

Dec. 9, 1941.

M. MAUL ET AL

2,265,442

SORTING MACHINE

Filed May 21, 1940

7 Sheets-Sheet 1

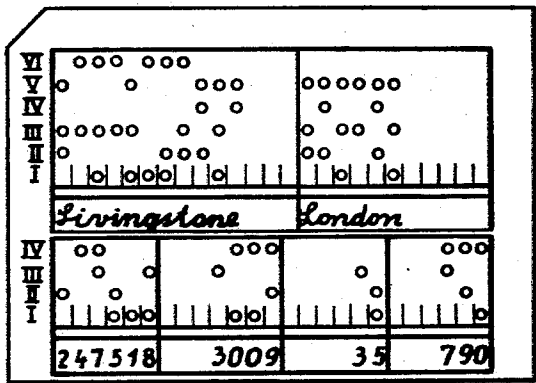


Fig. 1

Sk

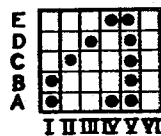
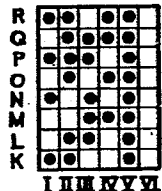
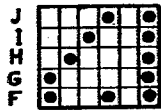
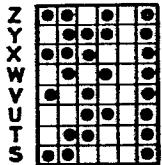
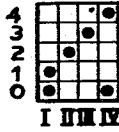
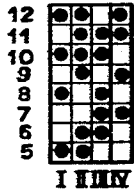


Fig. 2

INVENTOR.
Michael Maul
BY *Paul Hammel*
W. Wilson
ATTORNEYS.

Dec. 9, 1941.

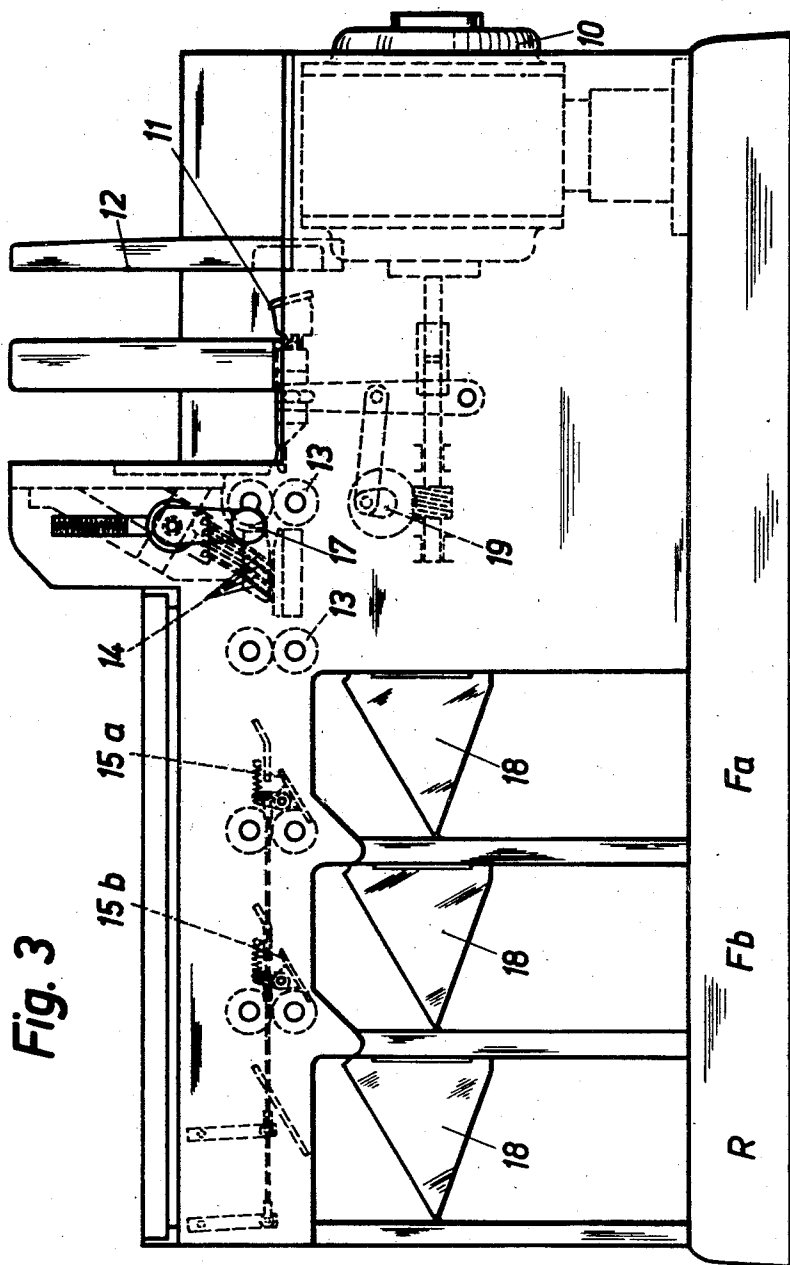
M. MAUL ET AL

2,265,442

SORTING MACHINE

Filed May 21, 1940

7 Sheets-Sheet 2



INVENTOR.
Michael Maul
BY *Carl Hummel*
W. M. Wilson
ATTORNEYS.

Dec. 9, 1941.

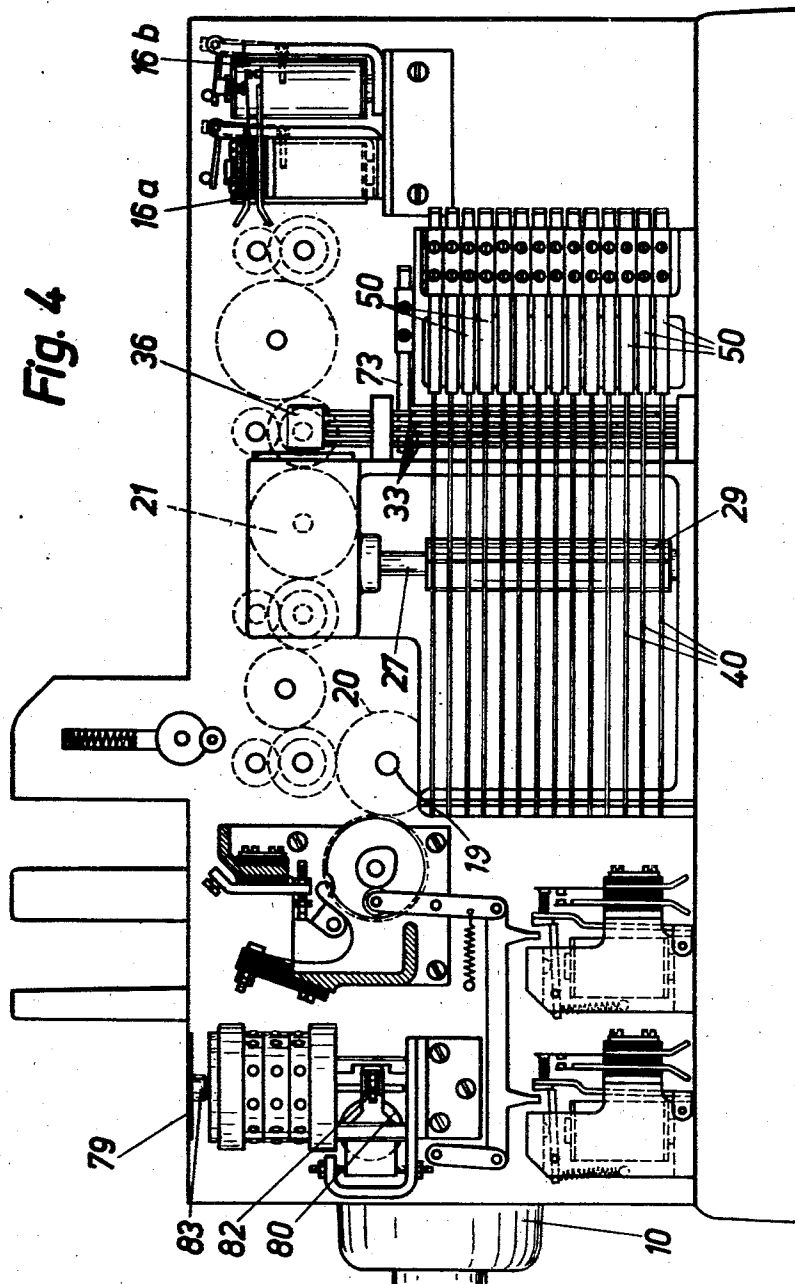
M. MAUL ET AL

2,265,442

SORTING MACHINE

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7 Sheets-Sheet 3



INVENTOR.
Michael Maul
BY *Herb J. Gurnee*
W. M. L. L.
ATTORNEYS.

Dec. 9, 1941.

