. 11 through an opening 101 in the standard 82, and at its projecting end the arm 99 has a bearing portion 102 normally disposed substantially over the guide-block 87. On the projecting bearing portion 102, the arm 99 carries a depending supporting cradle 103 that is pivotally mounted in the bearing portion 102 on a bearing pin 104 disposed parallel to the pivot pin 97. The cradle 103 has substantially triangularly shaped depending side walls 105 connected by a separately formed and hardened tie-bar 106 located in substantial alignment with the bearing 104 and spaced therebelow a considerable distance. The tie bar 106 has its ends disposed in slots 105' formed in the inner surfaces of the walls 105, and a bolt 105'' is passed through the walls 105 and the tie-bar 106 to hold the parts in the desired rigid relationship. The lowermost end portions of the depending side walls 105, below the tie-bar 106, are formed on opposed inside faces with horizontally extending grooves 107 (Fig. 15) into which the end edges of a retractor-bar 108 are inserted by sliding said retractor-bar into said groove from the right-hand side of the depending portions, as viewed in Fig. 14. The retractor-bar 108 is thus firmly supported in the side walls 105 of the cradle 103 and is movable vertically in unison therewith.

The retractor-bar 108 has a plurality of holes therein, each to receive one of the male punch elements 86 of the punches P. As best shown in Figs. 11 to 16, each of the male elements of the punch includes a substantially flat head 109 which rests upon the top surface of the retractor-bar 108 to limit downward movement of the male elements 86 and to thereby support said elements in the cradle 103. Thus, it will be evident that in an idle operation of the machine, when the

bell-crank 96 is rocked in a clockwise direction, Fig. 11, upon operation of mechanism to be described presently, so as to lower the cradle 103, the male elements 86 of the punches will be stopped upon engaging a control device 55 and the cradle 103 with its tie-bar 106 and retractor-bar 108 will idle downwardly along the male elements 86 so that said male punch elements are ineffective to perform a punching operation.

When punching action of the male elements 86 of the punches is desired, suitable interposers or blocking means are interposed between the heads 109 of one or more of the male elements 86 and the tie-bar 106 of the cradle 103. Such blocking action or selecting action is attained in the present machine by means of a plurality of generally horizontal selector bars 111, each having a blocking head portion 112 normally extending slightly over and resting on the tops of the heads 109, as best indicated in Fig. 11. There is one selector bar for each male punch element 86, and they are entirely supported and guided for the requisite sliding movement within the cradle 103, the selector bars 111 in the present instance being supported loosely in said cradle between the side walls 105 thereof by a supporting plate 113 firmly secured at its end to the bottoms of the side walls 105 of said cradle, as by screws 114. When a selected male punch element 86 is to be operated through a punching stroke, a related selector bar 111 is moved to the left in Fig. 11 to locate its blocking head portion 112 in an active blocking position over the male element head 109, as illustrated in Fig. 13. Such positioning of a selector bar 111 disposes its blocking head 112 beneath the tie-bar 106. As a consequence, downward movement of the cradle 103 in the manner described hereinabove, will result in the transmission of downward motion from the tie-bar 106 to the selected male element 86 so as to thereby cause the male element 86 to perform a perforating operation upon whichever card 65 or 66 is disposed therebeneath. The waste or slug resulting from perforation of a card passes downwardly through the die-block openings 89 into a waste chamber 115 formed in the standard 82.

Under some circumstances, vibration of the machine may tend to cause upward displacement of the male elements 86 into positions wherein sliding movement of the selector bars 111 into a punch actuating position would be prevented. It further might occur under certain circumstances of use that the free sliding male elements 86 of the punches may stick or bind in the retractor-bar 108 when the cradle 103 is returned to its elevated position after a downward or punching stroke. To avoid such action, a plate 116 (Fig. 15) is secured to right hand the face of the standard 82 as viewed in Fig. 11, directly in back of the cradle 103, preferably by means of screws 117 which extend through vertical slots 118 in said plate and are threaded into the standard 82. This plate 116 has an intermediate portion of its upper marginal edge, which portion is of a length corresponding to and in alignment with the width of the cradle 103, folded downwardly into a substantially horizontal plane to provide a lip 119 (Fig. 16) lying between the side walls 105 of the cradle above the end edge portions of the heads 109 of said male elements 86. The plate 116 is adjustably secured by the screws 117 so as to be readily adjusted vertically, when and if required, into such position that the lip 119 normally is abutted by the top surface of the heads 109 of the male elements when the cradle 103 is in its uppermost position, as shown in Fig. 11. Hence the lip 119 becomes effective, at the end of each perforating operation, to limit upward movement of all of the male elements 86 so as to move the heads 109 into engagement with the upper face of the retractor-bar 108. Thus proper clearance is assured between the upper faces of the heads 109 and the lower face of the bar 106 so that any one or all of the selector bars 111 may be moved readily into an effective position beneath the tie-bar 106 when this is desired in the next machine cycle. The plate 116 also carries a pair of guide brackets 120, each of which embraces one of the marginal edges of the cradle side walls 105 so as to insure its movement in a vertical plane during machine operation. Adjustment of the plate 116 also enables adjustment and repositioning of the cradle 103, and the male elements 86 carried thereby, with respect to the guide-block 87 and die-block 89 because in use it frequently becomes necessary to sharpen the male elements 86 as by grinding, which grinding obviously shortens the male elements, thus necessitating a lowering of the entire assembly for efficient performance. When such grinding or replacement of the male elements 86 is necessary, it is a simple matter to remove the screws 92 securing the die-block 88 to the standard, whereupon said die-block and its attached guide-block 87 may be lifted as a unit to disengage the same from the dowel 90', after which the die-block and guide-block may be moved to the right in Fig. 14. Inasmuch as the male elements 86 of the punches P are guided in the guide-block and accordingly must be removed therewith as a unit, the retractor-plate 108 is withdrawn edgewise from its engagement with the grooves 107 in the side walls of the cradle 103, thus carrying the male elements 86 out of the cradle 103. The male elements may be then easily withdrawn from the guide-block 87 and retractor-plate 108 for such grinding or other repair or even replacement as may be required.

The selector bars 111 are normally retained in an inoperative position, as shown in Fig. 11, or in an operative position, as shown in Fig. 13, preferably by means of a comb spring 121 firmly secured along one edge to a cross-bar 122 on the cradle 103, as by screws 123, which comb spring has a plurality of fingers, each formed at its end with an engaging portion 124 to selectively engage in one or the other of a pair of notches 125 (Fig. 18) formed in the top surface of an enlargement 126 on the rear end of the selector bar 111.

The punch operating means

The male elements 86 of the punches P are operated through a punching stroke and an idle stroke by force supplied to the other arm 127 of the bell crank 96. This arm 127 of the bell crank is in the present instance formed as an individual element separate from the arm 99 and, as best shown in Figs. 5, 9 and 10, it includes a cross-head portion 128 having one end pivotally mounted on the pin 97. The bell crank arm 99 is integral with an elongated tubular body portion 129 (Fig. 5) that surrounds and is supported on the pivot pin 97, and a second arm 131 extending outwardly from the sleeve or body portion 129 in a direction substantially opposite to the direction in which the arm 99 extends. The arm 131 is in substantial face to face abutment with the cross-head 128 on the bell crank arm 127. The free end of the arm 129 is suitably enlarged, as

at 132, and is provided with an arcuate slot 133, as best shown in Fig. 12, through which a bolt 134 is extended and which bolt is securely anchored in an end of the cross-head 128 so that when the nut 135 on said bolt is tightened, the two-piece bell crank constitutes, for all practical purposes, a one-piece device operable to transmit motion from the arm 127 to the arm 99 without lost motion of any kind.

The purpose of the two-part construction of the bell crank 96 is to provide for accurate and precise adjustment of the vertical location of the stroke of the cradle 103, as may be necessitated by the condition of the male elements 86 carried therein. Accordingly, should the male elements 86 be substantially shortened through wear or grinding, it may become necessary that the cradle 103 be positioned normally slightly lower than the position assumed by said cradle when the elements were of their original length. To accomplish this, the angular relationship of the arms 99 and 127 of the bell crank 96 is varied to suit such conditions by adjustment of said arms at their adjustable connection by means of bolt 134, thereby to compensate for such wear of the punches. Extreme accuracy may be attained in such adjustment by providing a set screw 136 on the arm 131 in position to abut against the bolt 134, thereby to afford positive means for moving and setting of the arm 131 relative to the cross-head 128 prior to the final tightening of the bolt 134.

Actuating power is supplied to the arm 127 of the bell crank 96 at the lower end of said arm and this power is derived, in the present instance, from an eccentric 137 carried firmly on a shaft 138 which is rotated during machine operation through one complete cycle of rotation in a manner and by means to be described in detail hereinafter. To this end, the lower end of the arm 127 has one end of a bifurcated member 139 pivoted thereto, as at 141, and at its other end the member 139 is formed to afford an annular strap portion which is fitted snugly over the eccentric 137, as best shown in Figs. 10 and 11. When the machine is in a normal inoperative position with the cradle 103 elevated, as shown in Fig. 11, the member 139 is disposed in a substantially horizontal plane with the center of the eccentric 137 in such plane and to the right of the shaft 138.

During machine operation, the shaft is rotated in a counterclockwise direction, as viewed in Fig. 11, whereupon the eccentric 137 moves upwardly over to the left side of said shaft, as illustrated in Fig. 13, to thereby impart a rocking motion to the bell crank 96. This motion causes the free end of the bell crank arm 99 to move downwardly to lower the cradle 103 and the parts carried thereby so as to perform a punching operation. It will thus be obvious that in each complete revolution of the shaft 138 the cradle 103 moves through a complete operative cycle in which the cradle 103 is first moved downwardly and is then returned to its initial elevated position.

As has been noted hereinbefore, the male elements 86 of the punches P that may be selected to perform a perforating operation upon a card 65 or 66 in a control device 55 are rendered effective by the blocking action of the interposer or blocking heads 112 of the selector bars 111. The selector bars 111 are moved into such a blocking position selectively upon actuation of manually operated means to be described presently, and such selector bars as are selected to effect positive operation of related male elements 86 will remain in such effective blocking position until positive restoring movement is applied thereto. Accordingly, positive means are provided in the present machine to return such of the selector bars 111 from their effective blocking positions to their ineffective positions near the completion of a punching cycle.

As best indicated in Figs. 10 to 14 inclusive, the standard 82 is provided with a pair of ears 142 on the face opposite that upon which the cradle 103 is mounted, which ears provide a journal for a rock shaft 143. A collar 144 is firmly secured on the shaft 143 and this collar 144 has an arm 145 secured thereto as by welding. The arm 145 extends upwardly and terminates at its upper end in an ear 146 disposed opposite the opening 101 in the standard 82. The ear 146 is extended freely through an opening 147 in a pusher plate 148, which plate extends forwardly from said arm 145 through the opening 101 and has its forward end turned downwardly, as at 149, and then horizontally, as at 151, so as to dispose its free forward edge in such a plane as to be capable of abutment with the adjacent vertical faces of the enlarged portions 126 on the selector bars 111. The free forward end of the pusher plate 148 is supported in such a position as described hereinabove, by having its margins rested on pins 152, Figs. 11 and 15, secured one in each side wall 105 of the cradle 103 and extending inwardly therefrom. A spring 153, having one end anchored as at 154 to the arm 145 and its other end secured to an ear 155 on the pusher plate 148, normally retains said plate in contact with the pins 152.

The shaft 143 carries a second collar 156 (Fig. 10) having an arm 157 secured thereto, as by welding, which arm extends downwardly and has its lower free end formed with a flat portion 158 afforded by bending the metal of the arm 157 substantially at right angles to the plane of said arm. The flattened portion 158 of the arm 157 normally rests against the periphery of a collar 159 firmly secured on the driven shaft 138 and is adapted to be moved away from said collar late in the cycle of machine operation so as to actuate the pusher plate 148 through a restoring operation.

