Dec. 9, 1941. M. MAUL 2,265,439

SORTING MACHINE FOR PERFORATED RECORDS

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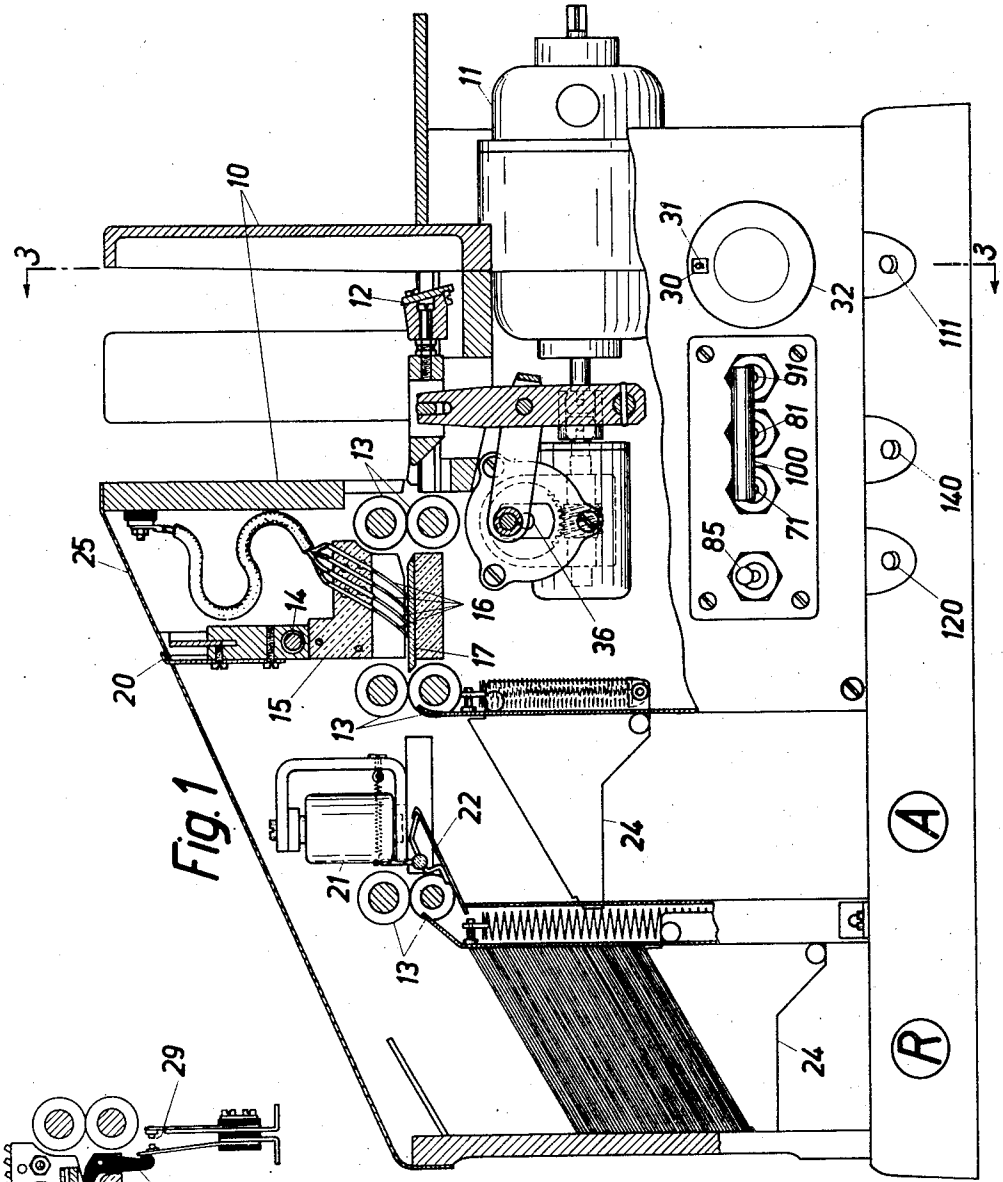


Fig. 1

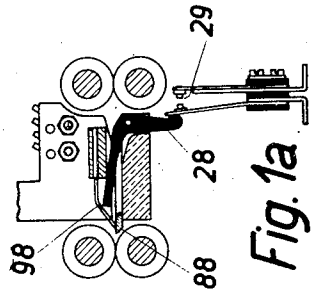


Fig. 1a

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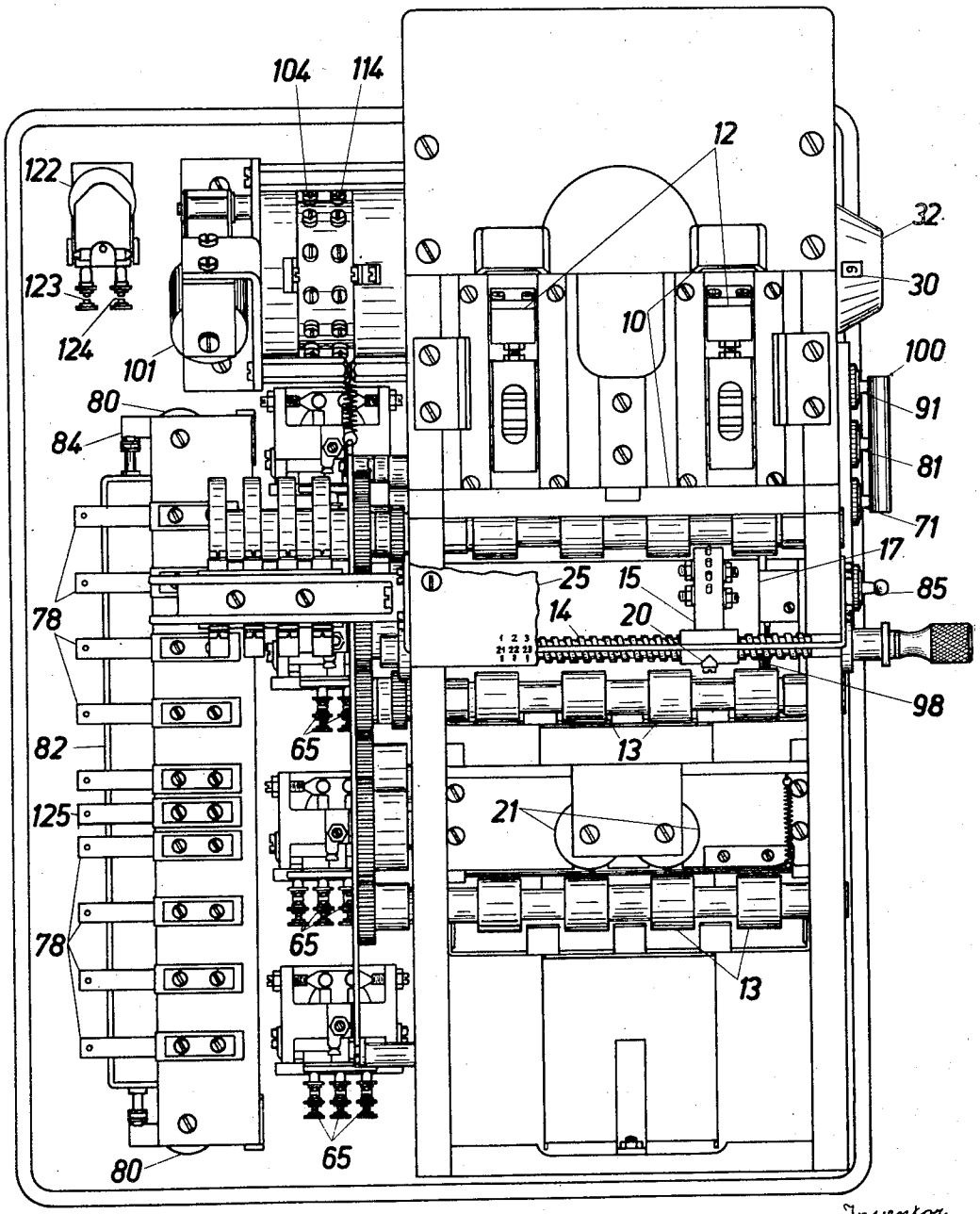
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SORTING MACHINE FOR PERFORATED RECORDS