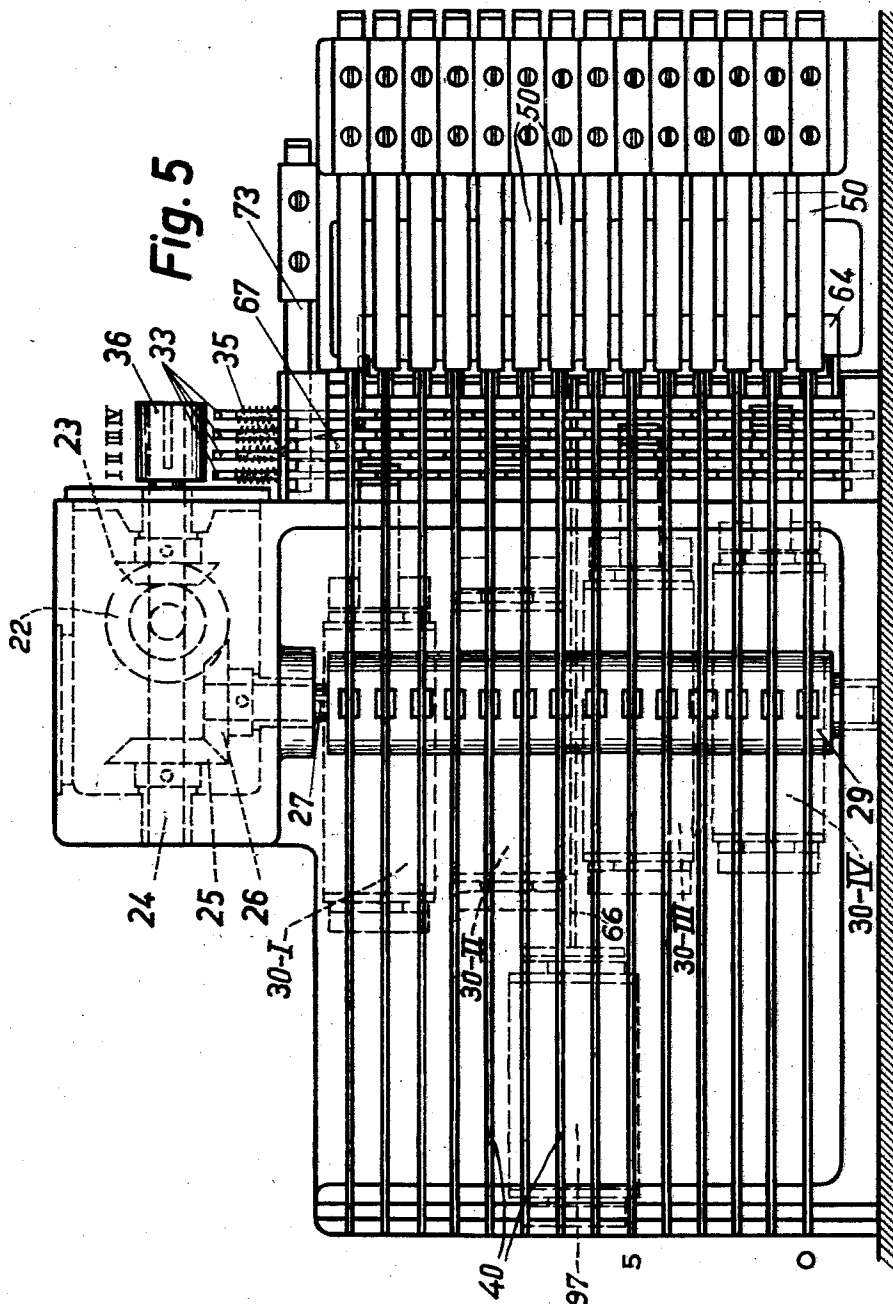
M. MAUL ET AL

2,265,442

SORTING MACHINE

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7 Sheets-Sheet 4



INVENTOR.
Michael Maul
BY *Paul Hummel*
W. M. Wilson
ATTORNEYS.

Dec. 9, 1941.

M. MAUL ET AL

2,265,442

SORTING MACHINE

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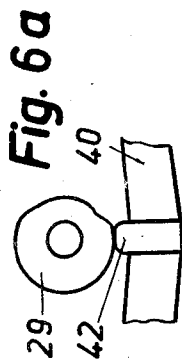
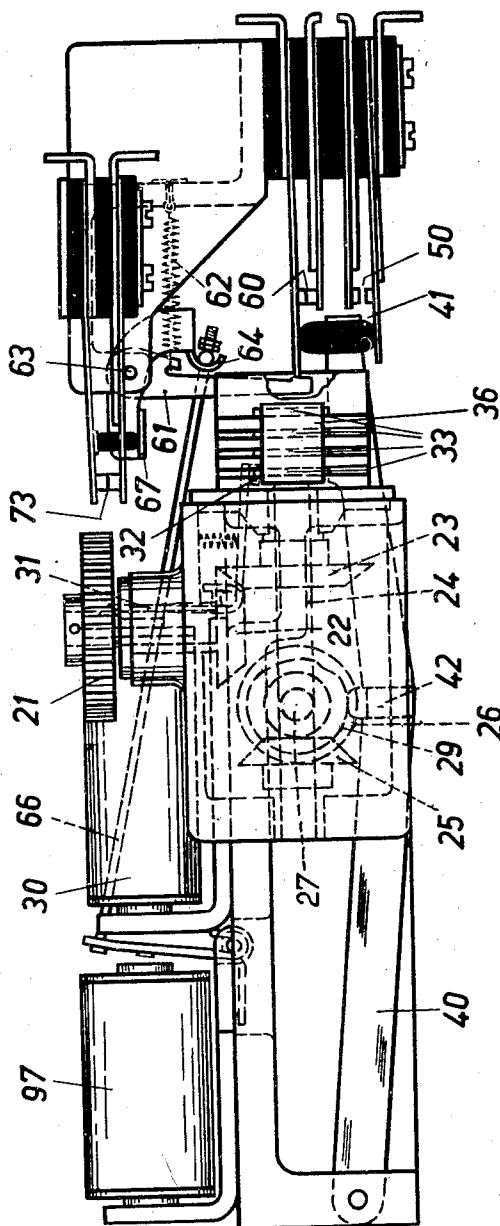


Fig. 6



INVENTORS
Michael Maul
Karl Hummel
BY *W. M. Gibson*
ATTORNEYS.

Dec. 9, 1941.

M. MAUL ET AL

2,265,442

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Fig. 8

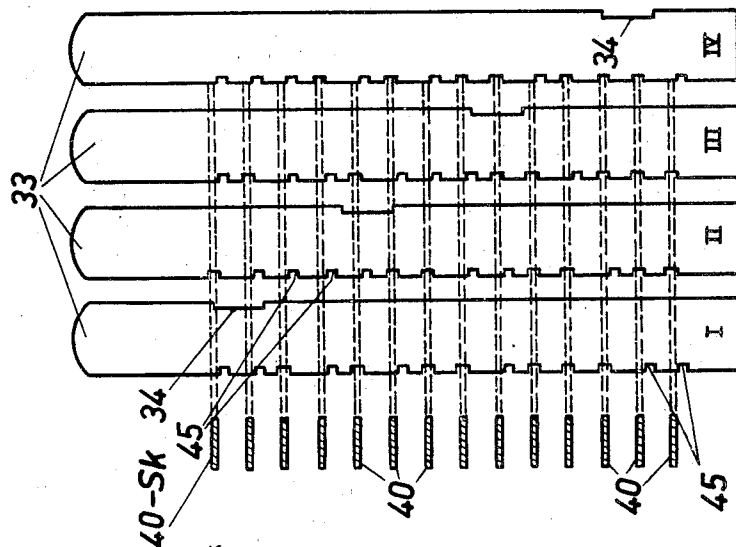
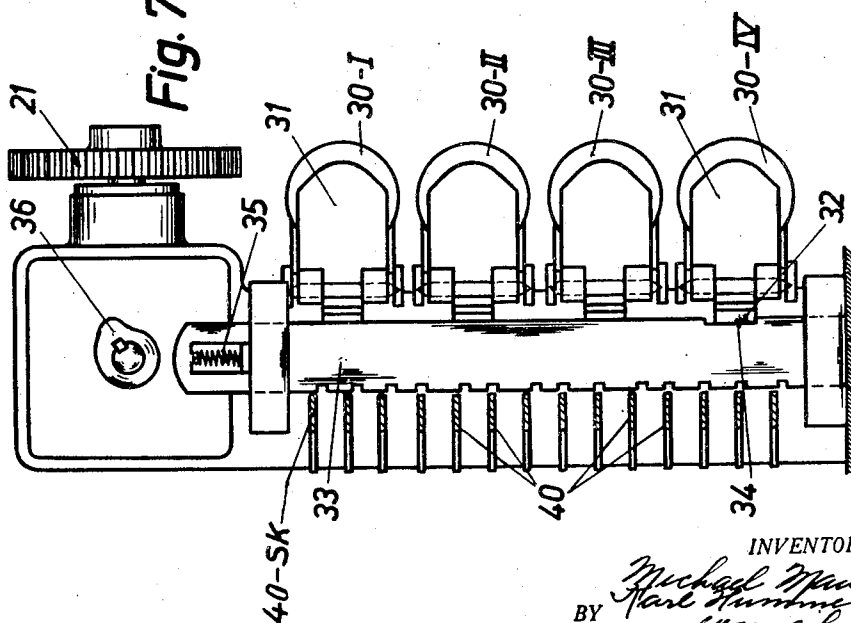


Fig. 8a

	Sk	12	11	10	9	8	7	6	5	4	3	2	1	0
I	○	○	○	○	○	○	○	○	○	○	○	○	○	○
II	○	○	○	○	○	○	○	○	○	○	○	○	○	○
III	○	○	○	○	○	○	○	○	○	○	○	○	○	○
IV	○	○	○	○	○	○	○	○	○	○	○	○	○	○

Fig. 7



INVENTORS
Michael Maul
Karl Hummel
 BY *W. M. Wilson*
 ATTORNEYS.

2,265,442

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INVENTORS
BY *Michael Maul*
Carl Hummel
W. M. Wilson
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,265,442

SORTING MACHINE

Michael Maul, Berlin-Johannisthal, and Karl Hummel, Berlin-Charlottenburg, Germany, assignors to the firm Deutsche Hollerith Maschinen Gesellschaft, m. b. H., Berlin-Leichterfelde, Germany

Application May 21, 1940, Serial No. 336,370
In Germany May 22, 1939

12 Claims. (Cl. 209—110)

The present invention relates to improvements in sorting machines and particularly to that form of sorting machine in which sorting of record cards is effected according to the designations thereon in a number of pockets which is less in number than the designations.

The present machine deals with the construction of a sorting machine of a relatively simple type which is based upon the principle of sorting records according to designations thereon and which are automatically selected in succession. While previous constructions have been devised with this object in view, the greatly reduced speed of sorting operations of prior constructions would not render machines of this type suitable for some purposes. The characteristics which are requisite for sorting machines such as speed, simplicity in construction and operation, facility in manufacture, and reduction in service requirements, are obtained in the present invention by the construction of a sorting machine which requires only two sorting pockets, in addition to the usual reject pocket. This desirable embodiment is the result of the utilization of a distinguishing principle of sorting operation, and which is believed to be novel herein, in which sorting operations are effected during each sorting run under control of a pair of selected designations.

In order that the present invention be more readily understood the general operation of the machine will now be described. During the first sorting run all of the records are passed through the machine, and in accordance with the adjustment of a digit designation selector, record cards having a pair of selected designations will be sorted out and the remaining record cards will be directed into the reject pocket. The digit designation selector is then adjusted to the next digit representing position and in the present machine this is performed by the passage of a control card at the termination of the first, and subsequent sorting runs. The cards which are directed into the sorting pockets may remain in these pockets if it is desired to sort records in their digital sequence, or they may be removed from the sorting pockets. The cards which are directed into the reject pocket are again placed in the supply hopper and a re-sorting operation is then effected which causes the sorting of the record cards bearing the next pair of selected designations and which are selected by the next position of the selector. Upon the completion of a plurality of sorting runs one of the pockets contains records bearing some of the digit designations and the other pocket receives the remaining records which bear the other digit designations.