The pusher plate 148 is illustrated in Fig. 11 in what might be termed the withdrawn or ineffective position which it occupies when the cradle 103 is in the elevated position. The pusher plate 148 remains in this withdrawn or ineffective position during that portion of a machine cycle when the cradle 103 is moving downwardly to effect perforation of the control device, and as the cradle 103 is being retracted in an upward direction and is approaching its elevated position, a protuberance or cam element in the form of a round headed stud 160 carried on the collar 159 moves into engagement with the flat portion 158 of the arm 157. Thus the stud 16 acts to rock the arm 157 about its pivot 143 in a clockwise direction, as indicated in Fig. 14, to thereby cause the arm 145 to rock in a forwardly direction so as to move the pusher plate 148 forwardly against the shoulder of any of the selector bars 111 which may have been in an effective position during the punching operation. By the time the cradle 103 reaches its uppermost position, all of the selector bars 111 will have been restored to their initial inoperative positions and as soon as the pusher plate 148

has accomplished its purpose in restoring the selector bars 111 as aforesaid, the stud 160 passes out from beneath the flat portion 158 of lever 157 thereby permitting said lever to again resume its normal position against the collar 159 and thus withdraw the pusher plate 148 into the position illustrated in Fig. 11. Thus the selector bars 111 are conditioned for the next selecting operation of the selector bar selection means, which will be described presently.

The punch carriage

During operation of the machine, the carriage 95 is shifted from one position to another longitudinally across the front of the machine and within the opening 81 with a step-by-step action and, novel means are provided for operating, guiding and controlling the carriage during such movement. The carriage 95, as herein shown, is supported and guided on a guide rod 161, Fig. 6, and comprises an elongated rectangular bar 162, Figs. 6, 24 and 32, secured substantially midway between its ends to a supporting base 163, as by screws 164. The supporting base 163 is slidable upon the guide rod 161 and is formed integral with a horizontally extending rider 165 disposed below the guide rod 161 and terminating at one end in an upwardly extending bearing portion 166 also slidable upon the guide rod 161. The end of the rider 165 carrying the bearing portion 166 has a downwardly extending yoke 167, best shown in Fig. 37, which straddles a square bar 168 supported at one of its ends in a bearing 169 formed integral with and extending forwardly from the standard 82, and at its other end in a bracket 170 secured to the base 83, as by bolts 171. The upper end of the bracket 170 terminates in a journal 172 in which one end of the guide rod 161 is mounted firmly as by a set screw 173. The other end of the guide rod 161 is fitted into a bearing boss 174 formed on an end of an extension 175 projecting from the side of said standard 82 upon which the cradle 103 is supported. The square bar 168 is provided at regularly spaced intervals on both its top and bottom surfaces with transverse parallel notches 176, Fig. 6, the spacing of such notches being equal to the spacing of the columns on the control area in which perforations are to be made. The notches 176 are adapted to receive a tabular stop 177 to be abutted by the yoke 167 so as to limit movement of the carriage 95 when the latter is shifted to the right, as viewed in Fig. 6, thus to determine the first or left hand column in which the first perforation is to be formed. The tabular stop 177 provides means easily adjustable for enabling the carriage 95 to be initially positioned at a selected location for production of the first control perforation that may be required in a control device 55. It should be noted at this time that the number of notches 176 in the square bar 168 corresponds with the number of potential columnar positions on the control areas of the control device so as to enable the carriage to be set initially in any one of a plurality of positions as may be required.

In order that a control device 55 may be easily and quickly mounted on the carriage 95 and be properly and accurately positioned firmly thereon during a punching operation; and further, that it may be released and removed readily from the carriage, means such as is best shown in Figs. 24 to 27 inclusive, may be provided for mounting and positioning the control device on the carriage. As herein shown such means are of the general character shown and claimed in the Benes Patent No. 2,265,222, patented December 9, 1941. Thus the carriage bar 162 is provided with a pair of spaced rearwardly extending guide elements 178 and 179 between and in which a control device 55 may be extended and supported. The guide element 178 is provided on its inwardly disposed edge with a groove 181 and a pair of rollers 182 are mounted on vertical axes in said guide element and extend slightly into the groove 181 at points spaced apart from front to rear of the guide element 178. These rollers 182 facilitate the insertion and removal of the left end edge of the control device 55 into and out of the groove 181 as viewed in Fig. 24. The other guide element 179 preferably is of a hollow construction and is formed with a groove 183 on its inwardly disposed edge.

It will be observed that each control device 55 is provided with a notch 184 formed in its right-hand edge, as viewed in Figs. 24 and 27. This notch 184 preferably is located adjacent the substantial center of the right-hand end edge of the control device and it is utilized in assuring proper positioning and locking of the control device on the carriage 95. This desired positioning is attained by means of a dog 185 pivoted at 186 within the hollow guide element 179. The free end of the dog 185 is pointed as at 187 and by engagement of this point with the notch 184 the control device 55 is positioned properly and accurately in a direction from front to rear of the machine. By pressing the point 187 firmly into the notch 184, the other or left-hand edge of the control device 55 is pressed accurately and firmly against the guide rollers 182 so that the control device is also accurately positioned in an endwise direction.

Operative engagement of the dog 185 with the control device 55 is effected by means of a cam surface 190 formed on a slidable plunger 189 mounted for movement within the hollow guide element 179 in a direction extending from front to rear of the machine. The cam surface 190 is so formed that in movement of the plunger forwardly of the machine from the position shown in Fig. 27 to the position shown in Fig. 24, it engages a complemental cam surface 188 on the dog 185 adjacent the point 187 so as to urge the dog in a clockwise direction about its pivot 186 and towards its operative engaging relation to the control device which is to be positioned thereby. The plunger 189 is normally urged in a forward direction by means such as a spring 191 (Fig. 25) secured at one end to a pin 192 mounted firmly in the plunger 189 and extending downwardly through a slot 193 in the guide element 179. The other end of the spring 191 is secured firmly to a pin 194 depending from the bottom wall of the guide element 179 adjacent the horizontal bar 162.

Normally, when the carriage 95 is unloaded, the plunger 189 is locked in its retracted or rearward position, Fig. 27, by a lug 195 carried on a pivoted lever 196, this lug 195 being engageable with a sloping latch surface 197 formed on the plunger 189. The lever 196 is in the nature of a bell crank pivoted on the guide element 179 by a pivot pin 198 firmly anchored in an ear 199 extending transversely outwardly beyond the side wall of the guide element 179, as best illustrated in Figs. 25 and 26. The lug 195 is, as shown, formed on one arm of the lever 196 and the other arm 201 of the lever 196 extends from the pivot 198 into the hollow body of the guide element 179 and out through the edge having guide slot 183 therein.

This extending end of the arm 201 is operatively positioned in the path of the control device 55 when such control device is being inserted into the slots 181 and 183 by means of a downwardly extending lug 202 (Fig. 26). The arm 201 is urged normally to the forward position shown in Fig. 27 by means of a spring 203 secured at one end to a lug 204 formed on the lever 196 and at its other end to an ear 205 provided at the rearmost end edge of the guide element 179. When the carriage is unloaded, the parts occupy substantially the position illustrated in Fig. 27.

When a frame or control device 55 is inserted into the guide slots 181 and 183 and moved rearwardly on the carriage 95, the lug 202 is engaged by the control device in its rearward movement, Fig. 27, and the arm 201 is thereby rotated about its pivot 198 in a clockwise direction so as to release the plunger 189 and permit forward movement of the plunger by its actuating spring 191. As the plunger 189 moves forwardly, its cam 190 acts upon the opposed cam 188 of the dog 185 and holds the point 187 of the dog against the end edge of the control device as the movement of the control devices continues rearwardly from the position shown in Fig. 27 into the position shown in Fig. 24. When the control device has been shifted to the position of Fig. 24, the point 187 of the dog 185 moves immediately into the notch 184 so as to prevent further rearward movement of the control device and accurately position the control device on the carriage 95. The point 187 of the dog 185 thereafter holds the control device 55 in place on the carriage 95 against the constantly exerted forwardly directed force applied to the control device by the arm 201 and its spring 203.

After completion of the desired punching operations, the control device 55 may be released and discharged from the carriage 95 merely by rearward actuation of the plunger 189, and to facilitate such actuation of the plunger, a finger-piece 206 is provided on the forward end of the plunger, which finger-piece extends somewhat beyond the front wall of the housing 53 substantially in the plane of the front wall portion of the housing part 52. In the rearward releasing movement of the plunger 189, the cam 190 is moved rearwardly from the active position of Fig. 23 to the inactive position of Fig. 26 with the result that the dog 185 is free to move in a counterclockwise direction. Inasmuch as the arm 192 of the bellcrank lever 196 exerts a constant forwardly directed force upon the rear edge of the control device 55, release of the dog 185 by the cam 190 causes the sloping surface of the notch 184 to exert a camming action upon the dog 185. The control device 55 is thereby released from the retarding action of the dog 185 and the spring actuated arm 201 imparts an unloading action to the control device 55 so as to move the control device to the exposed or forwardly extending relation to the carriage 95, as shown in Fig. 27, whereupon the control device may easily be grasped and withdrawn by the operator. This unloading action takes place quite rapidly so that the counterclockwise movement of the lever 201 positions the lug 195 thereon in the forward path of the retarding shoulder 197 and as a result, the plunger 189, upon release thereof by the operator, moves forwardly for a short distance until its shoulder 197 engages the lug 195 so that the plunger 189 is locked in a rearward position as an incident of the unloading of a control device 55 and the carriage mechanism is thereby conditioned for the next loading operation.

The carriage 95 is normally biased in a left-hand direction, as shown in Fig. 6, by means such as a spring biased rotative device 207 which has a flexible connecting tape 208 extending therefrom and connected to the bar 165 as by a fastening device 209. The biasing action of the spring device 207 upon the carriage 95 is controlled by an escapement mechanism, best shown in Figs. 32 and 33, so that during a punching operation the carriage 95 is maintained stationary and upon completion of the punching operation is advanced in an amount equal to the desired columnar spacing of the physical representations of the various digits of the control data. As previously mentioned herein, the carriage may be shifted to the right against the tension of the spring device 207 (Fig. 6) by a manual fingerpiece 210 which is secured to the top face of the carriage bar 162 and the columnar position to which the carriage is shifted in a right-hand direction is controlled by the tabulating stop 177. Visual means is provided to indicate the columnar position to which the carriage may be shifted or the position occupied during any step of machine operation by providing an indicator pointer 211, preferably at the right-hand end of the carriage bar 162, which pointer extends forwardly of said bar 162 and overlies an indicating scale 212 mounted on the inclined portion 213 at the upper end of the lower housing portion 52. The carriage 95 is maintained in the set position by the escapement mechanism heretofore referred to.

The controlled step-by-step advancing movement of the carriage 95 after the completion of a punching operation is attained through operation of the drive shaft 138, and such rotation of the shaft 138 during operation of the machine is utilized to actuate the escapement mechanism that is best illustrated in Figs. 6, 32 and 33. The shaft 138 carries a pair of cam elements 214 and 215. The cam element 214 cooperates with a pawl 216 pivoted at 217 to the wing extension 175 of the standard 82. A second pawl 218 is similarly pivoted at 217 and this pawl co-acts with the cam element 215. Referring particularly to Fig. 32, it will be noted that the bottom edge of the rider bar 165 is provided with a plurality of ratchet teeth 219 formed of the proper size and spaced apart distances equal to the columnar spacing of the potential perforations to be performed in the control device 55. The pawl 216 has a pointed projection 221 at the upper end of an offset 222 in said pawl while a cam follower portion 223 is formed on the free end of the pawl 216. A spring 224, anchored to the standard 82, as at 225, tends to urge the pawl 216 upwardly to retain its cam follower portion 223 in normal surface engagement with the cam 214 so that when the cam follower portion 223 is rested on the low dwell surface of the cam 214, the projection 221 engages one of the teeth of the ratchet 219 so as to thereby prevent the carriage from moving to the left under tension of the spring element 207 hereinbefore described.

The other pawl 218, Fig. 33, has a corresponding pointed projection 226 midway of its length and this projection 226 normally lies to the front of the pointed projection 221 but is out of alignment when viewed from front to rear of the machine, Fig. 6, a distance equal to substantially one-half the spacing of the teeth of the ratchet 219. This pointed projection 226 is normally bi-

ased for engagement with the teeth of the rack by means of a spring 227 anchored to it at one end and anchored at its other end, as at 228, to the standard 82. The free end of said pawl 218 has a cam follower 229 normally held in contact with the face of the cam element 215. The relationship of the two cams 214 and 215 is such that when the pointed end 226 of the pawl 218 is normally engaged with the teeth of the ratchet 219, the pointed end 221 of the pawl 216 is held out of engagement therewith. Accordingly, it will be observed that when the follower portion 229 of the pawl 225 rests in the depression 231 of cam 215, the follower portion 223 of pawl 216 is riding from the brief high dwell 232 of its related cam 214.