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Fig. 2



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Fig. 3

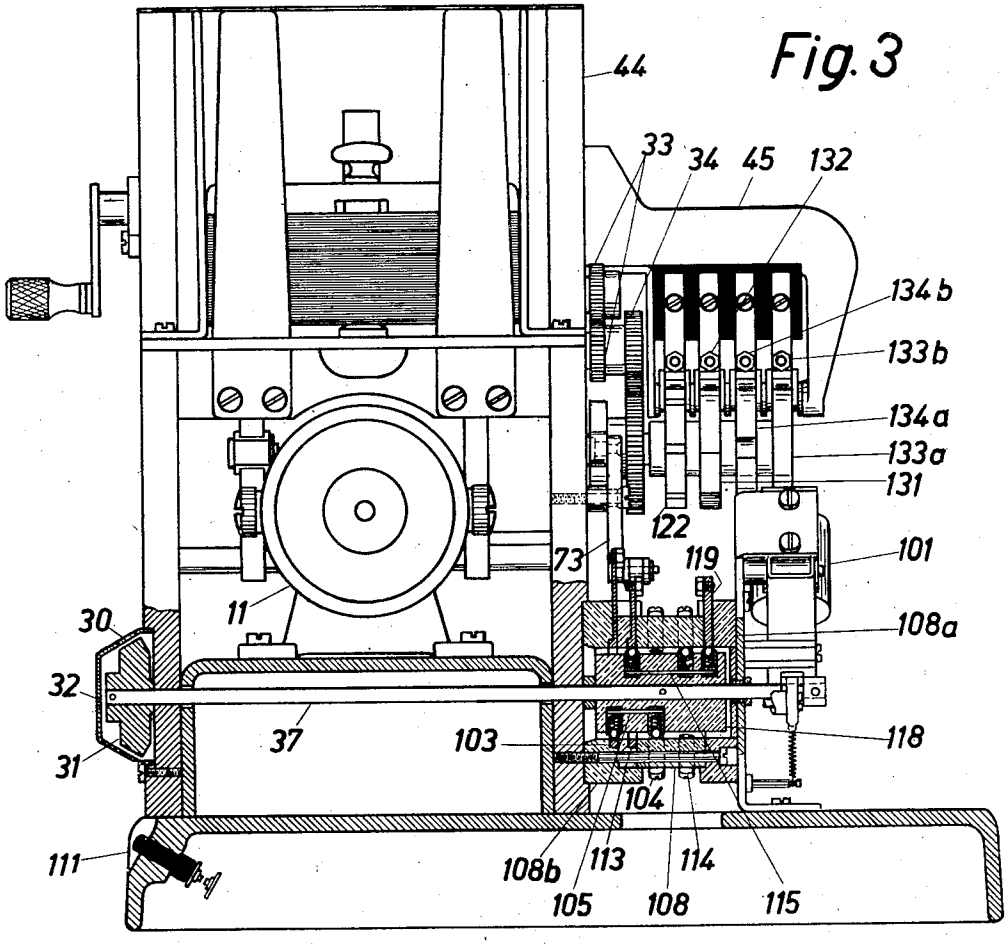


Fig. 8

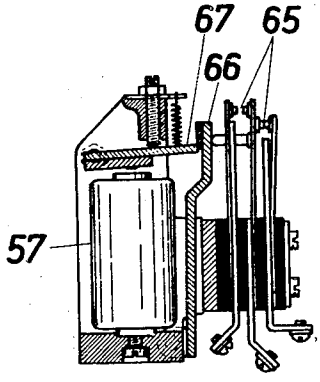
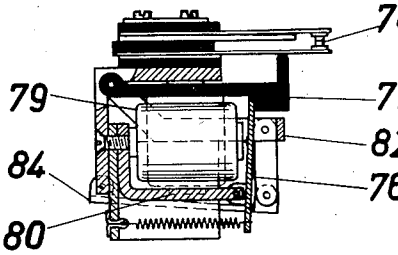


Fig. 9



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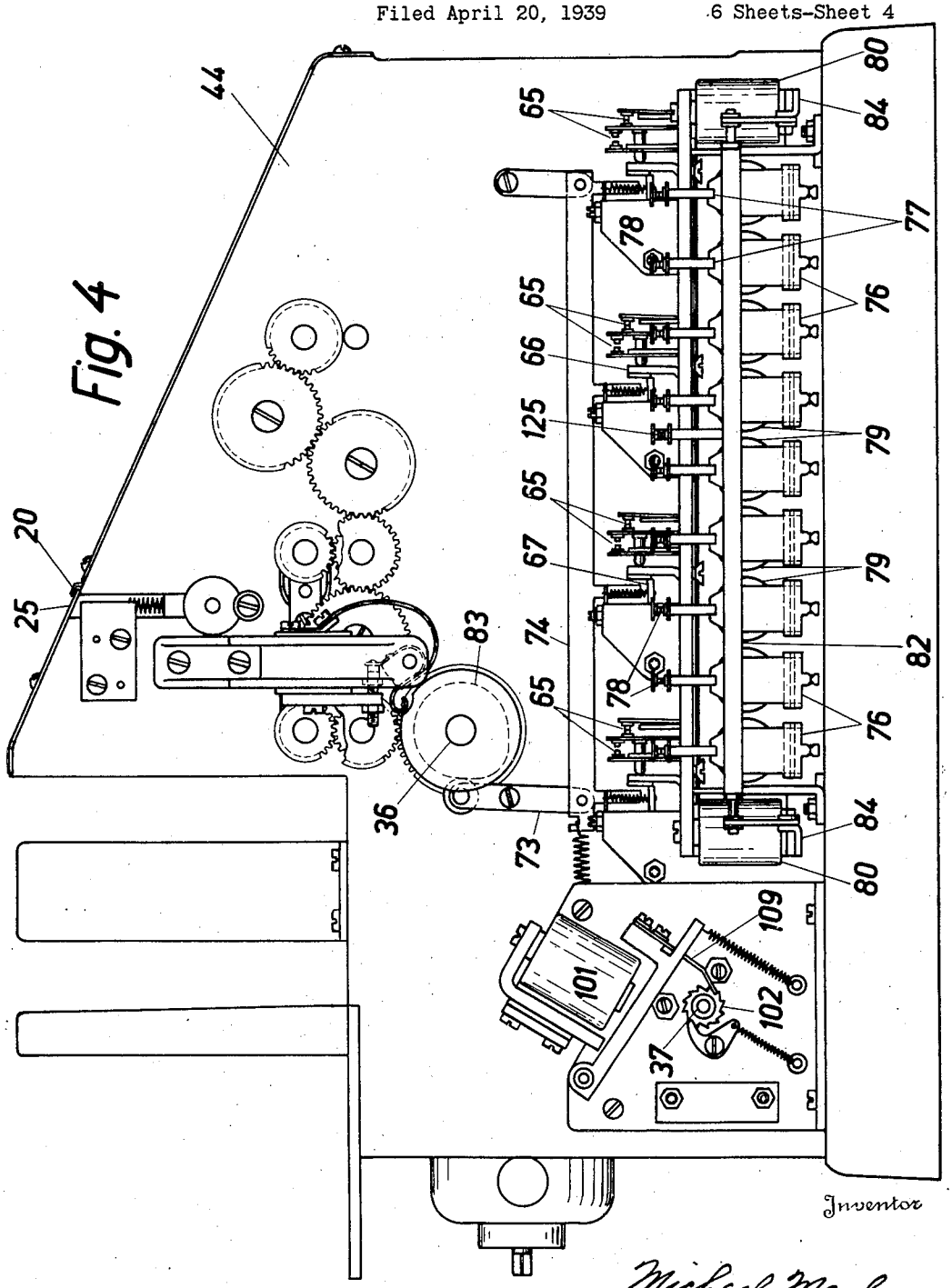
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Fig. 4



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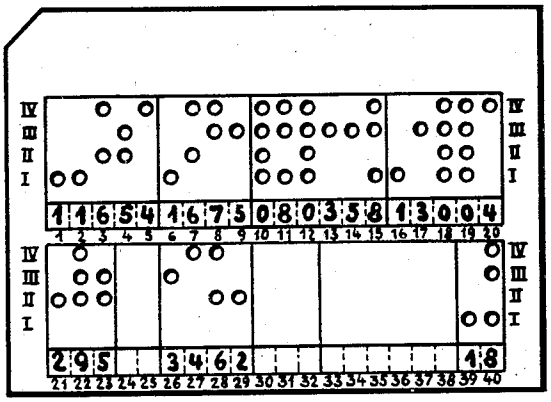