It is, therefore, a principal object of the present invention to devise a sorting machine which

is capable of effecting a sorting operation in accordance with a pair of selected designations during each sorting run and to direct these records into a plurality of sorting pockets.

It is a still further object of the present invention to provide a sorting machine of the type just described with a digit designation selector which selects these designations in such pairs as to effect a coordination between the sorting pockets and the designations whereby the cards which are sorted are directed into the sorting pockets in the proper digital sequence. In order that it may be better understood how this desirable result is secured, the following explanation is given indicating the pairing and sequence of sorting the record cards according to their digital values. During the first sorting run the aforementioned digit designation selector selects the record cards which bear the digital values 5 and 0. During the next sorting run, the record cards bearing the digital values 6 and 1 are selected, and in subsequent sorting runs the designations are selected so as to effect the sorting of the records in the required digital sequence. In tabulated form the record cards will, after five sorting runs, be sorted into the two sorting pockets as indicated below:

Left-hand pocket	Right-hand pocket
9	4
8	3
7	2
6	1
5	0

From the above, it will be seen that the record cards are sub-divided into two sorting pockets and in each sub-division the record cards are in the proper numerical sequence. In order to stack the cards so that all of the digital groups are in the right sequence, all that is necessary is to place the record groups bearing the designations 5 to 9 on top of the record groups bearing the designations 0 to 4, and this, of course, is effected by the removal of cards from the two sorting pockets.

It sometimes happens that a stack of record cards which is to be sorted does not contain all of the digital representations which form part of a complete series and, as previously described, the machine will, by means of the aforementioned digit designation selector, be conditioned at the termination of each sorting run for effecting the sorting of records according to the next pair of digit representations. In the event that the selected pair of designations does not appear upon the records the machine will go through an idle sorting run which will consume time,

which time will be saved by the elimination of such idle sorting cycles. With the above disadvantage in view, it will be understood that it is a still further object of the present invention to provide means which will effect the elimination of idle sorting runs when the machine is conditioned for sorting according to selected designations and when such designations do not appear upon the record cards. In the present machine this is effected by the incorporation of a digit set-up mechanism which, during the first sorting run, will effect the set-up of the digit representations which actually appear upon the record cards. In the event that a pair of related designations does not appear upon the record cards, a control mechanism will be automatically effective so as to bring the digit designation selector to the next position which corresponds to the pair of designations which actually appear upon the record cards. It is preferable, however, to construct this mechanism in such a manner that in the event one of the designations of the selected pair is actually represented upon the record cards the sorting run will nevertheless be executed so as to effect the sorting of such cards.

Another object of the present invention, and which is to be considered as a relatively important one, is the provision of means in the sorting machine for effecting the sorting of record cards according to the numerical designation 10, 11, and 12. In some forms of accounting practice these designations are used for the representations of months, and sorting operations are sometimes effected under control of these numerals. In the present machine provision is made for effecting the sorting in accordance with this classification and it is desirable that a sorting run be executed for each numerical designation. If so desired, two of these numerals may be paired so as to effect concomitantly sorting operations for records according to two numerals. Since sorting operations of this type occur rather infrequently, it would not be disadvantageous to utilize a single sorting run for each numerical designation.

The improved machine also includes an arrangement whereby sorting runs will be omitted when the numeral designations 10, 11, and 12 are not present on any of the cards which are to be sorted. This designation selector constitutes, preferably, the same designation selector utilized for controlling the sorting of digits 0 to 9 and its mode of operation and result thereof is similar to that previously described.

A still further object of the present invention is to provide means which is capable of sorting record cards in the manner previously described according to alphabetical designations. The principle for sorting the perforated record cards according to alphabetical designations is the same as that provided for sorting out record cards according to numerical designations.

The sorting of the record cards according to the alphabetical designations is preferably performed in two phases and in one phase successive sorting runs will effect the sorting of record cards according to selected alphabetical designations, and during the second phase the record cards are sorted into the pockets in accordance with the other alphabetical designations. The record cards are directed into the two sorting pockets in accordance with the selection of successive pairs of alphabetical designations and to provide for their successive selection,

the designation selector hereinbefore referred to, is adapted to make the desired selection.

It is a still further object of the invention to sub-divide the sorting of record cards under control of the alphabetical designations into two phases and to provide selecting means whereby the operator may predetermine the group of alphabetical designations to be effective during the phase of the sorting operations.

While any form of designation may be utilized to represent the numerical and alphabetical designations, it is preferable to designate them by combinationally arranged perforations. The combinational arrangement is translated into a single reading whether it represents a digit or an alphabetical designation.

In the present machine the same combinational arrangement of holes may represent either a digit or a letter. The record cards which are sorted during the first phase are distinguished from the digits which would be represented by the same combination of perforations by a hole in a special index point position and the same distinction is carried out for alphabetical designations which are sorted during the second phase, these alphabetical designations being indicated by a special hole at another index point position.

It is a still further object of the present invention in connection with sorting according to alphabetical designations to provide an alphabetical designation set-up means which provides for the omission of a sorting run when record cards do not bear designations representing a related pair of letters. This is provided by the same set-up means previously described in connection with the digit representations and by the provision of this means, idle sorting runs are eliminated.

At this time a general description of the operation of the machine when it is set to effect sorting according to alphabetical designations will now be described. During the first sorting phase a succession of sorting runs will be performed and these will direct records having alphabetical designations into the right and left hand sorting pocket in accordance with the following table:

Left-hand pocket	Right-hand pocket
R	E
Q	D
P	C
O	B
N	A
M	
L	
K	

During the second sorting phase the record cards are sorted during a plurality of sorting runs and they are deposited into the two sorting pockets according to the following table:

Left-hand pocket	Right-hand pocket
Z	J
Y	I
X	H
W	G
V	F
U	
T	
S	

If the operator is able to recognize that the capacity of the sorting pockets is such that they may accommodate all of the record cards sorted they may remain in the sorting pockets. At the termination of the last sorting run it should be noted that the right-hand pocket has contained therein the record cards divided up into the alphabetically arranged groups A to J. The left-hand sorting pocket has received record cards sorted according to the alphabetical designations K to Z. By placing the cards taken from the left-hand sorting pocket and superimposing them upon the record cards taken from the right-hand pocket, they will all be in the proper alphabetical sequence A to Z.

While the invention has been disclosed in one embodiment herein which utilizes cards representing characters by perforations it is to be understood that this specific disclosure is merely illustrative and should not be considered as restrictive. The designations may be effected in other ways, such as graphical characters or holes arranged in other codes, and it is further immaterial if the analysis of the records is effected either electrically or mechanically. It is to be understood that while an electro-mechanical embodiment of the invention has been selected this is merely the preferred embodiment of the invention and it may vary in different forms without departing from the spirit of the invention.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a plan view showing the preferred form of record card which is sorted by the improved sorting machine disclosed herein.

Fig. 2 comprises a series of diagrams which indicate the preferred code for arranging the holes in combination to represent all of the digits 0 to 9, the numerals 10, 11, and 12 and a complete series of alphabetical characters A to Z.

Fig. 3 is a front view of the improved sorting machine and shows particularly the two sorting pockets which are utilized to selectively receive the records sorted according to a pair of designations and also a reject pocket into which is directed the unwanted record cards.

Fig. 4 is a view in side elevation of the back of the machine showing particularly the electro-mechanical translating unit and also the sorting designation selecting unit.

Fig. 5 is a plan view of the electro-mechanical translating unit but taken on an enlarged scale with respect to the similar showing in Fig. 4.

Fig. 6 is a plan view of the translating unit shown in Fig. 5.

Fig. 6a is a detail view.

Fig. 7 is a view in side elevation of one side of the electro-mechanical translating unit.

Fig. 8 is a diagrammatic view showing the formation of the notches in a series of translating bars and the relationship of contact operating bars which are adapted to engage with these notches.

Fig. 8a is a diagrammatic illustration showing the code of combinationally arranged holes representing the digits 0 to 9, numerals 10, 11, and 12, and a special alphabetical designation Sk.

Fig. 9 represents an electrical wiring diagram for the machine.

Description of form of record cards sorted by the sorting machine

The preferred form of record card which is to be sorted is shown in Fig. 1 wherein it will be noted that the card is provided with two superimposed card fields, each said field being provided with twenty-five vertical card columns for receiving holes representing a corresponding number of characters. It will be noted that the upper card field is appropriated for the designation of alphabetical designations, or letters, as well as for numerals and the lower card field is utilized for designating only numerals. The alphabetical characters or letters are represented by combinationally arranged holes located at six different index point positions. The numerals are designated by holes in combinational arrangement located at four index point positions. It will be seen from Fig. 1 that the index point positions are designated by Roman numerals for convenience in reference and also for an understanding of the operation of the correspondingly designated parts of the machine.

Sorting control designations on cards

Any suitable code may be chosen for arranging the holes in a combinational arrangement so as to designate the letters and numerals and while the preferred arrangement is shown and described herein it will be understood that it may be varied at will to secure the same results. A very desirable characteristic in the selection of the code is one which will facilitate the analysis and translation of the combinationally arranged holes.

In Fig. 2 there is shown the code of the hole arrangement for representing both the digits and letters and the combinational arrangement of the holes for each character is shown aside of each character that is designated. For the designation of the digits 0 to 9, it will be seen that 0 is designated by two spaced holes. The digits 1 to 4 are represented by single holes located at different index point positions. Digits 5, 6, and 7 are represented by adjacent pairs of holes and the digits 8 and 9 are each represented by two spaced holes. The numbers 10, 11, and 12 are each represented by different arrangements of three holes. Ordinarily sorting operations are effected under control of the digit designations, but in some instances it may be desirable to sort record cards in accordance with the numbers 10, 11, and 12. These may represent the months of the year to control the sorting of cards in accordance with such designations. Fig. 2 also outlines the manner in which the cards are paired in the sorting runs, it being noted that during the first sorting run record cards bearing the digits 0 and 5 are sorted. During the second sorting run record cards bearing the digits 1 and 6 are sorted and then during the next three sorting runs record cards bearing the following designations are sorted in pairs: 2-7, 3-8, and 4-9. Thereafter, three sorting runs for sorting the record cards bearing the numbers 10, 11, and 12 are performed. In other words, for sorting according to the numerical designations the present machine requires only five sorting runs for sorting according to the digit designations 0 to 9. Three additional sorting runs are required for sorting according to the designations 10, 11, and 12 but cards having such designations appear quite infrequently in accounting practice and therefore, separate sort-

ing runs may be appropriated for sorting these records.