The shaft 138 is so arranged as to make one complete revolution each time the punching apparatus is actuated to perform a punching operation. Immediately upon completion of the punching operation, the carriage 95, carrying the control device, is advanced a distance equal to the columnar spacing of the perforations to be performed therein and this is effected automatically by the cam, pawl and ratchet arrangement just described. If it be assumed that a punching operation has just been effected and that the shaft 138 has completed a major part of its complete cycle or rotation and has assumed the position shown in Fig. 33, the cam follower portion 229 is, upon continued rotation of said shaft in the direction of the arrow, moved downwardly as it passes out of the dwell 231, thus carrying its pointed end 226 out of engagement with the tooth of the rack 219, whereupon the rack 219, and the carriage 95 of which it is a part, moves to the left in Figs. 32 and 33. At the time when this occurs, the follower 223 on the other pawl 216 has moved onto the low dwell of its related cam 214 to thereby position its pointed end 221 in the path of the tooth succeeding the one just disengaged by the pointed end 226 of pawl 218. Accordingly, when the carriage 95 moves to the left, the next succeeding tooth is engaged by the pointed end 221 to thereby stop further movement of the carriage. The movement of the carriage just described is equal to one-half the columnar spacing on the control device. It should be understood, of course, that during the period of rotation of the shaft just prior to its assuming the position illustrated in Figs. 32 and 33, the cam follower 223 was resting upon the low dwell of its cam 214 and that the cam follower 229 was resting on the high dwell of its cam 215. Thus, the carriage 95 was advanced a distance equal to one-half the distance between the columnar position by the reversal of the engagement of the pointed ends 221 and 226 with the ratchet 219. As a consequence of such action of the pawls 216 and 218, the control device 55 is now positioned to be again perforated in the next column of the control area.

The pawl and ratchet mechanism for advancing the carriage to the left in a step-by-step motion is utilized primarily when the coded perforations are being formed in consecutive columns of the control area or card 66 of the control device 55. However, in the forming of index perforations in the selecting card 65 such perforations 232 may be disposed at widely spaced points along the selecting area or card 65. For example, as shown in Fig. 2, a perforation 232 has been formed at the first columnar position in the index or selecting card 65 and that no other perforations have been formed in the selecting card until substantially the greater portion of the control device has been advanced through the machine, the next perforation appearing in Fig. 2 being that indicated at 232'. To facilitate such formation of the index perforations 232, means are provided in the present device to enable the operator to tabulate the movement of the carriage through the operation of a single tabulating element.

To accomplish this in the present machine, a tabulating key 233 is provided on the keyboard 56. This tabulating key 233, Fig. 19, is carried on the forward end of a lever 234 which extends rearwardly from the front of the machine and is secured by means such as a collar 235 to one end of a stud shaft 236. The shaft 236 is journalled in bosses 237 formed on opposite faces of the wall of the standard 82, and on the left side of the wall a collar 238 is fixed on the extending end of the shaft 236. The collar 238 carries an arm 239 which is positioned with relation to the key lever 234 so as to extend upwardly as best indicated in Fig. 37. The free upper end of the arm 239 is turned substantially at right angles to the plane of its lower end and said turned end portion carries an adjustable contact screw 241 which may be locked in any adjusted position by a lock nut 242. The forwardly extending end of the contact screw 241 bears against the rear end of a movable element 243 of a stop mechanism 244 that forms part of the carriage tabulating means.

In Figs. 28 to 32 inclusive, it will be noted that the rider bar 165 has a rectangular block 245 suitably secured on its front face, and this block and the rider bar 165 are, in the present instance, provided with two rows of equally spaced holes 246 which extend from front to rear through both of said parts. There are thirteen holes in each of the two rows illustrated, and the holes in each row are in substantial vertical alignment one with the other. The holes 246 in each row are spaced apart a distance equal to the columnar spacing employed on the control device 55 and such holes serve to accommodate means for cooperating with the stop mechanism 244 so as to stop movement of the carriage 95, in a left-hand direction as viewed in Figs. 28 and 32, and hold said carriage in such position that a punching operation may be performed at a selected columnar position on the control device.

In attaining this result, a pin 247 is inserted in a selected one of the holes 246, and as best shown in Figs. 29 and 32, the pin 247 is inserted in the ninth hole 246 in the bottom row of holes, and its end extends rearwardly beyond the back face of the rider bar 165. When in this position, the extended end of the pin 247 is in horizontal alignment with a plunger member 248 constituting one of a pair of plungers reciprocably mounted in the stop mechanism 244. The plunger 248 and its companion plunger 248', which is arranged thereabove in vertical alignment therewith, are mounted within a casing 249 constituting a part of the slidable element 243 arranged within the body 251 of the stop mechanism 244. The casing 249 extends normally rearwardly to the rear of said housing and a cover plate 252 is firmly secured on its rear end. The plate 252 is formed with spaced holes through which shaft portions 253 formed on each of the plungers 248 and 248' extend. Said shaft portions are threaded on their projecting ends to receive lock nuts 254 so as to limit forward movement of the plungers 248 and 248' with respect to the casing

249. The plungers 248 and 248' are, however, normally held in their forwardmost position relative to the containing casing 249 by springs 255, one of which is arranged around the shaft portion 253 of each plunger so as to bear against the inside face of the end plate 252 and the ends of the plungers 248 and 248'. The casing 249 and the plungers 248 and 248' contained therein are normally held in a withdrawn position, that is, in such position that the front ends of the plungers 248 and 248' are substantially flush with the front face of the body 251, by means of a spring 256 anchored at one end to the end plate 252 and at its other end to a pin 257 (Fig. 28) carried on the standard 82.

The lower plunger 248 is intended to be made effective to be engaged by the stop pin 247 when the carriage is released during a tabulating operation. Accordingly, when the tabulating key lever 234 is depressed momentarily, the shaft 236 upon which it is secured is rotated in a clockwise direction, as viewed in Fig. 37, so that the adjustable screw 241 carried on the lever 239 is urged against the plate 252 to thereby move the casing 249 and its contained plungers 248 and 248' forwardly to dispose the front end portions of said plungers in the path of any pins 247 which may be extending rearwardly from the rider bar 165.

Of course, movement of the carriage upon operation of the tabulating key 233 cannot be effected unless the escapement mechanism of the carriage is rendered ineffective, and such release is effected by the tabulating key 233. Thus, the pawl 218 of the escapement mechanism is provided, as best shown in Figs. 6 and 33, with an auxiliary element 258 in the form of an L-shaped lever pivoted also at 217 and detachably secured, as by a screw 259 to the lever 218 so as to be movable in unison therewith. The element 258 includes a horizontally extending end portion 261 which projects into the path of movement of the tabulating key lever 234 so as to be engaged by said lever when the latter is depressed to thereby cause the point 226 of the pawl 218 to be withdrawn from its engagement with the ratchet teeth 219; whereupon the carriage is freed so as to be moved to the left during a tabulating operation independently of the escapement mechanism.

Inasmuch as there are only one-half as many holes 248 in the rider bar 165 and block 245 as there are columnar positions in the control device, said holes receive such pins 247 as are required, in either the upper or lower rows of holes to insure proper columnar positioning of the control device, and the plungers 248 and 248' are arranged to have different controlling actions such as to afford a number of possible tabular positions that is equal to the number of columnar positions on the control devices 55. Hence, the plungers 248 and 248' are suitably formed on their forward ends, which are engaged by said stop pins, to enable a pin in the lower row to stop movement of the carriage a distance advanced one columnar row ahead of the columnar row at which the carriage would be stopped were a pin arranged in the corresponding hole in the upper row of holes.

Thus, as shown in Figs. 30 and 31, the front end of the lower plunger 248 is suitably cut away to provide a shoulder 262 spaced from the corresponding side face of the upper plunger a distance equal to one columnar spacing. The uppermost plunger 248' which is arranged for engagement by such pins as may be inserted in the upper row of holes 246 is similarly cut away on its front end, but in this instance the cut-away portion is on the opposite side to that from which the lower pin was cut, said cut-away portion being indicated at 263. The upper plunger 248' is effective to stop movement of the carriage when a stop pin 247' in the upper row of holes (Fig. 32) contacts its side face, which face is, as suggested hereinabove, spaced in advance of the shoulder 262 a distance equal to the desired columnar spacing of the perforations. While it is contemplated that the tabulating means will be employed principally when index perforations 232 are being formed, such tabulating means may, of course, be utilized to position the carriage when coded perforations 69 are being formed in the control area or card 66. Thus, in the present disclosure, the stop pin 247' is shown as being located in a position for effecting tabular spacing of the carriage to the desired position for the formation of the coded perforations 69, Fig. 2, in the control area 66 of the control device 55 after formation of the last index hole 232'.

The tabulating pins 247 preferably are formed with heads 264 which abut against the front face of the rider bar block 245 to limit the insertion of said pins, and their inadvertent removal is prevented by means such as a cover plate 265, Figs. 28 and 29, arranged over said block 245 and pivoted at 266 for movement about said pivot vertically so as to expose all of the holes 246 when in open position and completely cover the front of the block 245 when in closed position. A notch 267 provided on its lower edge adjacent its free end is engaged over a lock pin 268 to retain it in place. It should be apparent at this time that any number of pins 247 may be arranged selectively in the holes 246 so that the carriage 95 may be tabulated to in any desired columnar position or positions with relation to the punching mechanism.

Coded punch selection

For the purpose of selectively determining the particular punches P which are to be operated during each cycle of the punching mechanism, the key board 56 includes a plurality of control keys 269 and index or selecting keys 271, the actuation of which controls the positioning of the related selector bars 111. As best shown in Fig. 19, there are nine keys 269 pertaining to the several significant digits from "1" to "9" inclusive, a key 272 pertaining to "zero" and a pair of keys 271. The keys 271 pertain to the control of the punches P utilized to perform perforations in the index or selecting card 65 and the keys 269 are utilized to control actuation of the punches P for performing the perforations in the control card 66. The "zero" key 272 has its primary use in the present device in effecting an idling stroke in the punching means so as to space the carriage 95 one space to the left when the representation of "zero" is required or in the event of inaccurate initial setting or tabulating of the carriage.

The numbered keys 269 are carried on the forward ends of key supporting levers 273 and said levers extend rearwardly in a generally horizontal direction and are pivotally supported upon a common mounting shaft 274 in the desired spaced relation to each other. The shaft 274 is rested in a longitudinal channel 275 formed on the top surface of a supporting bracket 276 which is secured to a mounting plate 277, as by bolts 278, firmly supported at its ends on

bosses 279 formed on and extending upwardly from the machine base 83. Headed screws 281 retain the shaft 274 in the channel 275. It should be noted at this time that the levers 273, carrying the odd numbered keys, that is, the keys numbered 1, 3, 5, 7 and 9, extend rearwardly a greater distance beyond their pivotal mounting at 274 than the levers 273 supporting the even numbered keyes 2, 4, 6 and 8. A relatively wide bail 282, having downwardly turned end walls 283, extends across and is spaced from the tops of the rear portions of all of the key levers 273, and its end walls 283 are pivotally mounted upon the ends of the shaft 274. The end wall 283 of the bail lying adjacent to the lever 273 bearing the number "9" key is elongated to extend forwardly for a considerable distance, as best illustrated at 280 in Figs. 19 and 21, for a purpose to be described presently. This bail 282 has its rearmost edge turned downwardly, as at 284, and said edge normally rests upon the top edges of the rearwardly extending ends of the elongated levers 273 containing the odd number keys. One or more springs 285, Fig. 21, are attached to the rear edge of the bail 282, as at 286, and to an eyelet 287 mounted in the base 83 to normally urge said bail downwardly about its pivot 274 so as to normally retain the odd numbered key levers 273 biased in their normal substantially horizontal position. It should be apparent at this time that upon depression manually of any of the odd-numbered keys so as to cause their key levers 273 to swing downwardly about their pivot 274, the rearwardly extending ends thereon are carried upwardly against the bail 282 to cause said bail to be tilted in a counterclockwise direction, as best illustrated in Figs. 21 to 23, for a purpose to be explained hereinafter. Springs 288, Fig. 21, are connected to the rear ends of the short key levers 273 carrying the even numbers, and to the plate 277 to normally retain said levers in their horizontally disposed elevated position. The index keys 271 are mounted on the forward ends of levers 289 also pivoted on the shaft 274, and these levers are of a length equal to the length of the even numbered key levers 273 so as not to engage the bail 282 when depressed. These levers also are held in a normal substantially horizontal elevated position by springs 288 (Fig. 20) also connected to the plate 277.