Fig. 5

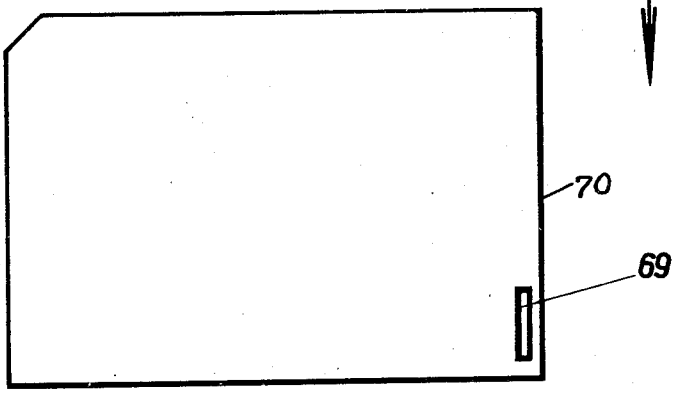


Fig. 6

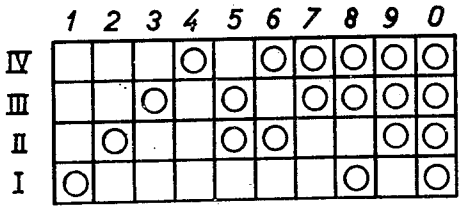


Fig. 7

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SORTING MACHINE FOR PERFORATED RECORDS

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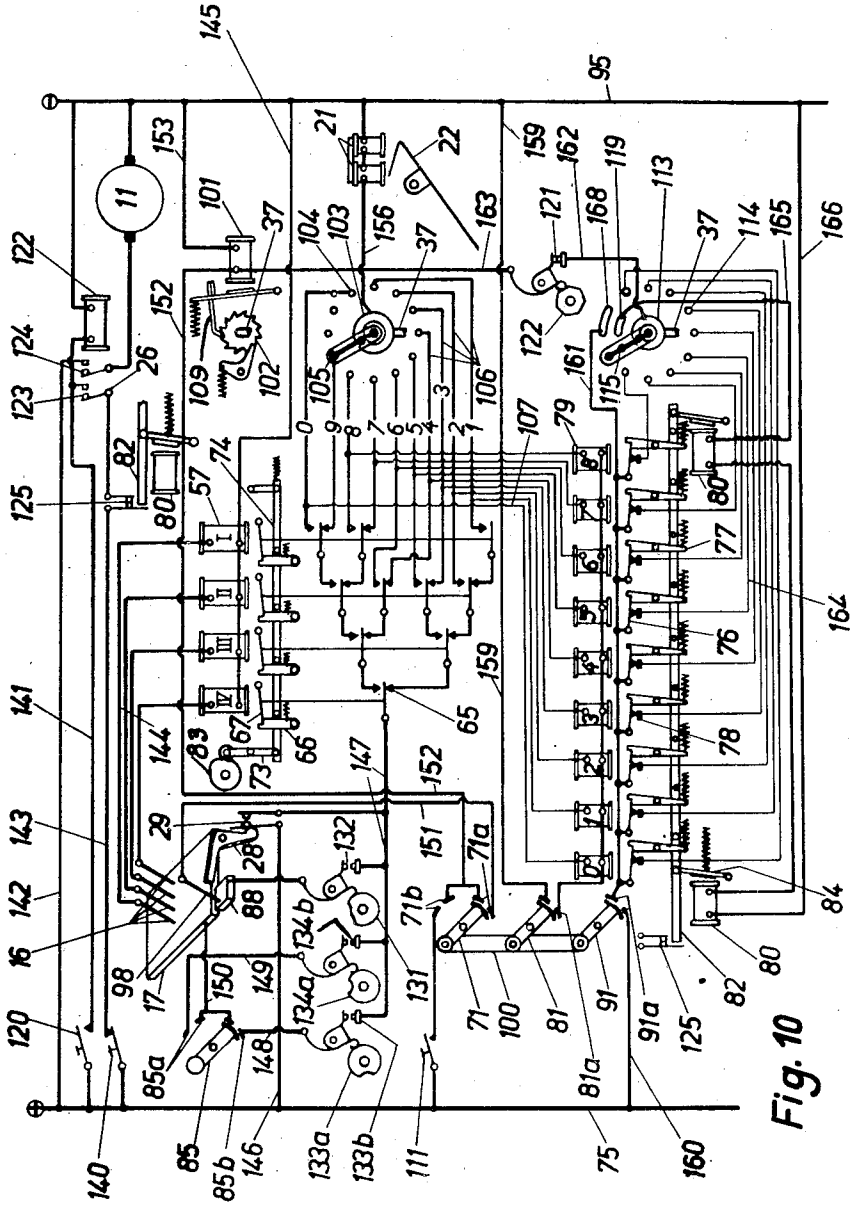


Fig. 10

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UNITED STATES PATENT OFFICE

2,265,439

SORTING MACHINE FOR PERFORATED RECORDS

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Application April 20, 1939, Serial No. 269,059
In Germany May 23, 1938

20 Claims. (Cl. 209—110)

The present invention relates to improvements for effecting the automatic sorting of record cards. Machines which have accomplished this purpose have, heretofore, been provided with an analyzing device for analyzing the designations represented upon the cards and as a result of such analysis the cards are sorted. Such machines, of a common and well known type, are provided with card receiving or sorting pockets which are commensurate in number with the representations on the card which are to control the sorting operations, and the analyzing device is adapted to control the sorting blades in such a manner that the cards will be directed to the sorting pockets in accordance with the representations on the card. If, in accordance with the customary arrangement, the cards contain the digital designations 0 to 9, the cards are automatically sorted into the ten sorting compartments in one sorting run, and the groups of records sorted are removed from the different pockets and are interposed one group above the other thus providing a stack of records which are arranged in digital sequence.

The representations which control sorting usually designate numerals but they may also represent letters or other characters. It is obvious that the representations must be made upon the records in a manner which is capable of being analyzed by the analyzing mechanism. The designations may be made on the cards by means of perforations therein but it is evident that such designations may also be made by graphical marks on the record cards in order that such designations may control the sorting instrumentalities of the machine. The perforations may be analyzed either mechanically or electrically but when graphical marks are utilized the analysis is usually effected photoelectrically.

Sorting machines which are capable of sorting in the previously described manner are capable of obtaining a high speed of operation but machines of this type are usually expensive in construction and operation since they require a number of sorting pockets which are commensurate in number to the designations which are to control sorting operations effected in one run. The use of such machines has, therefore, been limited in employment to large offices and industries which have a large output of punched records which are to be sorted and, therefore, can utilize the services rendered by the purchase or rental of such sorting machines.

According to the present invention the machine embodies a construction which will meet the demands and requirements of smaller businesses and mercantile establishments and such form of machine requires less space and is cheaper in construction and operation. While the output is relatively smaller than machines heretofore constructed, such output fits in very well with the requirements of certain types of business and permits a profitable application of the improved sorting machine for such types of business.

The main object of the present invention is to devise a sorting mechanism which is simpler in construction and operation than that devised heretofore and in one embodiment comprises a plurality of sorting pockets, into one of which records related to a selected sorting control designation are sorted and the remaining records are deposited into a "reject" pocket.

More specifically, it is an object of the present invention to provide a sorting mechanism with two card receiving pockets and a single sorting blade which is positioned in accordance with a single selected designation so as to sort related cards into one of said pockets and to deposit the remaining cards by said sorting blade into the other of said pockets.

A still further object of the present invention is to provide an automatically operated sorting designation selector which upon the termination of sorting operations for one run of the cards causes by means of a specially constructed card, the automatic adjustment of the machine so that cards pertaining to the next selected designation are sorted out during the next sorting run.

A still further object of the invention is to provide a manual means whereby the designations which are to control the sorting operations may be manually selected in the absence of the utilization of the automatic sorting designation selector just described.

A still further object, in connection with the automatic and manual sorting designation selector, is to provide an interlock which prevents the operation of, for example, the manual selector when the automatic selector is to be used thereby preventing possible misoperations of the machine.

A still further object of the invention, and a relatively important one, is the provision of means to eliminate unnecessary sorting runs for cards bearing designations which are not to be sorted out and which are to be deposited in the "reject" pocket.