In the event that no cards are contained in the stack which is to be sorted bearing the designations 10, 11, and 12 the sorting character designation selector will be positioned so as to omit sorting runs for all of these designations, or for any designation which is lacking. In the sorting of the record cards according to the digit designations the record cards bearing the digit representations 0 to 4, inclusive, will be directed into the right-hand sorting pocket Fa shown in Fig. 3. The record cards bearing the digit representations 5 to 9 will be directed into the left-hand sorting pocket Fb shown in Fig. 3. If the operator is able to discern the fact that all of the cards which are to be sorted may be received by the two sorting pockets, they may be left therein at the termination of the sorting runs. In this case at the termination of the last sorting run it is only necessary for the operator to first remove the stack of record cards sorted in the sequence 0 to 4 and place upon this stack the record cards which have been sorted in the digital sequence 5 to 9. This will produce a single stack of record cards which are arranged in the proper digital sequence.

If it happens that the capacity of the card pockets is insufficient to receive all the cards sorted therein, the operator will remove them from the sorting pockets and place them upon the table, or any suitable support, placing them in the same digital sequence they are sorted into the sorting pockets.

When the record cards are to be sorted according to the alphabetical designations, such as the letters A to Z, sorting operations are effected in two phases, each phase consisting of a plurality of sorting runs. For conditioning the machine for sorting operations which are to be effected according to the first phase, the analyzing brush which effects the analysis of the holes at the IV index point position is made effective so that all record cards having holes at this index point position, as well as other index point positions in combinational arrangement therewith will be sorted out. This will effect, as shown at the bottom of Fig. 2, the sorting of record cards bearing the alphabetical designations A to E and K to R. As outlined at the bottom of Fig. 2, during the first five sorting runs effected during the first phase, record cards will be sorted out according to the following pairs; A—K, B—L, C—M, D—N, and E—O. After these five sorting runs which sort record cards according to predetermined pairs there will be three successive sorting runs for sorting out the record cards bearing the alphabetical designations P, Q, and R. In other words, during the first sorting phase the record cards will be sorted according to the alphabetical letters A to R, inclusive. During this phase of sorting operations the right-hand sorting pocket Fa will have directed therein record cards bearing the alphabetical designations A to E and the left-hand sorting pocket Fb will receive record cards bearing the alphabetical designations K to R, inclusive.

The machine is then conditioned for sorting according to the second phase and this is effected by causing the analyzing brush which effects the analysis of the holes at the VI position effective and record cards having this designation and other designations in combinational hole arrangement therewith will be sorted out

during the second phase. As shown in the symbolic representation in Fig. 2 in the center thereof, the record cards are sorted out in five sorting runs, paired as follows; F—S, G—T, H—U, I—V, and J—W. Thereafter, three successive sorting runs will be effective for sorting out the record cards according to the alphabetical designations X, Y, and Z. During the second phase of the sorting operation, the right-hand sorting pocket Fa will receive the record cards grouped in the alphabetical sequence F, G, H, I, J. When the cards which have been sorted in the right-hand sorting pocket Fa during the first phase remain therein, it is obvious that at the termination of the second phase of the sorting runs the record cards in the right-hand sorting pocket will be in the alphabetical sequence; A, B, C, D, E, F, G, H, I, J. During the second phase of the sorting operations, the left-hand sorting pocket Fb will receive the record cards sorted according to the alphabetical sequence S, T, U, V, W, X, Y, Z. If the operator has not removed the record cards sorted in the left-hand sorting pocket Fb during the first phase, this pocket will now contain record cards sorted according to the alphabetical sequence K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z.

To place the record cards so that they are arranged in alphabetical sequence A to Z the operator merely removes the record cards from the right-hand sorting pocket, places them on a suitable support and superimposes the record cards taken out of the left-hand sorting pocket.

General operation of the machine

The construction and operation of the machine will be given in specific detail as the specification progresses. At present the general description of its operation will be given.

The record cards are fed singly from a supply hopper past analyzing brushes by means of the usual form of card feeding device. The record cards are provided with holes in combination arrangement and these are translated by means of a translator of an electro-mechanical type to translate the combinational hole representation into a single character representation, which may be either a numeral or a letter. The record cards are sorted during a plurality of sorting runs and during each sorting run, record cards having either one of a pair of selected designations, or cards having a single selected designation, are sorted out and in either sorting operation the remaining cards are directed into a reject pocket. By means of a sorting character designation selector, the sorting mechanism is made responsive to the designations successively during a plurality of successive sorting runs.

During the passage of all the records during the first sorting run the sorting designations set-up devices are operated by means of which representations of all of the different designations on the records are set up, whether the designations represent numerals or letters. The set-up devices preferably comprise electrical contacts and for those records in which a designation appears the related contacts will be opened and will remain open during the successive sorting runs.

In the present machine the set-up devices, or electrical contacts, are under control of the electro-mechanical translator whereby sorting runs will be omitted when selected pairs of designations do not appear on the records. These contacts are opened upon the presence of corre-

sponding designations which are on the cards passed through the machine. The contacts which are opened are latched in open position to control the successive positions of the designation selector during the successive sorting runs. When the contacts are open to designate either a pair of designations or a single designation on the cards to be sorted, a sorting run will be effective under control of these designations to sort a pair of cards, or a single card. The sorting of a pair of cards during the sorting run is effected by the selective displacement of a pair of sorting blades to direct the cards into the two sorting pockets hereinbefore referred to. When the machine is conditioned to effect the sorting of cards singly during the sorting cycles these cards are directed into one of the sorting pockets. In either form of sorting operation cards not bearing the selected designation are directed into the reject pocket in order to be utilized for subsequent sorting runs, the sorting of these cards then being effected in accordance with the next selected designation.

When some of the contacts remain in their normally closed position due to the absence of cards bearing corresponding designations, these contacts control the position of the designation selector to cause the latter to be shifted from one character designation position to another character designating position, omitting character designating positions if corresponding character designations do not appear upon the records which are passed through the machine during the first sorting run.

Card feeding, analyzing, and sorting mechanisms

Referring to Fig. 3, it will be seen that the card feed driving shaft 19 is driven by the driving motor 10 through a worm gear drive so that the shaft 19 rotates one revolution for each card feeding or sorting cycle. The means for feeding the record cards singly out of the supply hopper 12 consists of a card picker 11 which is reciprocated by the drive shaft 19 through a crank arm connection. This form of card feeding mechanism is well known in the art and feeds the record cards to be sorted singly from the bottom of the stack so that such cards are fed to the feeding rollers 13. In the present machine four sets of feeding rollers 13 are provided and these are driven by the motor 10 through the shaft 19.

The combinational hole designations of the selected card field are analyzed by four analyzing brushes 14. In the present machine although alphabetical characters are represented by combinations of six holes only four analyzing brushes are provided and the manner in which some of these brushes may effect the analysis of the two extra holes at the V and VI index point positions will be described later. The analyzing brushes 14 are mounted upon a carrier and the latter may be adjusted step by step by means of a crank handle 17 in a well known manner to cause the brushes 14 to be correlated with a selected card column, and successively with the other card columns.

The analyzing brushes may be selectively rendered effective when a selected card field is correlated therewith by means of a card field selecting switch 104, shown only in connection with the wiring diagram of Fig. 9. The manner in which the card fields are selected for sorting operations under control of the switch 104 will be explained later.

As previously pointed out the combinational

hole designations are translated into a single character representation, and by means of the sorting character designation selector either a single selected designation or a pair of selected designations may be effective during a sorting run to direct cards having corresponding designations into sorting pockets designated Fa and Fb in Fig. 3. Upon the analysis of a record card bearing a selected designation a corresponding sorting control magnet 16a or 16b (Fig. 4) will be energized. Upon the energization of one of these magnets the related armature will be attracted downwardly thereby drawing a related link shown in Fig. 3 to the left, rocking a sorting control blade 15a or 15b in a counterclockwise direction. From Fig. 3, it will be noted that the sorting blades are normally out of the path of the record cards which are fed by the rollers 13. When one of the sorting blades 15a or 15b is rocked counterclockwise it will be in the path of the leading edge of a card which is fed by the feeding rollers 13 causing the card to be deflected downwardly so that it will be disposed in one of the sorting pockets to drop upon the movable card bottom 18 of the pocket. Obviously, by the selective movement of the sorting blades 15a and 15b the cards will be directed into the respective sorting pockets Fb and Fa. When a record card which does not bear either selected designation passes through the analyzing devices the sorting control magnets 16a and 16b in Fig. 4 will remain deenergized and due to the normal positions of the sorting blades 15a and 15b the card will be unobstructedly fed by the feeding rollers 13 to be directed into the reject pocket R.