It will be evident that the key levers 273 and 289, together with the lever carrying the "zero" key, are selectively depressible to effect such machine operation as is initiated thereby. The present machine embodies means effective upon depression of any one of said key levers, to block the remaining key levers so as to prevent their being actuated. Such means is best illustrated in Figs. 7 and 8 and it includes a plate 291, secured along the inside face of the front wall of the housing portion 52, as by rivets 292, having slotted recesses 293 through which the key levers 273 and 289 extend and in which said levers operate. A dog 294 is pivoted on said plate at its upper end, as at 295, between each slot 293 and each dog has opposed slightly inclined shoulders 296 at their abutted lower ends which partially underlie a key lever when the latter is in its normal elevated position. Thus, when a key lever is depressed, the shoulders beneath said key lever are displaced to rock the related dogs in opposite directions and thereby force such remaining dogs tightly against one another so as to block depression of any of the remaining key levers.

When any one of the keys 269, numbered 1 to 9, or the index keys 271 is depressed, it must serve to cause actuation of the punching means in accordance with the code in Fig. 4 and to accomplish this purpose, means is provided for causing appropriate actuation of the proper selector bars 111. To this end a plurality of transmitting levers 297, Figs. 19 and 22, are mounted on the shaft 274 for actuation by certain of the key supporting levers 273. For the purpose of differentiating correlated punches, selector bars 111 and transmitting levers 297 which are operable as a unit during a punching operation, said elements will be further identified by adding differentiating letters *a*, *b*, *c*, *d* and *e* to the reference numerals designating these various parts. Thus, the forwardmost male element of the five punches P which are to be rendered effective in performing perforations corresponding to the selected code of Fig. 4, will be designated 86*a* (Fig. 16) and the fifth male element utilized in performing said coded perforations will be designated 86*e* and the intermediate punches will be designated with similar letters in appropriate order.

Upon referring again to Fig. 19 it will be seen that the transmitting lever 297*a* is mounted on the shaft 274 and projects forwardly therefrom between the levers 273 of the "1" key and the "2" key; the transmitting lever 297*b* is mounted on said shaft between the "3" key and the "4" key in the same manner; the transmitting lever 297*c* is mounted between the "5" key and the "6" key; the transmitting lever 297*d* is mounted between the "7" key and the "8" key. The "9" key, which is operated to effect actuation of a selector bar 111 for control operation of the 5th male element 86*e* of the punches P, cooperates with the forward extension 280 on the bail 282, hence no transmitting element is associated therewith. The several transmitting levers 297 extend but a short distance rearwardly of the shaft 274 and are provided with springs 298 also connected to the plate 277, Fig. 22, which springs act upon the transmitting levers to bias their forward ends upwardly in a manner similar to the operation of springs 288.

As will hereinafter be described in detail, the transmitting levers 297 and the bail extension 280 are operable to actuate related selector bars 111 from their inactive position to an active position and provision is made for actuation of the transmitting levers 297 by the related key levers 273 in accordance with the code shown in Fig. 4. Accordingly, the forward end of each transmitting lever 297 is provided with a pair of lugs 301 and 302, extending in opposite directions laterally therefrom, one of which underlies the related odd number key lever 273 and the other of which underlies the related even number key lever 273. Thus, the transmitting lever 297*a* has projecting lugs 301 and 302, as best shown in Figs. 6 and 19, which underlie the lever 273 of the "1" key on the left-hand side and the lever 273 of the "2" key on the right-hand side. Similarly, the transmitting lever 297*b* has lugs 301 and 302 underlying the supporting levers 273 of the "3" key and the "4" key, Fig. 22; the transmitting lever 297*c* has lugs 301 and 302 underlying the levers 273 of the "7" key and of the "8" key. The lever 273 of the "9" key has a horizontally extending lug 303 extending therebeneath, which lug is formed on the forward end of the bail extension

280, Fig. 21. With this construction, the depression of an even numbered key merely causes actuation of its directly associated transmitting lever 297 through the medium of the related lug 302 which underlies the supporting lever of the depressed key. Further, depression of a key representing an odd number 1, 3, 5 or 7 produces a similar actuation of the associated transmitting lever 297 through the related lug 301, and additionally functions through the action of its rearwardly extended rear end upon the bail 282 to cause said bail to tilt upwardly about its pivot 274 in the manner described hereinabove so as to cause its forward end of its extension 280 to be depressed. Similarly, depression of the lever 273 carrying the "9" key will act on said bail to lower its extension 280. Thus, the actuation of the various transmitting levers 297 by the related number keys 281 and actuation of the "9" key lever is effected in accordance with the five-unit number code of Fig. 4.

The two "S" keys 271, best shown in Figs. 19 and 20 are provided each to effect actuation of the related one of selector bars 111 for affording actuation of related male elements 86s of the punching mechanism P to effect formation of the holes in the index or selecting card 65. These two "S" keys 271 are, as previously mentioned, each mounted upon a related lever 289, both pivoted at 274, which levers are of a length corresponding to the lengths of the even numbered key levers 273 so that their actuation does not impart movement to the bail 282. These "S" levers 289 each carry a lateral lug 304 and 305 extending from their bottom edge in substantial transverse alignment with the lugs 301 and 302 on the transmitting levers 273.

Operating movements are transmitted from the transmitting levers 298, the bail 282 and the "S" key levers 289 to appropriate selector bars 111 by means, including a plurality of Bowden cables 306. Thus, as best shown in Figs. 6 and 19 to 22, the right-hand lug 302 of each transmitting lever 297 and the lugs 304 and 305 on the "S" levers, as well as the lug 303 on the bail extension 280 each overlie one of a plurality of vertically slidable plungers 307, Figs. 6 and 20, mounted in suitable bores in an enlargement 308 formed on and extending upwardly from the front edge of the base 83. Each of the plungers 307 is operatively connected to a wire 309 of its Bowden cable 306. Each Bowden wire 309 extends through its enclosing sheath to a point of operative connection with the appropriate selector bar 111. In order to distinguish the several Bowden cables and indicate the male element 86 of the punches P with which it is associated, these cables are also designated by the use of the added characters *a* to *e* and *s* and *s'* in association with the reference numbers 306. Thus, the seven Bowden cables that are required in this instance are lead downwardly from their connection in their enlargement 308 across the underside of the base 83 and then upwardly preferably at the rear corner thereof, as best shown in Fig. 5, and their sheaths thereof are secured by screws 311 in the cross-bar 122 of the cradle 103. The ends of the sheaths extend into bores in the cross-bar 121 and each bore has a plunger 312 therein which is secured to the end of the wire 309 in the related Bowden cable 306 and is movable therewith when said wire is actuated by movement of the related plunger 307. The plungers 312 are, as best shown in Fig. 16, arranged to bear against the end of the related selector bar 111 so that when these plungers are moved inwardly upon actuation of the related key or keys, the related selector bar 111 is shifted from the ineffective position shown in Fig. 11 into the effective blocking position shown in Fig. 13. Accordingly, depression of, for example, the "3" key of the keyboard will, as indicated in Figs. 22 and 23, cause the bail 282 to tilt, thus depressing the plungers 307*b* and 307*e*, Fig. 21, to move the selector bars 111*b* and 111*e*, Fig. 16, into blocking position over the related male elements 86*b* and 86*e*. Similarly, depression of an "S" key will move the related selector bar 111*s* into blocking position over the related male element 86*s*. It should be noted at this time that the cradle 103 contains a considerable number of male elements 86 and selector bars 111 and that only such number of selector bars as are required to effect the necessary perforations to perform the code of Fig. 4 and the index perforations, are operatively associated with Bowden cables 306. Those not so associated remain idle during all phases of machine operation and could, if desired, be entirely omitted.

The zero key 272, which is best illustrated in Fig. 19, is carried upon the end of a lever 313 which also is pivoted upon the rod 274. Depression of this key does not actuate any of the selector bars 111 inasmuch as a zero is represented in the code of Fig. 4 by the absence of a perforation. This key, however, is utilized, as previously described, to effect movement of the carriage without the production of a perforation in the particular column momentarily located beneath the punches P. Such movement of the carriage as is effected upon actuation of the zero key is accomplished by actuation of the escapement mechanism previously described. Since the escapement mechanism is actuated only during a cycle of machine operation, the zero key is necessarily operatively effective in the same manner as the other control keys to institute such operation. Accordingly, a crossplate 314, Figs. 7 and 19 to 22, extends laterally beneath each of the control key levers and is suitably supported on the forwardly extending end of a pair of arms 315 pivoted at 316 to the bracket 276 so that said plate 314 is moved downwardly about its pivot 316 each time a control key is depressed. On one of its ends the plate 314 carries a transversely projecting arm 314*a* carrying a switch element 317, Fig. 19, normally held in a switch open position while elevated but which, when lowered, closes an electrical circuit, Fig. 34, through a switch 318 to energize a solenoid 319, Figs. 9 and 35, which controls and initiates operation of the machine. Such control is effected through clutch mechanism to be described hereinafter, whereby the driven shaft 138 is connected to a source of power so as to be rotated through one revolution for each cycle of machine operation. The solenoid 319 is carried within a suitable U-frame 321 bolted or otherwise secured as by a screw 322 to a bracket 323 firmly mounted upon the standard 82. The circuit between the switch 318 and solenoid 319 includes a safety-switch generally indicated at 324, the operation and purpose of which will be described presently. However, during normal manipulation of the machine, the solenoid will be energized each time any of the control keys are depressed and when energized, it effects operation of the clutch mechanism to cause one cycle of machine operation.

The drive mechanism

As hereinabove noted, the drive shaft 138 is

driven by power means from any suitable source, preferably through a belt (not shown) operating upon a pulley 325. The clutch mechanism, best shown in Figs. 37 to 40, is a one-revolution clutch and is carried on the shaft 138. When this clutch is actuated upon energizing the solenoid 319, Fig. 9, the pulley 325, which normally idles on the shaft 138, is positively connected to said shaft so as to thereby cause the shaft to be rotated. The clutch may be of any preferred construction, but in the present instance it includes the pulley 325 which is secured upon a collar 326 mounted for free rotation upon the shaft 138 and preferably includes anti-friction bearings 327. A control member or sleeve 328 is telescoped over the projecting end of the collar 326 so as to have free rotation relative thereto, and said sleeve extends rearwardly a considerable distance, as best shown in Fig. 37. A pin 329 extending radially through a cam slot 331 in the sleeve 328, Fig. 40, serves to operatively connect the sleeve 328 with a driven clutch element 332 so that by relative rotation of the sleeve 328 and the driven clutch element 332, the clutch element may be moved endwise along the shaft 138 through clutch engaging and disengaging movements. The clutch element 332 is arranged entirely within the projecting end of the sleeve 328 and is mounted snugly upon the shaft 138. One face of the clutch element 332 is provided with teeth 333 arranged for clutching engagement with teeth 334 provided on the opposed end of the pulley collar 326, so that when said toothed faces are brought endwise into engagement one with the other, in a manner to be described hereinafter, the collar 326 will act as the driving element of the clutch and will impart rotation to the clutch element 332. In order that the clutch element 332 may be shifted longitudinally along the shaft 138, the clutch element 332 is suitably recessed on its other face, as at 335, to receive one or more lugs or keys 336 formed on an opposed end face of a hub 337 secured, as by a set screw 338, to the shaft 138. Thus, rotation of the driven clutch element 332 during meshing engagement of its teeth with the associated teeth on the pulley collar 326, will impart rotation to the hub 337 and which rotation is transmitted directly to the shaft 138.