The above described means is preferably electrical in nature and is used in conjunction with

the automatic sorting designation selector so that a preliminary set-up of the sorting designations of records in the stack is to be made thereby controlling the operation of the automatic designation selector so that the latter will cause the machine to be adjusted in such a manner that sorting runs for the desired designations will be effected and sorting runs for designations which are not represented by records in the stack will be omitted.

In order to understand how the machine is capable of carrying out the preceding objects, a brief description will be given of the operation of the improved sorting machine.

In order to sort cards in a sequence corresponding to the designations represented on the cards the machine carries out the sorting operations for a stack by a plurality of runs and in each sorting run cards representing a selected designation are sorted out and the remaining cards are deposited in a "reject" pocket. The remaining cards are then removed from the "reject" pocket and are again passed through the sorting machine, and in the next sorting run cards having designations corresponding to the next selected designation are sorted out and the remaining cards are deposited in the "reject" pocket. In this manner the sorted cards drop in the same pocket and are stacked one group above another in a sequence which corresponds to the sequence the sorting designations are selected.

For carrying out the above operation the machine is provided with only two card pockets and a single sorting blade and the number of sorting runs required to sort the records is commensurate with the number of designations which are to control the sorting operations.

In the above described sorting operations for sorting in accordance with the digital numerals 9 to 0 inclusive, the first sorting run effects the sorting of cards which are perforated to represent "9"; in the second run the cards perforated to represent "8" are sorted; in the third run the cards bearing the "7" representing perforations, etc., until the tenth sorting run in which the cards bearing the "0" perforation will be sorted out.

The cards which are deposited in the "reject" pocket in the tenth sorting run comprise cards which are unperforated in the column which controls the sorting operations. Obviously, by retaining the cards which are sorted out in the same sorting pocket the cards will be arranged in groups in a digital sequence, with the group of cards representing "0" at the top, and the group of cards representing "9" at the bottom.

For selecting the designations which are to control sorting operation, an automatic sorting designation selector is provided and such selector is shiftable step by step, either by manually operated means or by automatically operated means. For effecting its automatic operation a special card is placed in the stack of cards in the magazine and is so positioned as to be the last card which passes through the machine for each sorting run and this special card is provided with a special control perforation. When this special card passes through it will cause the automatic adjustment of the sorting designation selector so that sorting operations may be effected under control of the next selected designation.

When the last-named expedient is utilized successive sorting runs may be effected in automatic sequence by having the operator immediately remove the cards out of the "reject" pocket during each sorting run and place them in the magazine adjacent the unsorted cards, which are already in the magazine, and such unsorted cards are to be separated from the cards removed from the "reject" pocket by means of the special card hereinbefore described.

By a repetition of such operations the sorting runs may be effected in automatic sequence and by a continuous operation of the machine.

At other times it may be desirable to select the sorting control designations manually, and to this end a special key is provided and the machine includes a switch which locks out the special key when the automatic selection of sorting control designations is to be effected, and reversely, when manual selection of sorting control designations is to be effected, their automatic selection is rendered ineffective.

In order to eliminate unnecessary sorting runs for designations which are not to control sorting operations, the machine preferably includes a device which is electrical in nature and which is set up in accordance with designations which are to control sorting operations and which are not to control sorting operations, and such device controls the automatic sorting designation selector so that certain positions of the sorting designation selector, corresponding to the designations which are not to control sorting operations, are skipped.

This device preferably comprises a number of digit representing electrical relays the contacts of which are normally closed and which are opened during the first sorting run by correspondingly designated cards and are retained open for subsequent sorting runs. The normal adjustment of such relay contacts in closed position causes the omission of sorting operations for designations corresponding to the closed contacts whereby sorting runs for such designations will be omitted.

While the present improvements have been illustrated in connection with a card which is punched according to the combinational hole system, and which is translated to a single reading to control sorting operations, it is understood that such disclosure is merely illustrative and not restrictive. Furthermore, it is obvious that while the improved sorting machine is illustrated as capable of sorting perforated cards, with slight modification sorting may be effected for like devices in which the sorting designations are represented by graphical marks, and the like.

One embodiment of the invention, which is preferably electrical in form, is shown in the accompanying drawings in which:

Fig. 1 is a view in side elevation of the improved sorting machine showing the upper part broken away to more clearly illustrate certain parts thereof.

Fig. 1*a* is a detail view showing the construction of a card lever incorporated in the present machine and also showing the analyzing element coordinated with the perforation of the special card.

Fig. 2 is a plan view of the machine and shows the general arrangement of the machine with the card feeding mechanism provided at the right end of the machine and at the left end thereof the electrical instrumentalities for control purposes.

Fig. 3 is a sectional view of one end of the machine and is taken on the line 3—3 of Fig. 1.

Fig. 4 is a side elevation of the machine taken

at the side of the machine opposite to that disclosed in Fig. 1.

Fig. 5 is an illustration of a preferred form of perforated record card which is to be sorted by the present machine.

Fig. 6 is an illustration of one form of the special control card for effecting the automatic selection of the next sorting designation.

Fig. 7 is an illustration showing the code of the combinationally arranged perforations representing the digits.

Fig. 8 is a sectional view of one of the relays forming part of the translator.

Fig. 9 is a detail view showing one of the relays which is set up to represent the designations which are to control sorting operations.

Fig. 10 is a wiring diagram of the machine.

Form of tabulating and control cards

The cards which are to be sorted are preferably of the form shown in Fig. 5 and comprises two superimposed card fields each of which contains twenty card columns. Thus, the capacity for character representation, in the card shown, is forty digits or letters, and this is usually sufficient for small businesses. Below the perforations of each card field, there is a horizontal column provided for receiving printed or written characters representing the interpretation of the perforations. The code for the perforations is shown in Fig. 7. The cards are fed into the machine in the direction of the arrow, shown near Fig. 5. The cards are so placed in the magazine that the printed part of the card comprises the upper surface. With the direction of the card feed shown by the arrow near Fig. 5 the lower edge of the card is the leading edge.

Figure 6 represents a preferred form of a special card **70**, or other element, which provides for the automatic selection of the next sorting designation. This card may be of somewhat more rigid and unyielding material than the perforated record cards in view of the repeated use thereof. The control card **70** is provided with a rectangular perforation **69** through which the correlated analyzing device shown in Fig. 1*a* may pass and which effects the selection of the successive sorting control designation.

It is understood that the size, form of the cards, the form of the perforation for the special card may be varied without departing from the spirit of the invention and the form and construction shown herein is merely illustrative.

Card feeding mechanism

As is best shown in Fig. 1, the machine is provided with only two sorting pockets, one of which is a "reject" pocket, designated in Fig. 1 by the letter R, and the other pocket, designated by the letter A, is the assorting pocket in which the selected or sorted out cards are deposited.

The card feeding mechanism and other parts of the machine is operated by a motor **11** (Fig. 1) which through a speed reduction mechanism drives a shaft **36** and by means of a crank connection to the shaft **36** the usual picker **12** is reciprocated for each operation of the machine. The picker feeds the cards inserted in the magazine **10**, one by one, to the feed rollers **13**. To the shaft **36** there is secured a gear which meshes with a pinion **34** (see Fig. 3) and said pinion is secured to the lower feed roll shaft of the first set of feeding rollers **13** which are immediately adjacent the supply magazine **10** (see Fig. 1). Such feed rollers are intergeared by pinions **33** secured to the feed roller shafts. The machine is also provided with two other sets of feeding rollers **13**, best shown in Fig. 1, one set adjacent the pocket A, and the other adjacent the pocket designated R. By any suitable gearing mechanism, these feeding rollers may also be driven from and by the shaft **36**.

Analyzing means

The analyzing means for the cards to be sorted comprises four flexible electrical analyzing brushes **16** (Fig. 1) which establish electrical connections through the card holes at the respective analyzing positions to a contact plate **17**. The analyzing brushes **16** are carried by a brush holder **15** (Figs. 1 and 2) which has a worm connection with a worm screw **14** and to which a crank arm is mounted so that by the rotation of the crank arm, the brush holder **15** can be shifted transversely of the card and thus be coordinated with a selected column of either card field. The electrical analyzing brushes have flexible wire connections thereto, best shown in Fig. 1, and said wire connections are secured to binding posts of a common and well known construction.

The brush holder **15** is provided with an indicator **20** (Fig. 2) which passes through a slot in the machine cover, as best shown in Fig. 1, and moves over a scale on the machine cover. The scale is marked with columns 1 to 20 and also columns 21 to 40.