Translator and sorting designation selector set-up devices

The construction of the combinational hole translator and sorting designation selector set-up devices will now be explained with particular reference to Figs. 4, 5, 6, 7, 8, and 8a. These two mechanisms are assembled in a self-contained unit which is mounted at the rear of the machine as shown in Fig. 4. The translator comprises in part; four slidably mounted bars 33 which are notched as shown in Fig. 8; a series of fourteen contact operating bars 40 operatively correlated with the bars 33, and two series of contacts 50 and 60, one pair of which is shown in Fig. 6, the contacts 50 being provided to control the energization of the sorting control magnets 16a and 16b, and the contacts 60 comprise the contacts of the sorting designation selector set-up device. The unit now being described also includes a restoring magnet 97 (Fig. 6) which is adapted to effect the restoration of the contacts 60 which have been opened. The translator is controlled by the analyzing brushes and the control includes a series of magnets designated in Fig. 7 as 30—I, 30—II, 30—III, and 30—30IV. As best shown in Fig. 8, four bars 33 are provided and these are adjacently mounted as shown in Figs. 4 and 5. The bars 33 are individually moved to an adjusted position and to enable this movement the bars 33 are slidably mounted in brackets and each of the bars 33 is normally urged upwardly by the action of a normally compressed spring 35, best shown in Figs. 5 and 7. Each bar 33 has coordinated therewith its respective controlling magnet 30, and, as best shown in Fig. 6, the armature 31 of each controlling magnet 30 has an extension 32 which is adapted to normally engage a notch 34 (Fig. 8) of the respective controlling bar 33. Obviously, by the energization of a magnet 30 the

armature 31 will be attracted thereby withdrawing the extension 32 from the cooperating notch 34, unlatching the respective bar 33 so that it may be moved upwardly by its related spring 35. From Fig. 7, it will be seen that magnets 30 are designated by the Roman numerals I, II, III, and IV which correspond to the similar designations of the combinational holes in a card column of the card shown in Fig. 1. Upon the presence of a hole in a card column each of the magnets 30, which is correspondingly designated, will be energized. In this manner one or more of the bars 33 are moved to adjusted position in accordance with the combinational hole arrangement of the controlling column in the record which is being analyzed.

Mounted at right angles to the bars 33 is a series of thirteen contact operating bars 40 for controlling the single digit representations 0 to 12, and an additional contact operating bar designated 40—Sk in Fig. 8 for the Sk designation. These contact operating bars are pivotally mounted below the bars 33 at right angles thereto and are adapted to cooperate with notches 45 (Fig. 8) formed in the lower edges of the bars 33. Each contact operating bar 40, as best shown in Fig. 6, is provided with a block 41 of insulating material and the latter is interposed between the lengthened contact carrying blades of the related bars of contacts 50, 60. Each bar 40, as best shown in Figs. 6 and 6a, is provided with a projection 42 adapted to cooperate with the cam 29 mounted on a drive shaft 27. The bars 33 are first adjusted and thereafter the cam 29 will be rotated sufficiently so that the contact operating bars 40 will be moved upwardly by the resiliency of the lower blade of contacts 50 thereby closing related contacts 50 and opening contacts 60. The formation and arrangement of the notches formed at the underside of each of the bars 33 is so designed and arranged that for each combinational setting of the bars 33 there will be only one contact operating bar 40 which is in alignment with the notches of all the bars 33, so that only one bar 40 will be elevated during each record analyzing operation thereby converting the combinational hole designations to a single digit representation and which is reflected by the positioning of a single digit representing contact operating bar 40. Thirteen of the contact operating bars 40 are adapted to close respective contacts 50 and which, in Fig. 9, have corresponding digital representations.

Reference has been made to a special contact operating bar designated 40—Sk in Fig. 8 and this bar is moved to contact closing position when a special control card having perforations at the I, III, and IV index point positions are analyzed, (see symbol at the upper left of Fig. 2). This will enable the setting of the bars 33—I, 33—III, and 33—IV, thereby aligning notches in all of the bars 33 with the contact operating bar 40—Sk. This contact operating bar is adapted to close the set of contacts designated 50—Sk in Fig. 9. From what has just been described, it is obvious that since the designation Sk in Fig. 2 is represented by a combinational arrangement of holes which does not represent any of the numerals or letters, it is only by the passage of the special control card bearing the Sk designation that contacts 50—Sk will be closed. This control card comprises the last card passed through the machine in each sorting run, and initiates a number of functions which will be subsequently described in detail. From what has just been described, it is obvious that the translator mechanism is adapted

to convert combinational hole designations into a single digit representation. This electro-mechanical form of translating mechanism is well known in the art and further description of its construction and operation, therefore, need not be given.

Attention is directed to the fact that the sorting designation selector contacts 60 are set up under direct control of the translator and, as shown in Fig. 9, eleven sets of contacts 60 are provided for the representation of the numerals 1 to 4, 6 to 9, 10, 11, and 12. No contact 60 is provided for representing either the 0 digit or the 5 digit as it is desirable that during the first sorting run all of the 0 and 5 designated cards be sorted out.

In the present machine the sorting designation selector contacts 60 are set up during the first sorting run to represent by the opening of certain of the contacts 60 those designations which actually appear upon the record cards sorted during the first sorting run. This set-up should be maintained during successive sorting runs effected under control of one card column and in the present arrangement when the upper blade of a pair of contacts 60 is elevated this blade will be latched by means of a related latching lever 61 (Fig. 6), which is urged by a spring 62 so that its shoulder will catch beneath the extended blade of respective contacts 60 and retain contacts 60 open. The related contacts 50 will, however, not remain closed so that they will be subsequently free to be restored to their normal open position when the respective operating bar 40 is returned to normal. The magnet 97 (Fig. 6) is adapted to effect the subsequent unlatching of those contacts 60 which have been latched open. A restoring yoke 64 (Fig. 6) which is pivoted at 63 is interconnected with the armature of the magnet 97 by a link 66. The restoring yoke 64 extends across all of the latching levers 61 so that when the magnet 97 is energized it will attract its armature moving link 66 to the left and rocking the restoring arm 64 clockwise about its pivot 63. This will shift the levers 61 to cause the unlatching of those contacts 60 which have been maintained in open position.

The restoring yoke 64 is provided with a side lip 67 which is located adjacent the button of the upper contact blade (Fig. 6) of contacts 73 to open contacts 73 by the operation of yoke 64. As will be subsequently described in detail, contacts 73 are adapted by their opening to effect the de-energization of a relay 71 (Fig. 9) to cause the termination of the operation of the driving motor 10 and this, it will be seen, is performed when a plurality of sorting runs have been carried out for all of the designations of a selected card column.

There will now be described the driving parts of the translator and the sorting designation selector for causing the operation of certain of their parts and timing the operations so that they occur in a predetermined sequence.

Previous reference has been made to the main driving shaft 19 (Fig. 1) which, it will be recalled, is driven a complete revolution for each machine cycle and by referring to Fig. 4, it will be seen that secured to the drive shaft 19 is a gear 20 which through a train of interconnecting gears shown dotted in Fig. 4 is adapted to operate the feed roller driving shafts of the machine. Intergeared with a gear secured to one of the feed roller driving shafts is a gear 21 and the shaft of gear 21, as best shown in Figs. 4 and 5

is adapted through interconnecting bevel gears 22 and 23 to drive a shaft 24. At the other end of the shaft 24 there is secured a bevel gear 25 (Fig. 5) which meshes with the bevel gear 26 which is secured to the shaft 27 and, as previously described, the shaft 27 carries the cam 29 which cooperates with a series of contact operating bars 40. After the bars 33 have been unlatched and moved to adjusted positions in a predetermined combinational setting corresponding to the combinational holes analyzed, the cam 29 will be sufficiently rotated to withdraw the high part of the cam 29 (see Fig. 6a) from the projections 42 thereby releasing the contact operating bars 40 and one of these may now move upwardly permitted by the low part of the cam 29.

At this time the card is being moved by the feeding rollers and at the time one of the contact operating bars is moved to contact operating position the leading edge of the card is adjacent the sorting control blade 15a. The arrangement is such that the contact operating bar 40 which is moved into contact operating position will retain the closure of the selected contacts 50 a sufficient length of time to cause the selected sorting control magnet 16a or 16b to be energized to shift the respective sorting blade 15a or 15b so that upon the correlation of a card with the sorting blade which is operated the selecting sorting blade will deflect the card into the desired sorting pocket. If the contacts 50 which are closed correspond to the selected designation which is effective during the sorting run, or which is one of the designations of the selected pair which are effective during the sorting run, the related sorting control magnet 16a or 16b will be energized and the record analyzed will be passed into the selected sorting pocket. The shaft 27 is driven through the interconnecting bevel gears and is given a single revolution for each card cycle and its rotation is, of course, timed with card feed so that the operation just described may be performed.

After the card has been passed into the selected sorting pocket, or has been directed to the reject pocket R, if it does not bear a designation corresponding to the designations effective during a related sorting run, the bar 40 which is operated will be restored to its normal position by means of the high part of the cam 29 thereby disengaging the right end of the bar 40 from the notches 45 in the bars 33 which, in the meantime, remain in their adjusted positions. The restoration of the contact operating bar 40 which has been operated is timed so that the restoration will be effected after the leading edge of a card which is not to be directed into one of the sorting pockets has passed the sorting blade 15b. Obviously, with the sorting blade 15b in the normal position shown in Fig. 3, the record card will be fed unobstructedly to the reject pocket R.

Directly after the above described operation, the adjusted bars 33 are restored to their normal positions by means of a cam 36 shown in Figs. 4, 5 and 6 and which is secured to the shaft 24. The gear ratio of the bevel gears 22 and 23 is so chosen that cam 36 is adapted to be rotated a single revolution for each operating cycle of the machine and, therefore, rotates synchronously with card feeding operations and the restoration of the cam 29. When the operated bar 40 has been restored to normal a high part of the cam 36 (see Fig. 7) will engage the upper ends of the adjusted bars 33 moving them downwardly so

that when they are in their normal positions the notches 34 will be re-engaged by the extensions 32 of the armatures 31 of the corresponding magnets 30.

Recapitulating, during the first sorting run one or more contacts 60 will be opened and such contacts correspond in character designations with the designations of all the records which pass through the machine during the first sorting run. During each of the successive card sorting cycles of a sorting run, involving either a selected designation or a pair of designations, the related contacts 50 will be closed and if the particular contact 50 or contacts 50 which are closed correspond to the selected designation, or the selected pair of designations which are to be effective during that sorting run, the related sorting magnet 16a or 16b will be energized and the record will be directed into the respective sorting pocket Fa and Fb. Upon the passage of a card which does not bear the selected designation its contact 50 will be closed but due to the fact that it does not correspond to the selected character designation neither of the sorting magnets 16a or 16b will be energized and this card will be directed into the reject pocket R.