As previously noted, engagement or control of the clutch is effected through operation of the solenoid 319. To accomplish this, suitable clutch control mechanism, best shown in Figs. 9 and 35 to 40, is provided. Such mechanism includes a lever 339 pivotally secured at its upper end by a pin 341 to the lower end of the solenoid armature 342, and adjacent to its lower end the lever 339 has an extension 343 in the form of a plate riveted or otherwise secured thereto in such manner as to provide a shoulder 344, Fig. 38, adjacent its lower end. The extension plate 343 is disposed in a plane to align with the upper face of the control sleeve 328 of the clutch, and is biased so as to normally bear firmly against the adjacent side surface of the sleeve 328 by means such as a weight 345, Fig. 35, carried on the end of an arm 346 extending laterally from the pivoted upper end of the arm 339.

The clutch control mechanism also includes a pivoted stop lever 347 having one of its ends connected, as best shown in Figs. 5 and 7, to a spacer collar 348 freely mounted upon a rearwardly extended stud 349 secured, as by a nut 351, to a web of the standard 82. In the present instance, the lever 347 is attached to the collar 348, as by a bolt 352, having a washer 353 arranged above a spring 354 which normally bears against the top face of the lever 347 to hold it substantially rigid while permitting it to move relative to the collar 348 during machine operation. The free end of the lever 347 rests upon the upper face of the control sleeve 328 and extends beyond the top axial plane of said sleeve so as to normally overlie and rest upon the shoulder 344, as shown in Fig. 38. When the stop lever 347 is in this normal position, a slot 356 formed therein is so located as to be engageable by a radially projecting pin 355 fixed on the control sleeve 328. Such engagement takes place in the course of the rotation of the sleeve 328 with the driven element 332 of the clutch in the direction indicated in Fig. 38, and when this occurs, the control sleeve 328 is held against rotation while rotative movement of the driven member 332 of the clutch continues. In the course of such rotative movement the pin 329 on the driven clutch member 332 moves along the angular portion of the cam slot 331, thereby to impart endwise movement to the driven member 332 to the left in Figs. 37 and 40, thereby to separate the teeth 333 from the teeth 334. The clutch is thus disengaged by the action of the stop lever 347 and the control sleeve 328.

When the clutch is to be engaged, the arm 339 is drawn upwardly by energization of the solenoid 319, and the lever 347 is carried upwardly about its resilient mounting from the position indicated in Fig. 38 into an elevated position illustrated in Fig. 39. When this occurs, a pin 355 becomes disengaged from a slotted opening 356 in the lever 347, whereupon the sleeve 328 is permitted to rotate in a clockwise direction in response to tension applied thereto in a manner to be more fully described presently. Such clockwise rotation of the sleeve 328 causes the cam slot 331 therein, Fig. 40, to act upon the cam pin 329 carried on the driven element 332 so as to thereby cause said element to move forwardly or to the right in Fig. 37 to effect engagement of its teeth 333 with the teeth 334 on the pulley collar 326. This engagement thus affords a positive driving connection between the driven pulley 325 and the shaft 138.

As the sleeve 328 continues in its clockwise movement, Figs. 38 and 39, the pin 355 carried thereby is moved toward and into engagement with the plate 343, thus causing said plate to be moved outwardly, as indicated in dotted lines in Fig. 39, thereby carrying the shoulder 344 out from beneath the end of the lever 347; whereupon, the spring 354 causes said lever to drop downwardly into its normal position of rest against the top peripheral surface of the sleeve 328, thereby to condition the stop lever 347 for disengaging the clutch at the end of its one-revolution cycle as hereinbefore described. As soon as the solenoid 319 is de-energized, the arm 339 is lowered and when the shoulder 344 reaches the level of the lower face of the lever 347, the weight 345 acts to pivot the arm 339 so that the shoulder 344 passes into position beneath the end of the stop lever 347. The mechanism is thus conditioned for instituting the next machine operation when this is desired.

It is essential for accurate machine operation that the shaft 138 stop at precisely the same position at the completion of each operating cycle so that the parts of the machine are positioned for the institution of another cycle of operation. Accordingly, the hub 337 on shaft 138 has a substantially circular flange 357 secured thereon, as by welding, which flange is provided with a shoulder 358 on its periphery. The stud 349, Fig. 9,

has a rocker arm 359 mounted on its outer end, and this arm has a roller 361 on its free end which is biased against the periphery of the flange 357 by means of a spring 362 acting on the lever 359. It will be observed that the shoulder 358 faces in what may be termed a reverse direction, and the location of the shoulder on the flange 357 is such that the roller 361 will be engaged with the shoulder 358 when the shaft 138 is in the desired rest position. In attaining the accurate location of the shaft 138 in such a rest position, a spring 362A functions to urge the flange 357 and the shaft 138 in a reverse direction so as to urge the shoulder 358 into contact with the roller 361. The spring 362A is connected at one end to a pin 363 on the flange 357 and at its other end to a radial pin 364 secured on the face of the control sleeve 328. It is this spring 362 which maintains the clutch sleeve biased in a forward direction, or clockwise as viewed in Fig. 38, thereby to cause the cam pin 329 to effectively co-act with the cam slot 331 in the clutch sleeve when said sleeve is released by actuation of the solenoid as previously described. Thus, when rotation of the control sleeve 328 is stopped by the stop lever 347, the continued rotative movement of the clutch mechanism pending complete disengagement of the clutch, causes the spring 362A to be additionally tensioned. The location of the cam slot 331 is such that the clutch becomes fully disengaged at substantially the time when the shoulder 358 passes beneath the roller 361, and after the roller has dropped into the shoulder the tensioned spring 362A is operative to decelerate and stop shaft 138, and in this action the shoulder 358 may be moved into a slightly spaced relation with respect to the roller 361. When and if such movement occurs, the tension of the spring 362A becomes immediately effective to return the shoulder 358 into engagement with the roller 361, thereby to locate the shaft 138 accurately in the desired rest position.

Safety mechanism

When the punching apparatus is operated upon depression of any of the control keys 269, 271 and 272 in the manner described hereinabove, the machine is intended to operate through but one cycle of operation. In some instances of operation an inexperienced operator may inadvertently hold one of said control keys depressed for a period of time exceeding time required to complete the cycle of operation, with the result that, under ordinary conditions, the control switch 318 will be held in circuit closed position and the machine operation would tend automatically to repeat itself, thus causing repeated operation of the punches P and the formation of an incorrect control device 55. Accordingly, means are provided in accordance with the present invention to actuate the safety switch 324 so as to open the control circuit and thereby prevent such inadvertent continuous operation of the apparatus even though a control key be retained in its depressed machine actuating position for a time exceeding the time required for such machine operation. To this end, a lever 365, Figs. 19 and 20, is provided as an extension of one of the arms 315 supporting the plate 314. It will be noted that the lever 365 extends rearwardly of the keyboard mechanism and is pivotally connected at 367 at its rearmost end to the lower end of a substantially vertically disposed link 366. The link 366 has an elongated slot 368 formed therein so as to terminate at 369 near the upper end of the link, and an end of a latch element 371 extends through the slot 367 as shown in Figs. 9, 35 and 36. As shown in these figures, it will be seen that the latch element 371 consists preferably of a strip of metal pivoted at 372 intermediate its ends as a lever on the standard 82 and having a block 373 of hardened steel adjustably secured on its forwardly extending end as by the screw and slot connection 374. A spring 375 is connected at one of its ends to the upper end of the link 366 and at its other end to the adjacent end portion of the latch element 371 so as to normally bias the two members towards one another to thereby retain the latch element 371 in an uppermost pivoted position and to hold the link 366 against a bearing surface 376 secured to and forming a part of the latch element 371. The block 373 is provided on its forward edge with a shoulder 377 intended to cooperate, under certain conditions of machine operation, with an edge 378 formed on the lower end of a rock arm 379 firmly mounted at its upper end on the shaft 143. The arm 379 is operated through a rocking movement during each machine operation to rock from its inactive position shown in Figs. 9 and 35 into an active position substantially as illustrated in Fig. 36. When the rock arm 379 reaches the position illustrated in Fig. 36, said arm contacts an element 381 carried on the end of one of the blades 382 of the safety switch 324, to thereby move said switch blade 382 away from its contacting or switch-closing engagement with the other switch plate 383 to thereby open the circuit to the solenoid 319. Such opening of the switch 324 takes place in each machine cycle after the solenoid 319 has accomplished its clutch operating function, and when the solenoid is thus de-energized, the arm 339 and the shoulder 344 return to their normal positions of Fig. 38.

If the control key which had been depressed to impart an operating cycle to the machine has been released in the proper manner, the circuit to the solenoid 319 is, of course, broken through opening of the control switch 318, and under such circumstances, the momentary opening of the safety switch 324 is ineffective. However, should a control key be held in its depressed position to thereby retain the control switch 318 closed, the circuit to the solenoid 323 will be broken upon opening of the safety switch 324 in the manner described hereinabove. When said safety switch 324 is thus opened through rocking of the arm 379 into the position shown in Fig. 36, and while a key is held depressed, the latch element 371, which is biased in a clockwise direction through action of the spring 375 rocks clockwise so as to dispose the latching shoulder 377 into the path of the edge 378 of the rocker arm 379. Should the key be released as in proper machine operation, the link 366 is again lowered through action of a spring 384, and the upper end 369 of the slot contacts the latch element 371 to thereby rock it in a counterclockwise direction to carry the latching shoulder 377 thereof out of the path of the rocker arm 379, whereupon said arm may return to its inactive position, thus permitting the safety switch to again close. However, should a control key be held depressed during the entire cycle of machine operation, the latch element 371 remains in its adjusted position so that its latching shoulder 377 effectively blocks the return movement of the rocker arm 379. Thus the safety switch 324 is held open so as to thereby prevent repeated machine operation. As soon as

such depressed key is permitted to return to its normal elevated position, the latch element 371 is carried out of its blocking position, and the safety switch is then permitted to close so as to again condition the machine for normal operation.

Operation

In the use of the machine as hereinabove described, the operator is provided with a plurality of control devices 55 which have previously been partially prepared in accordance with a list which also embodies the control data and the index or selecting data which is to be formed upon each of the control devices through the use of the present machine. When the control devices are received by the operator of the present machine, the printing plate 58 has been embossed and mounted on the frame 57, as illustrated in Fig. 2, and the cards 65 and 66 have also been mounted upon the frame 57 in their proper relative positions. These partially formed control devices are received by the operator in drawers or stacks wherein the several control devices are arranged in an order which corresponds to the order of the corresponding names upon the list from which they were prepared so that the operator of the present machine may then take the first one of the partially formed control devices from the drawer or stack, and after placing it in the punch carriage 95, proceed with the formation of the punched representations of the index or selecting data and control data which are found in the list opposite the corresponding name.

When such a list and the corresponding group of control devices are received, the operator must first set the carriage resetting stop 177 and for this purpose the list is examined to determine what setting of the stop 177 will conform to the greatest proportion of control numbers found on the list. If, for example, it is found that the index or selecting number or numbers embraced in the list is such as to require the carriage in which the control device is mounted to be shifted entirely to the right, as in Fig. 6, then the resetting stop 177 is located on the bar 168 at the furthest right-hand pair of notches 176 therein. The selective tabulating mechanism, as illustrated in Figs. 28 to 32 inclusive, also is set or adjusted to regulate any tabulating spacing required by the control data or groups of control data appearing on the list and to be formed in the control device. When the carriage has been tabulated the pointer 211 will indicate the exact location of the control device carried on said carriage through its cooperative relationship with the scale 212 which bears numbers complemental to the columnar spacing employed on the index and control areas of the control devices. In the event it is necessary to space the carriage one or more spaces to the left after it has been initially positioned, as shown in Fig. 6, the operator depresses the tabulating key 233, and the carriage will move to the left such distance as is determined by the setting of a pin 247 in the tabulating mechanism of Figs. 28 and 32.

In Fig. 2, the index card 65 on the control device 55 has been illustrated as bearing punched representations of the index or selecting numerals 1 and 45, and the control card 66 has been illustrated as bearing punched representations of the control number 45269. In describing the operation of the machine, the index or selecting numbers and the control number above noted will be employed as by way of example and the drawings illustrate the positions assumed by various parts of the control and punching mechanism required to perform the necessary punching operations during operation of the machine.