The selection of the card field which is to control sorting is effected by means of a manually positioned switch **85** (Fig. 1) and by means, to be later described, when the switch is in its upper position, the brushes **16** will be coordinated with the upper card field and when moved to the lower position they will be coordinated with the lower card field.

In the front cover of the machine, there is provided a cover **32** (Fig. 3) provided with a window **30** through which numerals or characters on a dial **31** are visible. The numeral which is visible through the window corresponds to the character which is to control sorting operations and, as has been previously described, the selection may be effected manually, or automatically under control of the card **70** shown in Fig. 6.

Sorting devices

If the card which passes through the machine has a representation corresponding to the designation which is to control sorting, by means to be subsequently described, a sorting magnet **21** (Fig. 1) will be energized and will rock its armature **22** upwardly or counterclockwise and said armature is constructed as a sorting blade so that upon the upward movement of the armature, this card will be obstructed by the highest end of the blade to be guided into the A pocket and drop upon a movable card bottom **24** of said pocket. If the card does not contain the selected sorting designation there will be no energization of the magnet **21** and the card will be passed uninterruptedly by the set of feeding rollers **13** shown at the extreme left in Fig. 1 and be deposited in the reject or R pocket.

Translator

The translating mechanism provided herein is of the type which is well known in the art and fully shown and described in the patent to M. Maul, No. 2,025,602, dated December 24, 1935.

In general, the translating mechanism is controlled by the analyzing means and effects a set up of the combinational hole representation which is translated into a single controlling electrical impulse.

Each analyzing brush 16, as best shown in Fig. 10, is connected by a wire 144 to a respective translator magnet 57, each of which controls a different number of electrical contacts 65. As best shown in Fig. 8 when a translator magnet 57 is energized, the respective armature 67 will be attracted and moved downwardly so that a plate 66 will be unlatched to be moved to the left by the resilient middle contact plate so that the right hand contacts 65 will be open, and the left hand contacts 65 will be closed. The arrangement of the contacts 65 and their related wiring connections is shown in Fig. 10, while Figs. 2 and 4 show the arrangement of the contacts and their location in the machine. By closing different contacts 65 and opening other contacts, one of a series of ten digit lines 106, marked 1 to 9 and 0 in Fig. 10, will be selected.

After the passage of each card to be sorted, the operative parts of the translator are restored to normal position. The restoring of the plates 66 of the translator magnets is effected by means of a common restoring rod 74 (Figs. 4 and 10) which is actuated by a lever 73, the position of which is controlled by means of a cam 83 secured to the operating shaft 36 so that by the synchronous rotation of the cam 83 with respect to the passage of the cards through the machine, the operative parts of the translator will be restored to normal after each card is analyzed.

Sorting designation selector

As previously described, the translator is adapted to translate the combinational designations into a single reading. The function of the sorting designation selector is to successively select the digit lines 106 (Fig. 10) so that at a set position of said selector, electrical impulses corresponding to the selected digit line will effect the energization of the sorting magnet 21 at a differential time. Such impulses will, of course, be created under control of the perforated records bearing a designation corresponding to the selected digit line.

The sorting designation selector comprises, as diagrammatically shown in Fig. 10, a contact member designated generally by the reference numeral 105 which may occupy successive positions so that by said contact member 105 successive contact may be made with contact points 104 to which are connected the digit lines 106.

The step by step positioning of the sorting designation selector member 105 is effected by means of a pawl 109 (Figs. 4 and 10) which is actuated by the armature of a magnet 101 and which pawl cooperates with a ratchet wheel 102 secured to the shaft 37.

The structure of the sorting designation selector is diagrammatically shown in Fig. 10, but the details of the construction thereof are shown in Figs. 2 and 3. Referring to Fig. 3, it will be seen that surrounding a cylinder 118 of insulating material which is fastened to shaft 37, is a commutator body 108 which carries the contact points 104. The commutator body 108 is carried by two cylinders 108*a* and 108*b* also of insulating material. Embedded in the cylinder 108*b* is a contact ring 103 which forms a current supplying connection for the contact member 105 by means of a spring-pressed contact ball embedded in and carried by the cylinder 118. Also contacting with the member 105 is another spring-pressed contact ball embedded in the cylinder 118 and which makes contact with the contact points 104.

The step by step positioning of the shaft 37 and therefore, the sorting designation selector is effected, as previously described by means of the magnet 101 to which successive electrical impulses are described. To the shaft 37, as previously described, there is secured the number indicating wheel 31 which indicates the successive positions of the sorting designation selector.

Relay set-up means representing designations on records controlling sorting operations

If in the passage of a stack of cards which are to be sorted, and which cards consist of promiscuously arranged cards which are to be sorted, certain digit representaitons do not occur, it is preferable to eliminate the adjustment of the sorting designation selector for such designations and thus eliminate corresponding sorting runs. In order to eliminate sorting runs for such designations the machine is provided with a device which in the first passage of all of the cards comprising the stack through the machine, a set-up will be made to represent those designations which appear on the cards, and therefore, of course, also indirectly represent the designations which do not appear in cards in the stack. This device is so constructed that the indirect set up, which corresponds to designations which do not appear in cards in the stack, will cause the sorting designation selector to be adjusted so that it will immediately effect the next sorting of cards corresponding to the next digit representation, and which is represented by cards in the stack.

This device comprises, as shown in Fig. 10, a plurality of relays there being one relay for each of the digits 8 to 0 inclusive, but no relay is provided for the digit "9" since the normal condition of the machine requires a sorting run for the digit "9." The magnet 79 of each relay is adapted to control the position of its respective contacts 78 and from the details of construction disclosed in Fig. 9, it will be seen that the contacts 78 for each relay are normally closed. The armature 76 of the magnet of the relay normally engages a shoulder of a plate 77 of insulating material and such plate coacts with the contact 78 so as to retain said contacts in closed position.

In Fig. 10, it will be seen that by means of wire connections 107 the digit lines 106 are connected to the magnets 79 of the relays so that during the passage of the stack of cards through the machine for the first sorting run, or for "9," certain of the magnets 79 of these relays will be energized and those magnets which are energized will correspond to the digit representations on the cards which are passed through the machine. Upon the energization of a magnet 79 it will be noted that the respective contacts 78 will be opened and these contacts will remain opened for the several sorting runs necessary for sorting in accordance with the designations appearing on cards.

When the sorting runs are being effected for all of the digits the member 105 has caused a contact to be made with each of the contact points 106 successively and after the sorting run for the last digit, or "1" an electrical contact will be made by means to be subsequently de-

scribed to effect the energization of a pair of restoring magnets 80. As best shown in Figs. 9 and 10 the energization of the magnets 80 will elevate their respective armatures 84 and rock a yoke 82 so as to rock the series of members 77 to permit the armatures 76 of the relays to latch under the members 77 and retain the contact 78 in closed position. This is the normal condition of the machine so that upon the passage of a subsequent stack of cards the relays will again be set up in accordance with the designations appearing in the next stack of cards which are to be sorted.

As will be further described in detail the contacts 78 which remain closed and which, of course, correspond to designations which do not appear on cards in the stack, will cause an adjustment of the sorting designation control selector to omit sorting runs for such designations. To this end the contacts 78 have wire connections to a series of contact points 114 and coordinated with such contact points 114 is a contact member which is positioned step by step.

Figure 3 discloses the details of construction of such switch and it will be noted that a contact member 115 is carried by the rotatable cylinder 118 and making contact with the contact member 115 are three spring-pressed contact balls. The one at the left makes continuous contact with a current supply contact ring 113 while the one at the extreme right makes contact with a contact element 119 (see also Fig. 10). The intermediate spring-pressed ball makes successive contact with the contact points 114 as the selector 118 is given a step by step movement.

Manner of operation of the machine

After or before a stack of cards has been placed in the supply hopper 10, there will be certain preliminary adjustments of the machine so as to select the card field which is to control sorting operations and also to select the particular card column of the selected card field. The selection of the card column is effected by the rotation of a crank handle shown at the left in Fig. 3 which positions the brush holder 15 (Fig. 1) so as to coordinate the analyzing brushes 16 with a selected card column. The selection of the card field is effected by the appropriate adjustment of the switch 85 (Fig. 10) which selects a card field in a manner which is presently to be described.