The omission of sorting runs is effected by causing the sorting mechanism to be unresponsive to designations on cards which pass through the analyzing devices and the means for causing the sorting mechanism to be responsive to either a selected designation or a selected pair of designations is under control of the sorting character designation selector. When sorting operations are to be carried out for a pair of selected designations a sorting run is omitted for correspondingly designated record cards in the event that neither designation appears upon the cards passed through the machine during the first sorting run. This condition of the machine is effected by causing the contacts 50 which correspond to such character designations to remain in their normal closed position. This will control the subsequent position of the designation selector so that it will be directly moved to the next character representing position omitting intermediate character designating position not represented by the cards. When sorting operations are to be effected for a pair of selected designations and one of these designations appears upon the cards passed through the machine during the first sorting run the designation selector will occupy a character representing position corresponding to the designation appearing upon the card. During this sorting run record cards having one of these designations will control sorting operations and the record cards will be selectively directed into the sorting pockets Fa or Fb.

For each card sorting cycle the controlling bars 33 will be set up in a combinational setting and this will be translated into a single reading reflected by the positioning of one of the contact operating bars 40. This bar will close its corresponding contacts 50 to cause the energization of either the sorting magnet 16a or 16b in dependence upon whether it corresponds to the selected designation or selected pairs of designations.

After the card has been directed into the appropriate sorting pocket the contact operating bar 40 which has been positioned will be restored to its normal position free of all the bars 33, and thereafter, those bars 33 which have been moved to adjusted position will be retracted by the cam 36 to be subsequently re-latched by the armatures

of the associated magnets 30. The translator is now in normal position so that it is in condition to receive and represent the combinational representation under control of the holes of the card next passed through the analyzing devices and the operation just described will be repeated for each card passed through the machine for a sorting run.

At the termination of a sorting run, cards bearing the selected designation or selected pair of designations, will be found in the sorting pockets Fa and Fb and the unwanted cards not bearing the effective designations will be found in the reject pocket R. The record cards directed into the sorting pockets Fa and Fb may be taken out of these pockets or they may be left therein so that cards bearing the next selected designation will overlie the record cards retained therein. The record cards directed into the reject pocket during each sorting run are taken out of this pocket and replaced in the supply hopper 12 to be re-sorted under control of the next selected designation, or the selected pair of designations, to cause cards bearing these designations to be selectively disposed into the sorting pockets Fa, Fb.

Sorting designation selecting unit

The mechanism previously referred to which is provided for causing the sorting mechanism to be responsive to the character designations either singly or in pairs, successively during successive sorting runs and for preventing the sorting mechanism from being responsive to certain character designations which do not appear in the records passed through the machine, is diagrammatically shown in Fig. 4 and is constructed as a separate unit which is attached to the rear side of the machine.

In general this unit consists of three commutators which are diagrammatically shown in Fig. 9. The commutators 85a and 85b in Fig. 9 comprise the selecting mechanism for causing the sorting mechanism to be responsive to the designations either singly or in pairs, successively during successive sorting runs. A commutator 84 in Fig. 9 causes the sorting machine to omit sorting runs for character designations which do not appear upon the records first passed through the machine. As best shown in Fig. 9, the contact operating arms 87 and 92a and 92b of the respective commutators are interconnected by a shaft 83 to cause them to have corresponding character representing positions as is best shown in Fig. 4. The shaft 83 has secured thereto at its upper end an indicator disc 79 which carries a series of figures shown in Fig. 9 corresponding to the different digital positions of the contact arms of the three commutators. These figures are arranged in pairs and also singly, as outlined in Fig. 9, so that through a window of a cover for the disc 79 these figures are visible to the operator in order that he may know the different digit representing positions of the commutators, or the character representations which are to be utilized for effecting sorting operations during the successive sorting runs.

The means for effecting a step by step positioning of the switch arms of the different commutators is shown in Fig. 9 wherein it will be seen that the magnet 80 is adapted through its armature 81 and a cooperating ratchet wheel 82 connected to the shaft 83 to step the contact arms of the commutators successively by successive electrical impulses transmitted to the magnet 80.

By the digit representing positions of the contact arms 92a and 92b of the respective commutators 85a and 85b the sorting magnets 16a and 16b will be responsive to selected designations which appear on some of the records passed through the machine during a sorting run. To make this clearer, it should be understood that in the normal position of the switch arms 92a and 92b the machine is conditioned for effecting the sorting of record cards when cards having the designations 5 and 0 are passed through the machine during the first sorting run. Upon the presence of a card having the 5 digit designation, the related contacts 50 will be closed thereby rendering the commutator 85b effective to cause the sorting of the record cards by the energization of the sorting magnet 16b which is controlled by the commutator 85b. In a similar manner, the commutator 85a effects the energization of the sorting control magnet 16a during the first sorting run to sort 0 designated cards. Hence, during the first sorting run record cards are sorted out according to the pair 0—5. By stepping the switch arms 92a and 92b one step, record cards having the designations 1 and 6 are sorted out during the second sorting run. During the next two sorting runs the record cards are sorted out according to the pairs 3—8 and 4—9. Thereafter a successive step by step positioning of the commutators will be effected so that the successive positioning of only the switch arm 92b will cause sorting operations to be effected for record cards having the designations 10, 11, and 12 effected during the three final sorting runs.

The contact arm 87 of the commutator 84 has corresponding digit representing positions and the commutator contact elements contacted by contact arm 87 are wired to respective contacts 60 in such a manner that a related pair of selected contacts 60 must be simultaneously closed to cause the omission of a sorting run. To make this clearer, during the first sorting run record cards having the designations 0 and 5 are sorted out and it is for this reason correspondingly designated contacts 60 are not provided. In the next position of the switch arm 87, which is the position it occupies prior to the initiation of the second sorting run, it will be seen that the next commutator contact element in contact with switch arm 87 is in series with the two pairs of contacts 60 designated by the digits 6 and 1. In the event that both of these contacts are closed this is an indication that record cards having the designations 1 and 6 have not passed through the machine during the first sorting run and, therefore, a sorting run will not be performed for cards having these designations. In the event that only one designation appears, one of these contacts will have been left open thus causing sorting to be effected for cards having a corresponding designation. When record cards are passed through the machine during the first sorting run which do not bear the designations 1 and 6 the correspondingly designated contacts 60 will remain closed. This will enable an impulse to be transmitted to the magnet 80 and the commutators will be positioned so as to omit sorting for the designations 1 and 6 and directly condition the machine for the next sorting operation for sorting out cards bearing the designations 2 and 7, if either is designated on the cards.

Operation of machine in connection with wiring diagram

After or before a stack of record cards to be

sorted by the machine has been placed in the supply hopper 12 (Fig. 3), there will be certain preliminary adjustments of the machine to select the card field which is to control sorting operations and also to select the particular card column of the selected card field. In addition to these preliminary adjustments, there is an additional adjustment made by the operator which conditions the machine for sorting the record cards in accordance with alphabetical or numerical designations. As previously indicated, when the machine is conditioned for sorting according to alphabetical designations, sorting operations are effected in two phases, one phase consisting of sorting runs for effecting sorting according to alphabetical characters A—R and the second sorting phase for sorting according to the alphabetical designations F—Z. The machine is provided with a selector to determine this. The selection of a card column is effected by the rotation of the crank handle 17 shown in Fig. 3 which positions the brushes 14 laterally in a well known manner to correlate the analyzing brushes with a selected card column of the selected card field. The selection of a card field is effected by the appropriate adjustment of the switch 104, (Fig. 9) which selects a card field in a manner to be presently described.

The initiation of the operation of the machine is effected after the desired preliminary adjustments have been made, by the depression of a start key which closes a circuit from the positive line side 100, through contact 70 closed by the start key, to a motor control relay magnet 71, a wire 72, contacts 73, wire 74, to the negative line side 110, causing the energization of the motor control relay magnet 71 and the closure of its relay contacts 76 and 77. Contacts 76 are holding contacts for the relay magnet 71 and provide a holding circuit for the magnet through the relay contact 76 and the stop key contacts 75 which are connected to the positive line side 100. The closure of contacts 77 closes a circuit for the motor 10 leading from the positive line side 100, wire 78, relay contacts 77, motor 10, to the negative line side 110. The motor will thereby be set into operation and will be in continuous operation until the holding circuit is opened by the opening of the stop key contacts 75 or the contacts 73. The contacts 73 have been previously referred to particularly with reference to Fig. 6 and it will be recalled that these contacts are opened after a series of record cards has been sorted in accordance with all the designations appearing in one card column. In other words, after the last sorting run for the designations in a single card column contacts 73 are open in the manner and by the means previously described to automatically stop the operation of the motor 10.

After the machine is to be operated in such a manner that the commutators 85a, 85b and 84 will occupy successive character designating positions effected by the passage of a control card at the termination of each sorting run, a switch 51 shown at the upper left of Fig. 9 is placed in the full line position shown. At the beginning of the first sorting run, or the normal condition of the machine, the commutators just referred to will be in a character representing position to cause sorting operations under control of the 0 and 5 designations of the record cards first passed through the machine and which, of course, is the first sorting run.

The selection of the card field which is to control sorting operations is determined by the

position of the switch 104, and the selection of the card field is effected by transmitting current to the magnets 30 by either of two differently timed circuits depending upon which card field is to control sorting operations. When the switch 104 is in the position shown in Fig. 9, current will be transmitted to the magnets 30 from the positive line side 100, through the switch 104, through cam controlled contacts 102, to a wire which leads to one side of all of the magnets 30. The contacts 102 are timed to close at the time the holes of the upper card field are correlated with the analyzing brushes 14. It is to be noted that from the other side of the magnets 30 there are individual wire connections 105 to the respective analyzing brushes 14 and the circuit is closed by means of the brushes 14 through the holes in the card, the circuit being continued by a wire connection to the negative line side 110, and which wire is connected to the bed plate over which the record card is fed.

When the lower card field is to be selected for controlling sorting operations, the switch 104 is moved to the dotted line position shown in Fig. 9, the circuit then leading from the positive line side 100, through cam controlled contacts 103 and which continue the circuit by a wire 106 to the common line side of the magnets 30. Contacts 103 are timed to be closed by a cam at a time when the perforations of the lower card field are correlated with the analyzing brushes 14. By the above described circuits the magnets 30 are selectively energized in dependence upon the combinational location of the holes in the selected card field.