Assuming that the carriage 95 has been set at the extreme right-hand position shown in Fig. 6, the control device carried thereon is located with the first potential column aligned with the punches P so that manual depression of a selected "S" key 271, operates through a related Bowden cable 306*s* to set the related selector bar 111*s* to condition one of the male elements 86*s* (Fig. 15) for punching when the machine operates through its cycle of punching operation. In this instance the rear one of the selector keys 271 is pressed so that the machine will operate to perform the perforation 232, Fig. 2, in the top row of potential perforations in the index or selecting card 65. Actuation of the rear "S" key 271 causes the plate 314, Fig. 19, to be moved downwardly to thereby close the control switch 318 and complete the circuit to the solenoid 319, thereby initiate a cycle of machine operation. Upon completion of the cycle of operation the operator then depresses the tabulator key 233, thus disengaging the escapement mechanism so that the carriage may move to the left in Fig. 6 until the previously set stop pin 247, Fig. 32, strikes against the related stop plunger 248 which, as herein shown, holds the carriage in such a position as to locate the columnar row of potential perforations such as that containing the perforation numbered "45" on the index or selecting card 65 in punching position; whereupon, the other or forward "S" key 271 is depressed so as to effect selection and actuation of the other punch 86*s* to form the desired perforation 232', Fig. 2, in the second row in the index card in the number 45 position.

After formation of the perforation 232' in the number "45" position in the index card 65, the operator may again, as in the present illustration, actuate the tabulator key 233 to again disengage the escapement mechanism so as to enable the carriage to move further to the left until such time as the second stop pin 247' located in the upper row of holes in the rider bar 165 moves against the related stop plunger 248'. Thus, the carriage 95 is properly positioned for the punching pertaining to the "ten-thousands" order of the number 45269 to be represented on the control card 66. The operator then depresses the "4" key 269 which operates through the transmitting member 297*b* to impart movement to the related Bowden cable 306*b* for setting the related selector bar 111*b* to block and condition the male punch element 86*b* for operation to form the perforation in the ten-thousands column of the control card in accordance with the code indicated in Fig. 4. Actuation of the "4" key also causes the plate 314 to be urged downwardly, thereby closing the control switch 318 for operating the punching machine through one operating cycle. During this cycle of operation, the escapement mechanism, which also operates during operation in response to depression of an "S" key, is actuated after the completion of the actual punching operation to permit the carriage to move to the left in Fig. 6 a distance equal to the columnar spacing on the control device 55. Thus, the said control device is positioned with its "thousands" column located beneath the punches P.

The machine is now conditioned to form the perforation representative of the numeral "5" in the "thousands" column. Accordingly, the

operator will depress the "5" key **269** which operates through the transmission element **297c** to actuate the associated Bowden cable **306c**; whereupon, the related selector bar **111c**, Fig. 16, is positioned to cause actuation of the related male punch element **86c** when the machine operates through another cycle. Depression of the "5" key **269** also rocks the bail **282** so as to thereby depress the forward end of its arm **280**, Fig. 21, and actuate the related Bowden cable **306e** to render the male punch element **86e** operative in unison with male element **86c** and in accordance with the code of Fig. 4. During this operation, the control switch **318** is again closed so as to effect the operation of the machine and actuation of the escapement mechanism, as described hereinabove, whereupon the control device is advanced a distance equal to one column spacing to the left in Fig. 6 to position the "hundreds" column beneath the punches P. Successive operation of the "2," "6" and "9" keys **269** causes successive operation of the related Bowden cables **306** *c—d—e* and selector bars **111** *c—d—e* to render the selected punches effective to form perforations in the control card **66** in their correct columnar position in accordance with the code of Fig. 4.

Should the numeral "0" be included in the selected number to be represented on the control card **66**, or should it be desired to effect columnar spacing of the carriage to the left for any reason whatsoever, the "0" key **272** is depressed. This key does not condition any punches for formation of a perforation, since the absence of a perforation denotes "zero". However, depression of the "0" key closes the control switch **318** so as to thereby initiate a cycle of machine operation during which operation the escapement mechanism operates to enable the carriage to move to the left a distance equal to the columnar spacing.

Thus, it will be seen that upon completion of the manipulation of such number keys as are required to form the necessary perforations in the control card representative of the number or numbers to be represented thereon, the forming of the control card is complete, and it may be withdrawn from the carriage upon being released from the holding mechanism of Fig. 24 by momentarily depressing the release plunger **189**.

Alternative embodiment

The control devices in which perforations are to be formed with the machine of the present invention may take many different forms, and in some instances, the efficient utilization of the different areas on a printing and control device may make it desirable to dispose the columns in the control area in an acute angular relationship rather than in vertical relationship as hereinbefore discussed. One such printing and control device is illustrated and described in the copending application of Walter T. Gollwitzer, Ser. No. 478,378, filed March 8, 1943, and the machine of the present invention may be readily and easily embodied so as to enable the columns in the control area to be disposed in such an acute angular relationship with respect to the control device. Thus, such an embodiment of the present invention is illustrated in Figs. 41 to 47 of the drawings, and in this alternative embodiment of the invention the majority of the elements of the punching machine are the same as in the previously described embodiment and are identified by the same reference characters.

In this alternative embodiment of the invention, however, revisions or changes have been embodied in the elements of the guide block and die block as well as in the cradle and the related mechanism carried on or directly associated with the cradle. Thus, as will be evident in Figs. 41 and 44, a die block **88a** and a guide block **87a** are formed and associated in substantially the same manner as in the previously described embodiment of the invention, and a relatively wide supporting shoulder **90a** is provided on the standard **82** for supporting the assembly or unit that is thus provided. It will be observed, however, in Fig. 41 of the drawings, that the die block **88a** and the guide block **87a** are relatively wide, and that the die openings **89a** as well as the punches **86a** are located in a vertical plane that is disposed at an acute angle to the path of the travel of the punch carriage. The particular angle at which the punches are thus disposed is best shown in Figs. 44 and 45 and this angle corresponds with the angle of inclination of the columns of the coded representation illustrated in Fig. 47.

The male elements **86a** of the punches have elongated narrow heads **109a** that are disposed above a relatively wide retractor plate **108a**, this stripper plate being mounted in horizontal slots **107a** in the side walls of the cradle **103a** in substantially the same manner as in the previously described embodiment of the invention. The cradle **103a** is supported in the same manner as hereinbefore described, and the male punch elements **86a** are returned in a downward direction with respect to the retractor plate **108a** by an overhanging flange **119a** of the same general character as in the previously described embodiment. It will be observed, however, that the flange **119a** has an angularly disposed end edge **386**, as is best shown in Fig. 45 of the drawings, so as to afford clearance along the tops of the heads **109a** for selecting movement of selector elements **111a** that are mounted in the cradle **103a**. The cradle **103a** is generally similar to the cradle employed in the other embodiment of the invention, but is somewhat longer as will be evident in Figs. 41, 42 and 45 so as to accommodate selector elements **111a** of varying lengths as shown in Fig. 45. The outer or right-hand ends of the selector elements **111a** are associated with Bowden cables **306** in the same manner as in the other embodiment, and enlarged portions **126a** are provided at the outer ends in the same manner as hereinbefore described for cooperation with a restoring member **148a** that is of the same general form as in the other embodiment.

It will be observed, however, that the selecting members **111a** are of different lengths so that the left-hand ends thereof as viewed in Fig. 45 are disposed in what may be termed an echelon relationship so that each selecting member bears the same relationship to the head **109a** of the male punch element with which it is associated. Thus when all of the selector elements **111a** are in their restored or inactive positions, the left-hand ends thereof rest upon the adjacent edges of the related heads **109a** and are disposed just to the right of the stepped edge **387** of the tie bar **106a**. When the selector elements **111a** are thus located in their idle positions, the cradle **103a** may move downwardly through an idle stroke so that the stepped edge **109a** moves downwardly past the adjacent ends of the punch heads, and hence the movement of the cradle **103** takes

place without actuation of any of the punch elements 86a. When actuation of any of the related control keys 269 operates the related Bowden cables 306, the related selector members 111a are moved beyond the adjacent step of the edge 387 and into positions beneath the tie bar 106a, and when one or more selector elements 111a are thus positioned, an operation of the cradle 103a will result in operation of the related punch elements 86a through an operative punching stroke.

From the foregoing description, it will be apparent that the present invention facilitates the preparation of control devices and that this end is attained in such a manner as to insure maximum accuracy and speed. The machine provided by the present invention embodies an inherent mode of operation which requires the operator to follow a definite and predetermined sequence of movements and operations which are so correlated as to promote speed and accuracy. It will also be evident that the machine of the present invention embodies means for preventing inadvertent continuance of machine operation after the completion of one punching cycle, consequently, a control device 55 may be formed therein with speed and accuracy irrespective of the skill of the operator. It will also be apparent that the novel relationship of the various elements of the present apparatus enables the punch selecting connections between the keys and the selector elements to be materially simplified, and particularly it is to be observed that the setting and restoring means for the selector elements are operatively extended to the selector elements from opposite directions thereby to simplify the structure of the machine as a whole.

It will also be evident that the present invention simplifies the work of the operator by its inclusion of means to automatically tabulate the machine to a selected position, such that manual tabulating operations are minimized with the resultant increase in speed and accuracy. It will be evident further that the male elements 86 of the punches P as well as the guide block and the die block may be quickly removed by the simple removal of the two screws 92 holding the die block 88 to the standard 82, thereby increasing the efficiency and usefulness of the machine. The machine also is characterized by the inclusion of the adjustable stop plate 116 for the male elements, which enables the machine to be easily and accurately adjusted to compensate for any shortening in the required length of the male elements of the punches P resulting from grinding. Moreover, the upper face of the die block may be readily exposed for grinding or sharpening of the edges of the die openings, and all of the related operative parts may be readily adjusted and related to conform with changes of dimensions caused by such grinding of the die block or the punches.

Thus, while I have illustrated and described selected embodiments of the invention, it is to be understood that it is capable of variation and modification and I therefore do not wish to be limited to the precise details set forth but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. In a machine for forming control devices, a base affording an upstanding rigid standard having a slot extended therethrough adjacent to the upper end, a lever pivoted on a horizontal axis on said standard at one side thereof and extended through such slot in a generally horizontal direction and beyond the other side surface of the standard, actuating means disposed on said one side of said standard and operatively connected to said lever for imparting rocking movement thereto, a punch supporting cradle pivotally suspended from the extended end of said lever and extended downwardly therefrom along said other side of said standard, a punch and die unit mounted on the other side of said standard and including a plurality of headed punches suspended from said cradle and movable longitudinally with respect thereto, a tie bar on said cradle disposed in an upwardly spaced relationship with respect to the heads of said punches, a plurality of selector elements, means on said cradle supporting said selector elements with corresponding end portions of the several selector elements rested upon the heads of said punches in positions such that said selector elements may be moved longitudinally toward said standard and into blocking positions between said tie bar and said heads, said selector elements having shoulders formed thereon in positions such that said shoulders face at all times toward said standard, a keyboard including a plurality of individually operable keys, Bowden cable connections operatively connected at one end to said keys and extended to and supported at their other ends on said cradle, means on said cradle operatively associating said Bowden cables with said selector elements for pushing the same into such blocking positions, and restoring means for said selector elements mounted in part on said one side of said standard and extended through said slot for engagement with said shoulders of said selector elements to restore said selector elements to their normal positions.

2. In a machine for forming control devices, a base affording an upstanding rigid standard having a slot extended therethrough adjacent to the upper end, a lever pivoted on a horizontal axis on said standard at one side thereof and extended through such slot in a generally horizontal direction and beyond the other side surface of the standard, actuating means disposed on said one side of said standard and operatively connected to said lever for imparting rocking movement thereto, a punch supporting cradle pivotally suspended from the extended end of said lever and extended downwardly therefrom along said other side of said standard, said standard being formed with an upwardly facing shoulder on said other side thereof in downwardly spaced relation with respect to said cradle, a punch and die unit mounted on said upwardly facing shoulder and including a plurality of headed punches, a retractor plate through which said punches extend, means on said cradle affording a pair of upwardly facing shoulders upon which the end edges of said retractor plate are rested, a tie bar on said cradle disposed in an upwardly spaced relationship with respect to the heads of said punches, a plurality of selector elements, means on said cradle supporting said selector elements with corresponding end portions of the several selector elements rested upon the heads of said punches in positions such that said selector elements may be moved longitudinally toward said standard and into blocking positions between said tie bar and said heads, a keyboard including a plurality of

individually operable keys, means including Bowden cable connections operatively connected at one end to said keys and extended to and supported at their other ends on said cradle, means on said cradle operatively associating said Bowden cables with said selector elements for pushing the same into such blocking positions, and restoring means for said selector elements to restore the same to said normal inoperative positions.