The preferred, and more desirable operation of the machine, is the type of operation in which there is an automatic successive selection of the digits which are to control sorting operations. For this type of operation of the machine, three switches 71, 81, 91 (Figs. 2 and 10) are concurrently adjusted to the position shown in Fig. 10. Since these three switches must be concurrently positioned the operating levers thereof are joined together by a sleeve 100, shown in Figs. 2 and 10.

The initiation of the operation of the machine is effected when the desired preliminary adjustments have been made by the depression of a start key 120 which closes a circuit from the positive line side 75 through contacts closed thereby, a wire 141, to a holding relay magnet 122, thence to the negative line side 95 causing the energization of the motor relay magnet 122 and the closure of its related contacts 123 and 124. Contacts 123 are holding contacts for the magnet 122 and provide a holding circuit for said magnet through the contacts 123, through contacts 125 normally closed, and through the "stop" contacts 140. This holding circuit remains closed until either contacts 125 or contacts 140 are opened. The closure of the relay contacts 124 closes a circuit to the operating motor 11 and such motor will be in continuous operation until the aforementioned holding circuit is opened.

Current to the analyzing brushes 16 is transmitted by either of two circuits, depending upon which card field is to control sorting operations, such card fields being selected, as previously described, by the switch 85. With the switch 85 in the position shown in Fig. 10 current will be transmitted to the brushes 16 by the following described circuit: from the positive line side 75, a wire 146, through card lever contacts 29 closed by a card lever 28 (see also Fig. 1*a*) which are closed as long as cards are fed, thence from the contacts 29 by a wire 147 to contacts 133*b*, wire 148, switch contacts 85*b* now closed, wire 150 to the contact plate 17. Contacts 133*b* are closed by a cam 133*a* at a time when the perforations of the lower card field are beneath the brushes 16 thereby closing the circuit at such time to the contact plate 17. However, if the switch 85 is positioned so as to shortcircuit switch contacts 85*a*, the circuit will be closed through cam contacts 134*b*, wire 149, switch contacts 85*a* now shortcircuited, to the contact plate 17. The cam contacts 134*b* are closed by a cam 134*a* at a time when the perforations of the upper card field are beneath the brushes 16.

In accordance with the perforations present in the selected card field, certain of the translator magnets 57 will be energized and contacts 65 will be opened or closed accordingly and thereby in accordance with the combinational arrangement of perforations select a particular digit line 106. Assuming that the machine is normally conditioned to effect sorting of records bearing the designation "9," it will be seen that from the card lever contacts 29, there is a branch wire connection 147 which passes through certain of the closed contacts 65 to a particular digit line 106. If a card passes through which represents the digit "9," the "9" digit line 106 will be closed to the related contact point 104. By reference to Fig. 3, it will be seen that the circuit then extends from this contact point 104 to the spring pressed ball contact coordinated therewith, as shown in Fig. 3, through the contactor member 105, to the spring pressed contact ball at the left as shown in Fig. 3, to the current supply ring 103, and thence to the sorting magnet 21, to the negative line side 95. Hence, the sorting magnet 21 will be energized upon the passage of all cards bearing the representation "9" and such cards will be disposed in the sorting pocket A (Fig. 1). The remaining cards will, of course, pass to the "reject" pocket "R."

From the digit lines 106, there are wire connections 107 which lead to the magnets 79 of the digit representing relays thereby energizing during the passage of all of the cards in the stack placed in the supply magazine and in the first sorting run certain of the magnets 79, and such magnets will correspond to cards which bear digit representations in the column which is to be control sorting operations. It will be noted from Fig. 10 that there is a wire connection which commonly connects all of the magnets 79 and which leads to switch contacts 81*a* which are closed in the position of the switch 81 shown in Fig. 2, and thence by wire 159 the circuit is completed to the negative line side 95.

It is understood, of course, that the magnets

79 of the relays are retained energized during the passage of the cards for the first sorting run and all succeeding sorting runs.

The contacts 65 of the translator, are, however, restored to normal after the passage of each card by means of the bar 74. The contacts 78 which are opened remain opened, however, since they are only restored to normal closed position by means of the bar 82 which is operated only when sorting operations have been effected for all digit representations in a selected card column.

The successive positioning of the sorting designation selector is effected under control of the control card 70 shown in Fig. 6, as previously described. For analyzing the perforation 69 in the card shown in Fig. 6 there is provided an analyzing device 98 (see Fig. 1*a*) which passes through the perforation 69 and makes contact with a contact member 88. As previously indicated, the control card 70 is the last card in the card stack and the last card for each sorting run, and when this card reaches the analyzing brush 98 it will make engagement through the perforation 69 with the contact member 88 and effect the closure of a circuit described as follows: from the positive line side 75, wire 146, card lever contacts 29, cam contacts 132, contact member 88, brush 98, switch contacts 71*a* which are now closed, a wire 152, the magnet 101 and wire 153 to the negative line side 95. A cam 131 is driven by a suitable shaft of the machine so as to close contacts 132 at the time perforation 69 is disposed beneath the analyzing brush 98. From a comparison of the cards shown in Figs. 5 and 6 it will be seen that the cards to be sorted (Fig. 5) will have no effect upon the closure of the circuit just described since such cards are not provided with any perforation in alignment with the perforation 69 of the control card 70.

The energization of the magnet 101 will attract its armature thereby positioning pawl 109 so as to engage a successive tooth of the ratchet wheel 102. When the circuit to magnet 101 is broken by the opening of contacts 132, the pawl 109 will be retracted by a spring so as to turn the ratchet wheel 102 and the shaft 37 a single step. Since it is assumed that the machine is normally conditioned for sorting of cards having the "9" digit representations the automatic sorting designation selector will now be positioned so that the "8" digit line 106 will be selected for sorting of cards containing this digit representation. The cards which have been taken out of the reject pocket "R" (Fig. 1) are again placed in the magazine and these cards are again passed through the machine so as to sort out the cards having the "8" digit representation. The control card 70 is, of course, again placed in the magazine so as to be the last card in the stack of cards which have been taken from the reject pocket and placed in the magazine and upon the next passage of the control card through the machine the automatic sorting designation selector is given a step of movement so as to select the "7" digit line 106 and cause cards bearing this digit representation to be sorted out.

In the above described manner, sorting operations are repeated until the automatic sorting designation selector again reaches the "9" position.

At this time, as will be subsequently described, the rod 82 (Fig. 10) is operated so as to open the contacts 125 thereby opening the holding circuit of the motor 11 causing the motor 11 to stop in its operation.

The above described operation was based upon the assumption that the stack of cards placed in the magazine contained all of the digit representations or that it was immaterial whether sorting runs for cards which did not contain some of the digit representations in the series were not located in the stack so that for such cards sorting runs need not be eliminated. A description of the operation of the machine wherein sorting runs for certain digits are eliminated will now be described.

In the event that certain of the digit representations on the cards of the stack which are to be sorted are not present, the sorting designation selector is operated under control of the relay set-up means, which represents designations of the cards present in the stack, so that sorting runs pertaining to digit representations which are not present in the cards are eliminated. It will be recalled that certain of the magnets 79 of the digit set-up means are energized and such magnets represent digit representations of the cards which are to be sorted. The absence of the other digit representations of the series of digits will be indicated by the closure of contacts 78 which is the condition when the related magnets 79 are not energized.

It will also be understood from the preceding description that since the members 105 and 115 (Fig. 10) are carried by the cylinder 118 (Fig. 3) the switching mechanisms controlled thereby will be concurrently positioned. It will also be recalled that after a sorting run for each of said digit representations the cylinder 118 is given a step of movement and in the event that there are no records present in the stack for the successive digit representation a circuit will be closed which will now be described.

In this case one or more of the contacts 78 of the relay set-up means will remain in closed position thereby closing a circuit from the positive line side 75, a wire 160, through switch contacts 91*a*, now closed, one of the contacts 78 related to the magnet 79 of the relay pertaining to the successive digit representation, and through said closed contacts to a respective line 164, to a related contact point 114 (see Fig. 3), the intermediate spring pressed contact ball, the contact member 115, the left hand spring pressed contact ball, current supply ring 113, cam operated contacts 121 (Fig. 10), wire 163 to the stepping magnet 101, and wire 153 to the negative line side 95. By the circuit just described an electrical impulse is transmitted to the magnet 101 and through pawl 109 in cooperation with ratchet wheel 102, shaft 37 will be turned a single step, after which the cam operated contacts 121 open thereby deenergizing the magnet 101 and permitting the retraction of the pawl 109. It should be noted from Fig. 10 that contacts 121 are opened and closed by means of a cam 122 (see Fig. 3) rotated by a continuously rotating shaft so as to effect successive opening and closing of the contacts 121.