It will be recalled that sorting according to alphabetical character is effected in two different phases and during the first phase the records which are to be sorted all have a perforation located at the V index point position. During the second phase the record cards which are to be sorted according to their alphabetical designations each have a perforation located at the VI index point position. Depending upon the presence of holes at either the V or VI index point positions, the relay magnets 201 and 202 are selectively energized and their selective energization is dependent upon the presence of perforations at the last mentioned index point positions. When the machine is conditioned for effecting sorting in accordance with the alphabetical designations, the record card is fed in the direction shown by the arrow in Fig. 1 and, at the time the perforations at the I, II, III, and IV index point positions are correlated with the analyzing brushes, contacts 102 will close to effect the selective energization of the magnets 30, in the manner just described. After this analysis cam controlled contacts 102 open and at the time the index point positions V and VI are correlated with the two left-hand analyzing brushes 14, Fig. 9, contacts 203 will close. The circuit for causing the selective energization of the relay magnets 201, 202 is from the positive line side 100, through the switch 104, through cam controlled contacts 203, to the common line side connection for the relay magnets 201 and 202. From Fig. 9, it will be seen that from magnets 201, 202 there are individual wire connections to the respective analyzing brushes 14 which are at the extreme left in Fig. 9, so that depending upon the perforation located at the V or VI index point positions, the relay magnets 201 and 202 will be selectively energized.

As previously indicated, there is a preliminary adjustment of the machine for controlling the sorting mechanism so that it will sort the record cards according to numerals or alphabetical designations. This selection is controlled by the position of a switch 210 (Fig. 9) which is adapted to have three different positions of adjustment. When the switch 210 is in the full line position shown in Fig. 9, the machine is conditioned for effecting the sorting of record cards according to numeral designations. When the switch 210 is in the intermediate position, the sorting of record cards will be effected according to the alphabetical designations A—R. When switch 210 is positioned to the extreme right, sorting of the record cards will be effected according to the alphabetical designations S—Z.

There will now be described the circuits which are effective for controlling sorting of the record cards by the numeral designations thereon, and it is to be understood that the same circuits are involved whether the sorting operations are to be effected under control of the upper card field or the lower card field, this being determined, it will be recalled, by the position of the switch 104. In the normal condition of the machine, or when the machine is in condition for effecting the first sorting run, record cards bearing the numeral designations 0 and 5 are sorted out, and this is effected by the normal position of the commutators 85a, 85b, shown in Fig. 9.

It will be recalled that upon analysis of record cards having perforations representing either 0 or 5, the combinational arrangement is translated into a single digit representation which is reflected by the closure of the correspondingly designated contacts 50. Assuming, for example, that the card passing through the machine represents 0, and the correspondingly designated contacts 50 are closed, it will be seen that a circuit will be closed from the positive line side 100, through the switch 210, wire 211, to the 0 contacts 50, the circuit then leading to the contact element of commutator 85a designated 0. The switch arm 92a of the commutator is in contact with this element, thereby extending the circuit to a commutator ring 93a in continuous contact with the switch arm 92a. The circuit then extends from the commutator ring through switch 260a and wire 94a to the sorting control magnet 16a, the other side of this magnet being connected to the negative line side 110. The closure of this circuit will effect the energization of the sorting magnet 16a and the latter will position its related sorting blade 15a to deflect the 0 designated card into the sorting pocket Fa.

Assume, for example, that the next record card passing through the machine in the same sorting run bears the designation 5, the combinational hole arrangement designating this digit will be translated into a single digit representation reflected by the closure of the correspondingly designated contacts 50. The sorting control circuit in this instance leads from the positive line side 100, through the switch 210, the wire 211, the 5 designated contacts 50, thence by a related wire 91b to the 5 contact element of the commutator 85b. This contact element is in electrical contact with the switch arm 92b of the commutator and the latter is in continuous contact with commutator ring 93b so that the circuit will be extended from this commutator ring through the switch 260b, wire 94b, to the

sorting control magnet 16b, the latter having a wire connection to the negative line side 110.

When sorting operations are effected under control of the magnet 16a, the energization of this magnet may be held by the contacts 50 for a sufficient length of time so that the sorting blade 15a will be in card deflecting position at the time the leading edge of the card to be sorted will be obstructed by the sorting blade so as to be directed into the sorting pocket Fa. When sorting operations are to be effected for cards directed into the sorting pocket Fb, the extent of record card feed is substantially increased, and it is preferable to provide a holding circuit for the sorting control magnet 16b to enable the latter to be held energized until the card to be sorted is obstructed by the sorting blade 15b and thereby directed into the sorting pocket Fb. In the present arrangement this holding circuit leads from the positive line side 100, through cam controlled contacts 226, a pair of contacts which are bridged by the armature of magnet 16b, the circuit then extending to one side of the sorting control magnet 16b, thence from the other side of this magnet to the negative line side 110. This will retain the energization of the sorting control magnet 16b a sufficient length of time to insure proper sorting operations.

The circuits just described have been described in connection with the sorting of record cards bearing the designations 0 and 5 and which is effected during the first sorting run. It is pointed out that sorting operations for sorting subsequent record cards according to other designations are effected in substantially the same manner and by means of the same circuit connections. The closure of the circuits of the sorting magnets 16a and 16b is effected under control of the contacts 50 and, if the closure of these contacts corresponds in designations to the designations which are effective during that sorting run, sorting of correspondingly designated record cards will ensue.

As previously pointed out, during successive sorting runs the record cards will be sorted out in pairs according to the following paired numeral designations: 6—1, 7—2, 8—3, 9—4, and thereafter the three successive sorting runs effected for the numerals 10, 11, and 12.

For sorting of record cards according to the alphabetical designations A—R, the switch 210 is placed in its intermediate position. Upon the passage of any of the record cards bearing a perforation at the V index point position, the relay magnet 201 will be energized, thereby causing the closure of its related contacts 221, thus establishing the closure of the circuit leading from the positive line side 100, through the relay contacts 221, to the switch 210 now in the intermediate dotted line position, wire 211, and thence to the common line connection for all of the contacts 50. Therefore, sorting of the record cards during the first sorting run will be effected whenever a record card has a perforation at the V index point position and, if a record card has the designation which is to be effective during that sorting run, it will be directed into either the sorting pocket Fa or Fb. Whether or not sorting will be effected for certain cards which have the perforation at the V index point position will be determined by the position of the switch arms of the commutators 85a and 85b, in the same manner as has been previously described in connection with sorting operations for numerals. While during the first sorting run

sorting operations are effected for the numerals 0 and 5, when the machine is conditioned for sorting according to alphabetical designations, cards bearing the alphabetical designations A and K will be sorted out. The reason that similar sorting operations are effected under control of the commutators for numerals and the alphabet is due to the fact that, with the exception of the extra designation at the V index point position, the combinational arrangement of perforations is the same for representing numerals and alphabetical designations. For example, 0 is represented by holes at the I and IV index point positions and A is represented by holes similarly arranged. The same hole arrangement is effected for designating the numeral 5 and the letter k. Since the translation of the combinational arrangement of perforations is the same whether they represent letters or numerals, obviously the machine will effect similar sorting operations under control of the commutators 85a and 85b during the successive sorting runs.

For sorting record cards bearing the alphabetical designations which are effective during the second phase, the switch 210 is positioned at the extreme right as shown by dotted lines. In this case only record cards having perforations at the VI index point position will cause the energization of the relay magnet 202 and the closure of its related contacts 222, thereby extending the circuit from the positive line side 100, through the relay contacts 222, the switch 210 at its extreme right hand position, wire 211, which is the common wire connection for the contacts 50. Thus, record cards having alphabetical designations and having the extra designations at the VI index point position will be sorted out and the sorting operations will be in accordance with the designations which are to be effective during the successive sorting runs.

During the first sorting run all of the cards placed in the supply hopper will pass through the machine and certain of the contacts 60 will be operated to cause the digital representations of the stack of cards to be set up. Assuming, for example, that the characters 1, 2, and 7 are not represented upon any of the cards passed through the machine and, accordingly, the contacts 60 bearing the digit designations 1, 2, and 7 in Fig. 9 will remain closed which, of course, is their normal condition. These contacts will remain closed during successive sorting runs. For the digit representations which are on the cards passed through the first sorting run the correspondingly designated contacts 60 will be opened as previously described.

The machine first sorts cards bearing the digit representations 0—5 in the first sorting run, the commutators being in the normal position shown in Fig. 9. Sorting operations will be effected for sorting out cards bearing the 0 digit representation by the energization of the sorting control magnet 16a and sorting of the cards bearing the 5 digit representation will be effected by the energization of the sorting control magnet 16b. At the termination of the first sorting run the control card will pass through the machine resulting in the closure of the contacts 50—Sk in Fig. 9, causing the closure of a circuit leading from a positive line side 100, wire 112, contacts 50—Sk, wire 54, wire 53, magnet 80, which is connected to the negative line side 110. This will cause the energization of the magnet 80 and the attraction of its armature 81 and when the circuit to the magnet 80 is broken, a spring (not designated in

Fig. 9) will restore the armature 81 thus turning the ratchet wheel 82 a single step to correlate the contact arms 87, 92a, and 92b of the respective commutators with the next commutator contact element. This setting of the commutators will then condition the machine for causing sorting operations according to the digit representations 1 and 6. It has been assumed that the cards which have first passed through the machine included some which represented the digit 6 but no cards were present which included the character representation 1 so that the correspondingly designated contacts 60 will remain closed. This will, nevertheless, require that the machine go through the second sorting operation, sorting out only the record cards which bear the designation 6 and at the termination of the second sorting run the control card passes through the machine effecting in the manner previously described the energization of the magnet 80 causing the commutators to be stepped to the next character representing position.

In the third position of the commutators the machine will be conditioned for sorting out record cards bearing the digit representations 2 and 7 and it has been assumed that cards bearing these designations are not present in the stack which is to be sorted. When the commutators are in the position for effecting the sorting of the digit representations 2 and 7 a circuit will be closed which leads from the positive line side 100, switch 51, wire 98, to the contacts 60 designated by the digit 2, the contacts 60 designated by the digit 7, the contact element of the commutator 84, the switch arm 87, the collector ring 88, intermittently closed contacts 90, wire 53, to the magnet 80 and thence to the negative line side 110. The cam which intermittently closes contact 90 may be rotated by any suitable driving shaft of the machine and upon the closure and opening of the contacts 90 it is evident that the magnet 80 will be energized and deenergized to cause the shaft 83 to be turned one step thereby bringing the contact arms 87, 92a and 92b to the 3 and 8 digit representing positions. It is apparent, therefore, that a sorting run for sorting out record cards bearing the 2 and 7 digit representation will be omitted and the machine will be directly conditioned for sorting out cards bearing the digit representations 3 and 8.