3. In a machine for forming control devices, a base affording an upstanding rigid standard having a slot extended therethrough adjacent to the upper end, a lever pivoted on a horizontal axis on said standard at one side thereof and extended through such slot in a generally horizontal direction and beyond the other side surface of the standard, actuating means disposed on said one side of said standard and operatively connected to said lever for imparting rocking movement thereto, a punch supporting cradle pivotally suspended from the extended end of said lever and extended downwardly therefrom along said other side of said standard, said standard being formed with an upwardly facing shoulder on said other side thereof in downwardly spaced relation with respect to said cradle, a punch and die unit mounted on said upwardly facing shoulder and including a plurality of headed punches, a retractor plate through which said punches extend, means on said cradle affording a pair of upwardly facing shoulders upon which the end edges of said retractor plate are rested, a tie bar on said cradle disposed in an upwardly spaced relationship with respect to the heads of said punches, a plurality of selector elements, means on said cradle supporting said selector elements with corresponding end portions of the several selector elements rested upon the heads of said punches in positions such that said selector elements may be moved longtiudinally toward said standard and into blocking positions between said tie bar and said heads, said selector elements having shoulders formed thereon facing toward said standard, a keyboard including a plurality of individually operable keys, means including Bowden cable connections operatively connected at one end to said keys and extended to and supported at their other ends on said cradle, means on said cradle operatively associating said Bowden cables with said selector elements for pushing the same into such blocking positions, and restoring means for said selector elements mounted in part on said one side of said standard and extended through said slot for engagement with said shoulders of said selector elements to restore said selector elements to their normal positions.

4. In a machine for forming control devices, a base affording an upstanding standard having a slot formed therethrough adjacent to its upper end, a rocking lever mounted on a horizontal axis on one side of said standard and extended through said slot to a point beyond the other side face of said standard, punching means including a punch and die assembly mounted on said other side of said standard, a punch supporting cradle pivotally suspended from the projecting end of said lever on said other side of said standard and operatively associated with said punch and die assembly, punch selecting means mounted on said cradle, a keyboard mounted on said base and operatively associated with said punch selecting means, means for restoring said punch selecting elements, and means for actuating said lever through rocking movements comprising a main drive shaft mounted on said base on said one side of said standard, an arm operatively connected to said drive shaft for operation thereby through predetermined rocking movements, said arm being pivoted at its other end on the same axis as said lever, and means forming an adjustable transmitting connection between said arm and said lever for rocking said lever and arranged by such adjustable connection to adjust the location of the rocking stroke imparted to said lever by said arm.

5. In a machine for forming control devices, a base providing a narrow upstanding standard having a slot formed therein adjacent to the upper end thereof, a punch operating lever mounted on a horizontal pivot on one side of said standard and extended through said slot to a point beyond the other side face of said standard, and operating shaft disposed in a horizontal position on said one side of said standard, means forming an operative connection between said shaft and said lever to impart rocking movements to said lever, a punch and die assembly supported upon said standard on the other side thereof and beneath the extended end of said lever, a punch supporting cradle pivotally suspended from said extended end of said lever and having a plurality of punches mounted therein and forming part of said punch and die assembly, a keyboard including a plurality of keys, punch selecting elements mounted on said cradle and operatively associated with said keys of said keyboard for movement from normal positions to active positions selectively through actuation of selected keys of said keyboard, a restoring rocker mounted on said one side of said standard and operatively associated with said drive shaft for operation through a rocking movement late in the cycle of rocking movement of said lever, a restoring plate pivotally connected to said restoring rocker and extended therefrom through said slot and into said cradle, means on said cradle supporting said restoring plate for sliding and pivotal movement with respect thereto, said selecting elements having shoulders thereon adapted for engagement by said rocking plate to restore said selecting elements to their normal inactive positions.

6. In a machine for forming control devices, a base providing a narrow upstanding standard, a punch operating rocker mounted on a horizontal pivot on one side of said standard and extended to a point beyond the other side face of said standard, an operating shaft disposed in a horizontal position on said one side of said standard, means forming an operative connection between said shaft and said rocker to impart rocking movements to said lever, a punch and die assembly supported upon said standard on the other side thereof and beneath the extended end of said rocker, a punch supporting cradle pivotally suspended from said extended end of said rocker and having a plurality of punches mounted therein and forming part of said punch and die assembly, a keyboard including a plurality of keys, punch selecting elements mounted on said cradle and operatively associated with said keys of said keyboard for movement from normal positions to active positions selectively through actuation of selected keys of said keyboard, a restoring rocker mounted on said one side of said standard and operatively associated with said drive shaft for operation through a rocking

movement late in the cycle of rocking movement of said lever, a restoring plate pivotally connected to said restoring rocker and extended therefrom to the other side of said standard and into said cradle, means on said cradle supporting said restoring plate for sliding and pivotal movement with respect thereto, said selecting elements having shoulders thereon adapted for engagement by said rocking plate to restore said selecting elements to their normal inactive positions.

7. In a machine for forming control devices, a base affording an upstanding standard, a rocking lever mounted on a horizontal axis on one side adjacent to the upper end of said standard and extended to a point beyond the other side face of said standard, punching means including a punch and die assembly mounted on said other side of said standard, a punch supporting cradle pivotally suspended from the projecting end of said lever on said other side of said standard and operatively associated with said punch and die assembly, punch selecting means mounted on said cradle, a keyboard mounted on said base and operatively associated with said punch and die assembly, punch selecting means mounted on said cradle, a keyboard mounted on said base and operatively associated with said punch selecting means, means for restoring said punch selecting elements, and means for actuating said lever through rocking movements comprising a main drive shaft mounted on said base on said one side of said standard, an arm operatively connected to said drive shaft for operation thereby through predetermined rocking movements, said arm being pivoted at its other end on the same axis as said lever, and means forming an adjustable transmitting connection between said arm and said lever for rocking said lever and arranged by such adjustable connection to adjust the location of the rocking stroke imparted to said lever by said arm.

8. In a machine of the character described for forming control devices, a plurality of punches, means for supporting and automatically advancing a control device with relation to said punches, a common reciprocable actuator for said punches, a plurality of selector bars mounted on and carried by said actuator and individually shiftable from normal inoperative positions on said actuator to operative positions for rendering said actuator operable selectively with respect to said punches, said bars being wholly supported in said actuator, a plurality of selectively operable keys, transmitting elements associated with said keys for operation thereby, a plurality of Bowden cables operatively associated at corresponding ends with the respective transmitting elements, the other ends of said Bowden cables being extended to said actuator and being mounted thereon for movement laterally with said actuator during reciprocation thereof, said other ends of said Bowden cables being operatively associated with the respective selector bars for moving the same, said selector keys being operable to actuate their associated Bowden cables to move the related selector bars to their operative positions, a control element operable to initiate a cycle of operation of said actuator upon actuation of any one of said keys, and means for restoring said selector bars after operation of the selected punches.

9. In a machine for forming control devices with punched representations of desired control data in predetermined positional relationship on each control device, a base, a plurality of punches for selective operation to form coded data on a control device, a movable carriage mounted on said base for positioning such control device with relation to said punches, actuating means for said punches including a cradle mounted on said base, a retractor plate supported on said cradle for removal therefrom in a predetermined horizontal direction, said punches being supported by said stripper plate for removal therewith, a plurality of selector elements carried within said cradle individually shiftable from normal inoperative positions to operative positions for rendering said actuating means operable selectively with relation to said punches, a plurality of manually actuable control keys each operable selectively, means operatively connecting the keys to selected of said selector elements to impart movement to the selector elements into an operative position when the related keys are actuated, and guide means for said punches stationarily supported on said base and adapted for removal from said base by movement in said horizontal direction to thereby permit removal of said guide means, said retractor plate and said punches from the machine as a unit.

10. A machine for forming control devices with punched representations of desired control data in selected positional relationships on such control device, said machine comprising a plurality of punches for selective operation to form coded data representing perforations in a control device, a movable carriage for positioning such control device with relation to said punches, actuating means for said punches including a cradle in which said punches are removably supported, a plurality of selector elements mounted and guided solely on said cradle and individually shiftable from normal inoperative positions to operative positions for rendering said actuating means operable selectively with relation to said punches, a plurality of manually actuable control keys each operable selectively, and a plurality of Bowden cables having corresponding ends operatively connected to the keys and having their other ends extended to and supported by said cradle and operatively connected to selected selector elements to impart movement to such selector elements into an operative position when the keys are actuated.

11. In a machine for forming control devices with punched representations of desired control data in selected positional relationships on such control devices, a plurality of punches for selective operation to form coded data representations on a control device, a movable carriage for positioning such control device with relation to said punches, actuating means for said punches including a cradle in which said punches are supported, a plurality of selector elements mounted on said cradle and individually shiftable from normal inoperative positions to operative positions for rendering said actuating means operative selectively with relation to said punches, a plurality of manually actuable control keys each operable selectively, means operatively connecting the keys to each of the selector elements to impart movement to related of the selector elements into an operative position when the keys are actuated, and means mounted in part upon said cradle and operative to return said selector elements to their normal inoperative position.

12. In a machine for forming control devices with punched representations of the desired control data in predetermined positional relationship on such control devices, a plurality of punches for

selective operation to form coded data representations on a control device, a movable carriage for positioning such control device with relation to said punches, actuating means for said punches including a cradle having spaced side walls formed with horizontally aligned upwardly facing shoulders on their adjacent faces, a retractor bar slidable horizontally between said side walls and supported on said shoulders, said retractor bar providing a support for said punches, a plurality of selector elements carried in said cradle individually shiftable from normal inoperative positions to operative positions for rendering said actuating means operable selectively with relation to said punches, a plurality of manually actuable control keys each operable selectively, and means operatively connecting the keys to each of selected selector elements to impart movement to such selector elements into an operative position when the keys are actuated.

13. In a machine for forming control devices with punched representations of the desired control data in predetermined positional relationship on each control device, a plurality of punches for selective operation to form coded data on a control device, a movable carriage for positioning and advancing such control device with relation to said punches, actuating means for said punches including a cradle in which said punches are supported, a stationary guide means slidably engaged by said cradle and effective to guide the same in its operating movements, a plurality of selector elements carried in said cradle and individually shiftable from normal inoperative positions to operative positions for rendering said actuating means operable selectively with relation to said punches, means carried by said guide means to limit upward movement of the punches to thereby insure clearance for positioning movement of said selector elements, a plurality of manually actuatable control keys each operable selectively, and means operatively connecting the keys to the selector elements to impart movement to the selector elements into an operative position when the keys are actuated.

14. In a machine for forming control devices with punched representations of the desired control data in predetermined positional relationship on each control device, a plurality of punches for selective operation to form coded data on a control device, a movable carriage for positioning such control device with relation to said punches, actuating means for said punches including a cradle in which said punches removably are supported, stationary guide means for said cradle, a plurality of selector elements carried in said cradle and individually shiftable from normal inoperative positions to operative positions for rendering said actuating means operable selectively with relation to said punches, and stationary means carried by said guide means operable to limit upward movement of the punches to thereby insure clearance for said selector elements in the positioning movements thereof.

15. In a machine for forming control devices with punched representations of the desired control data in predetermined positional relationship on each control device, a plurality of punches for selective operation to form coded data on a control device, a movable carriage for positioning such control device with relation to said punches, actuating means for said punches including a cradle guided for vertical reciprocating movement and in which said punches removably are supported, a plurality of selector elements carried in said cradle and individually shiftable from normal inoperative positions to operative positions for rendering said actuating means operable selectively with relation to said punches, and adjustable stop means operable to limit upward movement of said punches to thereby insure proper clearance for movement of said selector elements to their operative positions.