In the event that the next selected digit line 106 corresponds to a card bearing a similar designation which is absent from the stack to be sorted, the above described operation will be repeated so that for each ineffective position of the sorting designation selector a sorting run will be omitted for a corresponding designation.

The closure of those contacts 78 which have been opened by the energization of certain of

the respective magnets 79, is effected when sorting operations have been completed for all of the different digit representing cards appearing in the stack or, in other words, when all of the digits of a selected card column have controlled sorting operations. At this time contact member 115 passes from the last or "0" position on the related contact point 114 to the position shown in Fig. 10 and this passage will take place in three steps of operation. During the first step of such movement there will be an electrical connection across the contact members 168 and 119 (Fig. 10) thus closing a circuit which extends from the positive line side 75, wire 160, switch points 91a now closed, wire 161, contact member 168 which is engaged by the intermediate contact ball (Fig. 3) engaging contact member 115, contact member 115, the right contact ball engaging contact member 115, contact member 110, wire 165 (Fig. 10), through both of the restoring magnets 80, line 166 to the negative line side 95 thereby, by means previously described, effect the restoration of the contacts 78 which have previously been opened.

It will be noted that member 82 (see top of Fig. 10) will be operated so as to cause the opening of contacts 125 thus stopping motor 11.

A branch circuit leads from the contact member 115 as just described to contact ring 113 through the left spring pressed contact ball, to wire 162, cam contacts 121, magnet 101, wire 153 to the negative line side 95. While the circuit of the motor has been opened cam contacts 121 are capable of transmitting sufficient electrical impulses to the stepping magnet 101 so as to position the cylinder 118 and the switching mechanisms to their normal position, as shown in Fig. 10.

For certain types of machine operations it may be desirable to manually adjust the sorting designation selector in order to adjust the machine for the sorting of records bearing a certain designation. For this type of machine operation, the switching members 71, 81, 91 (Fig. 10) are moved from the position shown so that the switch contacts 71a, 81a and 91a are open and contacts 71b are closed. This will disconnect the circuits and electrical instrumentalities for the automatic sorting designation selector and also for the digit sorting designation setup means.

For the desired adjustment, a key 111 (Fig. 10) is successively depressed so that for each depression an impulse will be transmitted to the magnet 101 by a circuit described as follows: to the positive line side 75, through contacts closed by the key 111, switch contacts 71b now closed, wire 152 to magnet 101, and thence by wire 153 to the negative line side 95. By a succession of impulses to the magnet 101, the sorting designation selector may be adjusted to the desired position and sorting operations for records having a certain designation may be effected.

While it is preferable to construct the machine to include all of the novel features herein disclosed, the machine may be constructed so as to include only some of these features. For example, in a simplified construction of the machine, the sorting designation setup means may be omitted without interfering with the manner of operation of other parts of the machine. However, the elimination of this mechanism necessitates a sorting run for each sorting designation.

If it is desired to use records perforated according to the Hollerith system, then, of course, the translator device herein shown for the combinational designations will not be necessary and may be dispensed with. With the additional elimination of the sorting designation setup means a very simple construction of a sorting machine is effected which requires; a very short card feed to the sorting compartments; a single analyzing means, and a sorting magnet controlled thereby. A machine constructed according to the above embodies a very simplified construction of sorting machine and differs from a sorting machine of a well known type in that it eliminates the use of a long card feed, the provision of a plurality of sorting blades, sorting compartments, and a synchronized control for the sorting blades from the analyzing means.

Another construction of the machine which is obvious is to provide the armatures of the magnet 79 with visible indicators so that during the passage of all the cards of a card stack, the positioning of certain of the armatures would visually indicate the sorting designations which are present in the cards passed through the machine. With such designations noted by the operator, the sorting designation selector may be adjusted to corresponding positions by means of the key 111 and sorting runs for such designations may then be effected, obviously omitting sorting runs for those designations which are not represented by cards in the stack. The automatic restoration of the attracted armatures of the digit setup means will, nevertheless, be obtained when the machine is operated in this manner.

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

What is claimed is:

1. In a sorting machine for sorting out in a single sorting run a single group of records having a selected designation in one column from other groups of records having other designations in the same column, analyzing means for effecting the analysis of said designations, a sorting mechanism, designation sorting controller means intermediate said analyzing means and said sorting mechanism for selecting the designations which, upon analysis, will effect the operation of said sorting mechanism, means for effecting an operation of said controller means at the termination of each sorting run to select the next designation while maintaining the same operative relationship between the analyzing means and the record column containing the next designation, and means including a record indicative of the termination of each sorting run for automatically operating said last named means upon the completion of each sorting run to select the next designation for sorting operations.

2. In a sorting machine for sorting records according to a selected designation on the records for each sorting run, an analyzing means for analyzing said designations, a sorting mechanism including an electro-magnet controlling said sorting mechanism, a plurality of digit representing circuits, means intermediate said analyzing means and said circuits to effect the transmission of an electrical impulse over a se-

lected digit representing circuit when corresponding digit representing designations are analyzed, a step by step controller intermediate said circuits and said electro-magnet for selecting said circuits to cause an electrical digit representing impulse to be transmitted over said circuit to energize said electro-magnet, and means for automatically operating said circuit controller upon the completion of each sorting run to select a successive digit representing circuit for the succeeding sorting run.

3. In a sorting machine for sorting out in a single sorting run a single group of records which have a selected designation and rejecting all other groups of records having other designations in the same record column, a commutator comprising a step by step switch member and a plurality of digit representing lines selected by said switch member, a designation analyzing means for transmitting sorting controlling impulses over said lines in response to the analysis of the different designations analyzed in said record column, and means for automatically effecting a step of movement of said switch member upon the completion of each sorting operation to select a successive digit representing line for the succeeding sorting operation.

4. In a sorting machine in which a sorting run is effected for each record designation and said sorting runs are effected in sequence according to the ordinal sequence of the designations a record designation analyzing means, a sorting mechanism controlled thereby, selecting means intermediate said analyzing means and said sorting mechanism for controlling sorting operations for successive designations in their ordinal sequence, and means including a specially designated card comprising the last card in the series to be sorted in each sorting run for controlling said selecting means for effecting the selection of the next designation to be effective upon the subsequent sorting run for sorting operations.

5. In a sorting machine for sorting out in the same sorting run a single group of records which have a selected designation and rejecting all other records having other designations in the same record column, a commutator comprising a step by step switch member and a plurality of digit representing lines selected by said switch member, a designation analyzing means for transmitting sorting controlling impulses over said lines in response to the analysis of all of the designations analyzed in said record column, and means including a special record member forming the last record in each sorting run to effect a step of movement of said switch member to thereby select a successive digit representing line.

6. In a sorting machine for sorting out in a single sorting run a single group of records having a selected designation in one column from other groups of records having other designations in the same column, analyzing means for effecting the analysis of said designations, a sorting mechanism, designation sorting controller means intermediate said analyzing means and said sorting mechanism and operable step by step for selecting the designations in an invariable sequence which, upon analysis, will effect the operation of said sorting mechanism, means for effecting a step of operation of said controller means at the termination of each sorting run to select the next designation while maintaining the same operative relationship between the analyzing means and the record column containing the next designation, and means including a record passed through the machine at the termination of each sorting run for automatically operating said last named means upon the completion of each sorting run to select the next designation for sorting operations.

7. In a sorting machine for sorting out in a single sorting run a single group of records having a selected designation in one column from other groups of records having other designations in the same column, an analyzing brush contact in the path of designations of the records for effecting the analysis of said designations, a sorting mechanism comprising a single electromagnet, designation sorting switch controller means and impulse transmitting means intermediate said analyzing brush contact and said sorting mechanism for transmitting impulses directed by said analyzing means and for selecting the designations which, upon analysis, will effect the energization of said sorting control electromagnet, electromagnetic means for effecting by a closure of its circuit an operation of said switch controller means at the termination of each sorting run to select the next designation while maintaining the same operative relationship between the analyzing brush contact and the record column containing the next designation, and means including a circuit passed through the machine during each sorting run for closing said circuit for automatically operating said last named means upon the completion of each sorting run to select the next designation for sorting operations.