In this manner two successive sorting runs will take place for cards according to the sorting paired digits 3—8, 4—9. Thereafter, three successive sorting runs will ensue for sorting out record cards bearing the numeral representations 10, 11, and 12. At the end of the sorting run for sorting out record cards bearing the numeral designation 12 the magnet 80 will be energized due to the passage of the control card thereby moving the switch arms of the commutators another step in a clockwise direction, as shown in Fig. 9, and closing circuits now to be traced.

When the contact arm 92b engages the contact element to which the wire 95 is connected, a circuit will be closed leading from the positive line side 100 through the switch 51, the wire 98, the restoring magnet 97, the wire 96 to a contact element of the commutator 85b which is insulated from the collector ring 93b and which is now in contact with the switch arm 92b. The circuit then leads from the switch arm 92b to an insulated contact element to which the wire 95 is connected and since the wire 95 is connected to the negative line side 110 the closure of the circuit will result in the energization of the magnet 97.

The closure of the last described circuit will cause, as previously described, the restoration of those contacts 60 which have been latched in open position. It will be remembered that the energization of the magnet 97 will result in the opening of the contacts 73 and this will cause the opening of the circuit of the motor 10 and the latter will automatically terminate its operation. The machine, however, will continue in its operation a sufficient length of time so that contacts 90 are again closed and opened to effect the energization and deenergization of the magnet 80 thereby causing the switch arms of the commutators to be moved an additional step to bring them in the normal positions shown in Fig. 9.

When the machine is conditioned for sorting according to alphabetical designations, the machine operations are performed in the manner previously described. If record cards are absent which do not bear certain alphabetical designations in selected pairs there will be an omission of sorting runs for such omitted pairs of alphabetical designations. The manner in which this is performed is precisely the same as has been described in connection with the sorting of numerically designated cards.

It is sometimes desirable to accomplish the sorting of the record cards according to selected designations and without utilizing the automatic digit designation selector which is positioned under control of the control cards. At other times it may be desirable to condition the machine so that the first digit which is selected to control sorting operations may be selected directly and without utilizing the control card. To this end, contacts 52 (Fig. 9) are closed by the actuation of a manually operable key, the circuit leading from the positive line side 100 through the switch 51 in the dotted line position, contacts 52, to the magnet 80, thence to the negative line side 110. By a succession of impulses sent to the magnet 80 the sorting designation selector may be directly adjusted to the desired initial position as indicated by the disc 79 (Fig. 9) and record sorting operations for records having only a selected pair of designations may be performed. When sorting operations are to be effected for a selected pair of designations the switches 260a and 260b remain closed, or in the position shown in Fig. 9. If it is desired to sort under control of only one of the designations of the selected pair the appropriate switch 260a or 260b will be opened. It is desirable that the operator be either supplied with a diagram, or a suitable label be placed in juxtaposition to the switches 260a, 260b so that the operator will know which switches should be manipulated to effect the sorting in accordance with the single selected designation.

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 during each sorting run only one group of records having a selected pair of designations and rejecting during the same sorting run all other

groups of records having other designations, a reject compartment and a pair of sorting compartments, sorting mechanism operable for selectively sorting records into said sorting compartments, analyzing means for analyzing said designations, selecting devices for effecting the selection of designations in pairs to cause the operation of said sorting mechanism upon analysis of either one of a selected pair of designations, and automatically operated means for automatically causing said devices to select the designations in successive pairs for causing said sorting mechanism to be responsive to a successive selected pair of designations to thereby sort out for each sorting run a group of records having either one of a selected pair of designations and reject during the same sorting run all other groups of records having other designations.

2. In a sorting machine in which sorting is effected for each selected pair of record designations and sorting is effected in a predetermined sequence according to paired designations, record designation analyzing means, sorting mechanism controlled thereby, selecting means intermediate said analyzing means and said sort sorting mechanism for causing said sorting mechanism to be responsive to selected pairs of designations and including means for operating said selecting means to select pairs of designations in a predetermined sequence, and means including a specially designated card for effecting the operation of said operating means for effecting the selection of the next pair of designations utilized to control the sorting mechanism.

3. In a sorting machine for sorting in a plurality of sorting operations records containing designations, and for effecting the sorting of records according to a pair of selected designations, record designation analyzing means, set-up designation representing means under control of the analyzing means for setting up representations appearing on the records analyzed, sorting mechanism for sorting records according to the analysis of selected pairs of designations, selecting means for determining the particular pairs of designations which are to control said sorting mechanism, and means controlled by said set-up digit representing means to control said selecting means to cause said sorting mechanism to sort only records bearing a selected pair of designations represented by the records analyzed by said analyzing means and by the set-up designation representing means.

4. In a sorting machine for sorting records containing designations, in combination, record sorting mechanism, record designation analyzing means for controlling said sorting mechanism, means for selecting and determining the particular pairs of designations which are to control upon their analysis said sorting mechanism, set-up designation representing means representing all of the records to be sorted, and means controlled by said set-up means to control said selecting means to cause the latter to successively select designations in pairs and corresponding to only those actually appearing on the records to be sorted.

5. In a sorting machine in which sorting is effected for each pair of record designations according to designations paired in a predetermined sequence, designation analyzing means, sorting mechanism controlled thereby, selecting means intermediate said analyzing means and said sort-

ing mechanism for causing sorting to be effected for pairs of designations in the predetermined sequence, means to operate said selecting means to successively select the next pair of designations according to the predetermined sequence, character representing set-up means for representing designations on the records, and means controlled by said set-up means to cause said selecting means to select only such pairs of designations as appear on the records to thereby eliminate sorting operations for non-existing pairs of designations, but cause sorting to be effected whenever one of a selected pair of designations exists on the records to be sorted.

6. In a sorting machine for sorting records containing designations, each sorting run effecting the sorting of records containing a pair of selected designations, record designation analyzing means, set-up designation means for setting up all the representations of designations appearing on the records, means for retaining said set-up means in designation representing positions during successive sorting operations, sorting mechanism for sorting records according to the analysis of selected pairs of designations, means controlled by said set-up representing means to render said sorting mechanism effective to sort only records bearing designations in selected pairs represented by the set-up digit representing means, and means for rendering said retaining means ineffective upon the completion of sorting operations for all the designations represented by the setup means.

7. In a sorting machine for sorting character designating records according to a selected pair of characters, and a plurality of sorting operations being effected according to the sequence of all the paired characters which appear in a full complement of records to be sorted, record character designation analyzing means, character set-up means under control of said analyzing means for setting up representations of the characters appearing on records to be sorted, sorting mechanism, means for selecting pairs of characters including means for operating said selecting means for causing the sorting mechanism to be responsive to the next pair of character designations to be selected for sorting correspondingly designated records, and means under control of said character set-up means to render said selecting means ineffective when the next pair of character designations does not appear on any of the records to be sorted and for causing the sorting mechanism to be responsive to the next pair of character designations and which are represented by the character set-up means, thereby eliminating idle sorting for pairs of characters not appearing on records.

8. In a sorting machine for sorting character designating records according to a selected pair of characters, and a plurality of sorting operations being effected according to the sequence of all the paired characters which appear in a full complement of records to be sorted, record character designation analyzing means, character set-up means under control of said analyzing means for setting up representations of the characters appearing on records to be sorted, sorting mechanism, means for selecting pairs of characters for causing the sorting mechanism to be responsive to either or both characters of the next pair of characters to be selected for controlling the sorting of correspondingly designated records including means for operating said selecting means for selecting successive pairs of characters, and

means under control of said character set-up means to render said selecting means ineffective when only both of the next selected pair of character designations do not appear on any of the records to be sorted and for causing the sorting mechanism to be responsive to either or both of the next selected pair of character designations and which are represented by the character set-up means, thereby eliminating idle sorting for pairs of characters not appearing on records.

9. In a sorting machine for sorting records, said records representing by designations thereon characters according to which sorting operations ensue in selected pairs, a sorting mechanism including a pair of sorting pockets 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 either one of a selected pair of designations in the respective sorting pockets and remaining records in said reject pocket, selecting means for causing said sorting mechanism to be responsive to the designations in pairs and including means for operating said selecting means for selecting designations in pairs according to a predetermined sequence, character representing set-up means controlled by said analyzing means to represent the characters of the records analyzed, and means controlled by said set-up means to control said selecting means to cause said selecting means to select only such designations in pairs as appear on the records analyzed to thereby eliminate sorting operations for non-existing pairs of designations.

10. In a sorting machine for sorting records in a plurality of sorting runs, said records representing by designations thereon characters according to which sorting operations ensue, a sorting mechanism including a pair of sorting pockets and a single 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 pair of designations in the sorting pockets in each sorting run 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 in pairs and successively in pairs in a predetermined sequence, character representing set-up means controlled by said analyzing means to represent the characters 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 selected pairs of designations as appear on the records analyzed to thereby eliminate sorting runs for non-existing designations in selected pairs.

11. In a sorting machine for sorting records according to single designations on the records but according to a selected pair of designations for each sorting run, an analyzing brush contact in the path of the designations of the records, a sorting mechanism including a pair of electro-magnets for selectively sorting the records, a step by step operated circuit controller means for said electro-magnets for effecting the selective operation of the sorting mechanism by the selected pair of designations during succeeding sorting runs, means for effecting the step by step operation of said circuit controller means, and means including a record passed through the machine during each sorting run to cause the auto-

matic operation of said last named means whereby only such records as have either of the pair of designations selected by the circuit controller means 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 means to cause the latter to select a succeeding pair of designations whereby only such designations that are on the records to be sorted control sorting operations and sorting runs for non-existing designations are omitted.

12. In a sorting machine for sorting records according to their character representations, the characters 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 single character representation, selecting means for successively selecting said translated character representations in selected pairs for causing said sorting mechanism to be responsive to the successive pairs of character representations, a character representing set-up means controlled by said analyzing means, and means controlled by said set-up means to operate said selecting means to select only such pairs of character designations as appear on the records to thereby eliminate idle sorting operations for non-existing pairs of designations on records which are not to be sorted.

MICHAEL MAUL.
KARL HUMMEL.