16. In a machine for forming perforations in control devices and the like, an upstanding narrow standard having a horizontal clearance throat formed therein from one edge thereof, and having an upwardly facing die supporting shoulder formed on one side thereof beneath said throat, a punch actuating member mounted and guided on said one side of said standard above said throat for vertical reciprocation, a guide block and a die block detachably secured together to define a clearance throat therebetween and supported on said shoulder with the two clearance throats in substantial registry, means detachably holding said guide block and die block against the side of said standard and in position on said shoulder, a retractor plate, said retractor plate, said die block and said guide block having corresponding aligned sets of openings therein, a plurality of headed punches extended through the openings in said stripper plate and said guide block and having the heads thereof rested on said retractor plate, and means on said punch actuating member affording upwardly facing shoulders upon which portions of said retractor plate are rested for removal in a direction away from said standard.

17. In a machine for forming control devices with data representing perforations therein, a standard, a cradle mounted for vertical reciprocating movement on said standard, punching means including male punch elements carried in said cradle and a die block for said elements mounted on said standard, an operating shaft, and means connecting said shaft to said cradle actuatable to impart reciprocating motion to said cradle during an operating cycle of said machine, said means being adjustable to vary the normal position of the cradle relative to the die block.

18. In a machine for forming control devices with punched representations of desired control data in predetermined positional relationship on each control device, a standard, a reciprocable cradle, guide means on the standard for the cradle to guide the cradle for vertical reciprocating movement, a plurality of punches including male elements removably supported in said cradle for lateral removal therefrom and a die block detachably secured to said standard in position as to cooperate with the male elements to effect a perforating operation, a guide block through which said male elements extend and firmly secured on said die block, said die block and guide block being removable from the standard as a unit so as to enable the male elements to be withdrawn from the cradle.

19. In a machine of the character described for forming control devices, a plurality of punches, a carriage for supporting and automatically advancing such a device with relation to said punches, actuating means for said punches including selector bars for rendering said actuating means operable selectively with relation to said punches, manually operable keys selectively actuatable to render said selector bars effective, an escapement operable upon operation of the machine for controlling the advancing movement of the carriage, a tabulator key actuatable for ren-

dering said escapement ineffective during machine operation to enable said carriage to advance a distance exceeding that effected during normal operation of the escapement, and selectively settable stop means rendered effective when said tabulating key is actuated to limit the advance of said carriage.

20. In a machine for forming control devices, punching mechanisms including a plurality of punches, a carriage upon which a control device may be mounted for a punching operation, a plurality of manually actuable control keys each operable selectively upon said punches to form coded character representations on a control device corresponding to the actuated keys, means operable to impart character spacing movement to said carriage, a manually actuatable tabulator key operable to render the character spacing means ineffective so as to enable the carriage to advance freely a distance exceeding that effected during normal operation of said character spacing means, a stop pin mounted at a selected position of adjustment on and movable with said carriage, and means actuatable when the tabulator key is actuated for movement into the path of said stop pin to halt and limit free movement of the carriage.

21. In a machine for forming control devices, punching mechanisms including a plurality of punches, a carriage upon which a control device may be mounted for a punching operation, a plurality of means operable selectively upon said punches to form coded representations on a control device, means operable to impart character spacing movement to said punch carriage, a manually actuatable tabulator key operable to render the character spacing means ineffective so as to enable the carriage to advance freely a distance exceeding that effected during normal operation of said character spacing means, a stop pin mounted at a selected position of adjustment on and movable with said carriage, and means rendered effective when the tabulator key is actuated to be engaged by a stop pin to halt free movement of the carriage.

22. In a machine of the character described for forming control devices, a plurality of punches, a carriage for supporting and automatically advancing such a device with relation to said punches, actuating means for said punches including means for rendering said actuating means operable selectively with relation to said punches, an escapement for controlling the advancing movement of the carriage, selectively operable means for rendering said escapement ineffective during machine operation to enable said carriage to advance a distance exceeding that effected during normal operation of the escapement, a normally ineffective stop element, and a plurality of stop pins selectively positioned on said carriage, said stop element being rendered effective upon actuation of said selectively operable means so as to be engaged by said pins to limit the advance of said carriage when said selectively operable means is actuated.

23. A machine for forming control devices, said machine comprising punching mechanisms including a plurality of punches, a carriage upon which a control device may be mounted for a punching operation, a plurality of manually actuatable control keys each operable selectively upon said punches to form coded character representations on a control device corresponding to the actuated keys, means operable to impart character spacing movement to said carriage, a manually actuatable tabulator key operable to render the character spacing means ineffective so as to enable the carriage to advance freely a distance exceeding that effected during normal operation of said character spacing means, a plurality of stop pins mounted at a selected position of adjustment on and movable with said carriage, said carriage having mounting holes to receive said pins, the holes being arranged in two corresponding rows disposed one above the other and being spaced apart horizontally in distances equal to twice the spacing of the character spacing means, and a pair of stop members shiftable when the tabulator key is actuated for movement into the paths of stop pins in either row to halt free movement of the carriage at a proper character spacing position, said stop members having differentially located abutment surfaces so arranged that stop pins disposed one above the other will be engaged successively with said abutment surfaces to thereby stop the carriage in successive character spacing positions.

24. In a machine for forming control devices and the like, a plurality of punches, actuating means for said punches, key controlled punch selecting means including a plurality of selecting keys and operable to select one or more punches for operation in a cycle of the machine, means operable by any one of said keys when actuated to institute a cycle of operation of said actuating means, and means operable jointly by said actuating means and any one of said keys when actuated to disable said last mentioned means.

25. In a machine for forming control devices and the like, a plurality of punches, single-cycle actuating means for said punches, key controlled punch selecting means including a plurality of selecting keys and operable to select one or more punches for operation in a cycle of the machine, starting means for said actuating means operable by actuation of any one of said keys to initiate a single cycle operation of said actuating means, and disabling means rendered effective jointly by said actuating means and any one of said keys when actuated to disable said starting means and thereby prevent a second cycle of machine operation when a key is not released prior to completion of a machine cycle.

26. In a machine for forming control devices, a plurality of punches, actuating means for said punches including a shaft rotatable through one revolution during each punching cycle, punch selecting means for selectively rendering said actuating means operable upon said punches, said selecting means including a plurality of keys adapted to be depressed from a normal elevated position through a predetermined stroke, a normally disengaged one-revolution clutch effective when engaged to operatively connect the shaft with a power source, a solenoid effective when energized to permit engagement of said clutch, an energizing circuit for said solenoid including a normally open key-controlled switch and a normally closed safety switch, means operable when any of said keys are depressed effective to close the key-controlled switch to energize the solenoid and enable engagement of the clutch to rotate the shaft, means actuatable during the latter part of the rotating cycle of said shaft effective to momentarily open said safety switch, and means effective in the event that a key is in depressed position when said safety switch is opened to latch said safety switch in such open position to

prevent energization of said solenoid so long as such key remains in such depressed position.

27. In a machine for forming control devices, a plurality of punches, actuating means for said punches including a shaft rotatable through one revolution during each punching cycle, a normally disengaged one-revolution clutch effective when engaged to operatively connect the shaft with a power source, a solenoid effective when energized to permit engagement of said clutch, an energizing circuit for said solenoid including a normally open control switch and a normally closed safety switch, means actuatable to close the normally open switch to energize the solenoid and enable the engagement of the clutch to rotate the shaft, means actuatable during rotation of said shaft to momentarily open said safety switch, and means effective should the normally open control switch be retained closed at the end of a punching cycle to lock said safety switch in such open position.

28. In a machine for forming control devices, a plurality of punches, actuating means for said punches including a shaft rotatable through one revolution during each punching cycle, punch selecting means for selectively rendering said actuating means operable upon said punches, said selecting means including a plurality of manually actuatable keys, a normally disengaged one-revolution clutch effective when engaged to operatively connect the shaft with a power source, a solenoid effective when energized to permit engagement of said clutch, an energizing circuit for said solenoid including a normally open key-controlled switch and a normally closed safety switch, means operable when any of said keys is actuated to close the key controlled switch to energize the solenoid and enable engagement of the clutch to rotate the shaft, means operable during shaft rotation effective to momentarily open said safety switch, normally ineffective latching means for latching said safety switch in its open position, and means operated by any one of said keys when actuated to yieldingly urge said latching means toward an effective latching relationship with respect to said safety switch.

29. In a machine for forming control devices, a plurality of punches, actuating means for said punches including a shaft rotatable through one revolution during each punching cycle, a plurality of control keys adapted to be depressed from a normal elevated position through a predetermined stroke, a normally disengaged one-revolution clutch effective when engaged to operatively connect the shaft with a power source, a solenoid effective when energized to permit engagement of said clutch, an energizing circuit for said solenoid including a normally open key-controlled switch and a normally closed safety switch, means operable when any of said keys are depressed to close the key-controlled switch to energize the solenoid and enable engagement of the clutch to rotate the shaft, means actuatable during rotation of said shaft to momentarily open said safety switch, and means effective should a control key be held depressed at the completion of a punching cycle to lock said safety switch in such open position so that the clutch will remain disengaged upon completion of such operating cycle.

30. In a machine for forming control devices, a plurality of punches, actuating means for said punches including a shaft rotatable through one revolution during each punching cycle, a plurality of control keys, a normally disengaged one-revolution clutch effective when engaged to operatively connect the shaft with a power source, a solenoid effective when energized to permit engagement of said clutch, an energizing circuit for said solenoid including a normally open key-controlled switch and a normally closed safety switch, means operable when any of said keys are actuated to close the key-controlled switch to energize the solenoid and enable the engagement of the clutch to rotate the shaft, means actuatable during rotation of said shaft to momentarily open said safety switch, and means effective should a control key be held in switch closing position at the completion of a punching cycle to retain said safety switch in such open position so that the clutch will remain disengaged upon completion of such operating cycle, said retaining means being restorable automatically to its initial inffective position upon release of such key.

31. In a machine for forming control devices, a plurality of punches, actuating means for said punches including a rotatable shaft, punch selecting means for selectively rendering said actuating means operable upon said punches, a normally disengaged clutch effective when engaged to connect said shaft with a source of power so as to actuate such selected punches, a solenoid operatively connected with said clutch, an energizing circuit for said solenoid, a normally open control switch in said circuit, manual means operable to close said switch to energize the solenoid and engage the clutch, means operable during the operation of said shaft to return the punch selecting means to an ineffective position, a normally closed switch in said circuit, means associated with the means to render the punch selecting means ineffective operable to open said second switch, and means controlled by actuation of the control switch closing means to lock said second switch open should such manual means be in actuated position at the completion of one cycle of operation.

32. In a machine for forming control devices, means including a rotatable shaft to actuate said device, a normally disengaged clutch effective when engaged to connect said shaft with a source of power, a solenoid operatively connected with said clutch, a normally open energizing circuit for said solenoid, a manually depressible member actuatable to close a control switch in said circuit to energize the solenoid and permit the clutch to engage, a second normally closed switch in said circuit, means operable during shaft rotation to open said second switch, a lever operatively associated with the depressible member, and latch means actuatable by said lever and effective to retain said second switch open should the depressible member be held depressed at the conclusion of the operating cycle of said shaft.

33. In a machine for forming control devices, a plurality of punches, actuating means for said punches including a rotatable shaft, a normally disengaged one-revolution clutch effective when engaged to connect said shaft with a source of power, a solenoid operatively connected with said clutch, a normally open energizing circuit for said solenoid, manual means operable to close said circuit to energize the solenoid and engage the clutch, means operable during rotation of said shaft to open a switch in said circuit, and means operatively associated with the circuit closing means actuatable to retain said switch open to

prevent rotation of the shaft beyond one revolution.

34. In a machine for forming control devices, a plurality of punches, actuating means for said punches including a rotatable shaft, a normally disengaged one-revolution clutch effective when engaged to connect said shaft with a source of power, a solenoid operatively connected with said clutch, an energizing circuit for said solenoid including a normally open switch, manual means actuatable to close said switch to energize the solenoid and engage the clutch, means operable during rotation of said shaft to open momentarily a second switch in said circuit, and means operatively associated with said manual means actuatable to prevent closing of said second switch should the first named switch remain closed at the completion of one revolution of the clutch.

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