8. In a sorting machine for sorting in a plurality of runs records containing digit representations, in combination, a sorting mechanism, a record designation analyzing means for controlling said sorting mechanism, means for selecting and determining the particular designation which is to control upon the sensing thereof said sorting mechanism during each run of unsorted records, set-up digit representing means responsive to the passage of all of the records to be sorted during the first sorting run, and means controlled by said set-up means to control said selecting means to cause the latter to successively select designations corresponding to only those appearing on the records to be sorted.

9. In a sorting machine in which a sorting run is effected for each record designation and said sorting runs are effected in sequence according to the ordinal sequence of the designations, an analyzing means, a sorting mechanism controlled thereby, selecting means intermediate said analyzing means and said sorting mechanism for causing successive sorting runs to be effected for successive designations in their ordinal sequence, means responsive to each sorting run to select the next designation according to the ordinal sequence thereof, a digit representing set-up means responsive to the passage of all the records during the first run for representing designations on the records, and means controlled by said set-up means to cause said selecting means to select only such designations as appear on the records to thereby eliminate sorting operations for non-existing designations.

10. In a sorting machine for sorting records according to single designations on the records for each sorting run, an analyzing brush contact in the path of the designations of the records, a sorting mechanism including an electromagnet, a step by step operated circuit controller for said electromagnet for effecting the operation of the

sorting mechanism by the successive designations during succeeding sorting runs, means for effecting the step by step operation of said circuit controller, and means including a record passed through the machine during each sorting run to cause the automatic operation of said last named means whereby only such cards as have designations selected by the circuit controller will be sorted by said sorting mechanism during that sorting run, set-up digit representing means responsive to the passage of all the records to be sorted during the first sorting run, and means controlled thereby for effecting an operation of said circuit controller to cause the latter to select a succeeding designation corresponding to the next designation in their ordinal sequence, said digit set-up means causing said circuit controller to be advanced to omit designations not represented on records passed through the machine during the first sorting run whereby only such designations that are on the records to be sorted control sorting operations and sorting runs for non-existing designations are omitted.

11. In a sorting machine for sorting records containing digit representing designations, record designation analyzing means, set-up digit representing means under control of the analyzing means for setting up digit representations appearing on the records analyzed, a designation selecting means, sorting mechanism controlled by said designation selecting means for sorting records according to the analysis of designations, and means for causing said designation selecting means to be controlled by said set-up digit representing means to render said sorting mechanism effective to sort only records bearing designations represented by the records analyzed by said analyzing means and represented by the set-up digit representing means, said set-up means causing said designation selecting means to be ineffective to select designations for sorting control which correspond to designations not appearing on the records and which are not set up on said digit representing means.

12. In a sorting machine for sorting in a plurality of runs record containing digit representing designations, record designation analyzing means, set-up digit representing means under control of the analyzing means for setting up digit representations appearing on the records analyzed during the first sorting run, means for retaining said set-up means in digit representing positions during successive sorting runs, sorting mechanism for sorting records according to the analysis of designations and during a plurality of sorting runs, means controlled by said set-up digit representing means to render said sorting mechanism effective to sort during successive sorting runs only records bearing designations represented by the records analyzed by said analyzing means and represented by the set-up digit representing means, and means responsive to the completion of the last sorting run for records represented by the set-up digit representing means for rendering said retaining means ineffective.

13. In a sorting machine for sorting records in a plurality of sorting runs according to the sequence of all the digits which appear in a full complement of records to be sorted, record designation analyzing means, digit set-up means under control of said analyzing means for setting up representations of the digits appearing on records to be sorted, sorting mechanism, means responsive to the termination of each sorting run for causing the sorting mechanism to be responsive to the next digit designation to be analyzed for sorting correspondingly designated records, and means under control of said digit set-up means to render said last named means ineffective when the next digit designation does not appear on any of the records to be sorted and for causing the sorting mechanism to be responsive to the next digit designation and which is represented by the digit set-up means, thereby eliminating idle sorting runs for digits not appearing on records.

14. In a sorting machine for sorting records in a plurality of sorting runs according to the sequence of all the digits which appear in a full complement of records to be sorted, record designation analyzing means, digit set-up means under control of said analyzing means for setting up representations of the digits appearing on records to be sorted, sorting mechanism, means responsive to the passage of a control card comprising the last card analyzed at the termination of each sorting run for causing when said card is analyzed by the analyzing means the sorting mechanism to be responsive to the next digit designation to be analyzed for sorting correspondingly designated records, and means under control of said digit set-up means to render said last named means ineffective when the next digit designation does not appear on any of the records to be sorted and for causing the sorting mechanism to be responsive to the next digit designation and which is represented by the digit set-up means, thereby eliminating idle sorting runs for digits not appearing on records.

15. In a sorting machine for sorting records according to their digit representations, the digits being represented by holes in combinational hole arrangement, a sorting mechanism, record designation analyzing means, means for translating the designations analyzed into a single reading comprising a digit representation, selecting means for successively selecting said translated digit representations for causing said sorting mechanism to be responsive to the successive digit representations, a digit representing set-up means controlled by said analyzing means, and means controlled by said set-up means to select only such digit designations as appear on the records to thereby eliminate idle sorting operations for non-existing designations on records which are not to be sorted.

16. In a sorting machine for sorting records in a plurality of sorting runs according to their digit representations, the digits being represented by holes in combinational hole arrangement, a sorting mechanism including a single sorting pocket and a reject pocket, record designation analyzing means, means for translating the designations analyzed into a single reading comprising a digit representation, selecting means for successively selecting said translated digit representations for causing said sorting mechanism to be responsive to the successive digit representations during successive sorting runs to direct records representing the selected digits in the sorting pocket in successive sorting runs and to direct other records in the reject pocket, a digit representing set-up means controlled by said analyzing means, and means controlled by said set-up means to select only such digit designations as appear on the records to thereby eliminate idle sorting runs for non-existing designations on records which are not to be sorted.

17. In a sorting machine for sorting records,

said records representing by designations thereon digits according to which sorting operations ensue, a sorting mechanism including a sorting pocket and a reject pocket, record designation analyzing means, means controlled by said record designation analyzing means for controlling said sorting mechanism to direct records bearing a selected designation in the sorting pocket and remaining records in said reject pocket, selecting means for causing said sorting mechanism to be responsive to the designations successively in the ordinal sequence of the digits, digit representing set-up means controlled by said analyzing means to represent the digits of the records analyzed, and means controlled by said set-up means to cause said selecting means to select only such designations as appear on the records analyzed to thereby eliminate sorting operations for non-existing designations.

18. In a sorting machine for sorting records in a plurality of sorting runs, said records representing by designations thereon digits according to which sorting operations ensue, a sorting mechanism including a sorting pocket and a reject pocket, record designation analyzing means, means controlled by said record designation analyzing means for controlling said sorting mechanism to direct records bearing a selected designation in the sorting pocket and remaining records in said reject pocket, selecting means comprising a step by step operated controller for causing said sorting mechanism to be responsive to the designations analyzed by the analyzing means successively in the ordinal sequence of the digits, digit representing set-up means controlled by said analyzing means to represent the digits of the records analyzed, and means controlled by said set-up means to cause said controller to be operated a plurality of steps to select for successive sorting runs only such designations as appear on the records analyzed to thereby eliminate sorting runs for non-existing designations.

19. In a sorting machine for sorting records according to digit designations of records during successive sorting runs effected to sort records in a predetermined ordinal sequence, designation analyzing means, sorting mechanism controlled thereby, selecting means intermediate said sorting mechanism and analyzing means to cause sorting runs to be effected for successive designations in their ordinal sequence, digit representing means comprising a plurality of digit representing relays set up under control of said analyzing means, and means controlled by said relays to control said selecting means to select only such designations as appear on the records to thereby eliminate sorting runs for non-existing designations.

20. In a sorting machine for sorting records according to digit designations of records during successive sorting runs effected to sort records in a predetermined ordinal sequence, designation analyzing means, sorting mechanism controlled thereby, selecting means intermediate said sorting mechanism and analyzing means to cause sorting runs to be effected for successive designations in their ordinal sequence, digit representing means comprising a plurality of digit representing relays set up under control of said analyzing means during the first record analyzing operation for all records to be sorted, means for retaining the set up of said relays, means controlled by said relays to control said selecting means to select only such designations as appear on the records to thereby eliminate sorting runs for non-existing designations, and means responsive to the last sorting run for the designation appearing on the records to cause said retaining means to be ineffective.

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