June 16, 1936. W. W. LASKER 2,044,120

SORTING MACHINE

Filed June 30, 1931 8 Sheets-Sheet 1

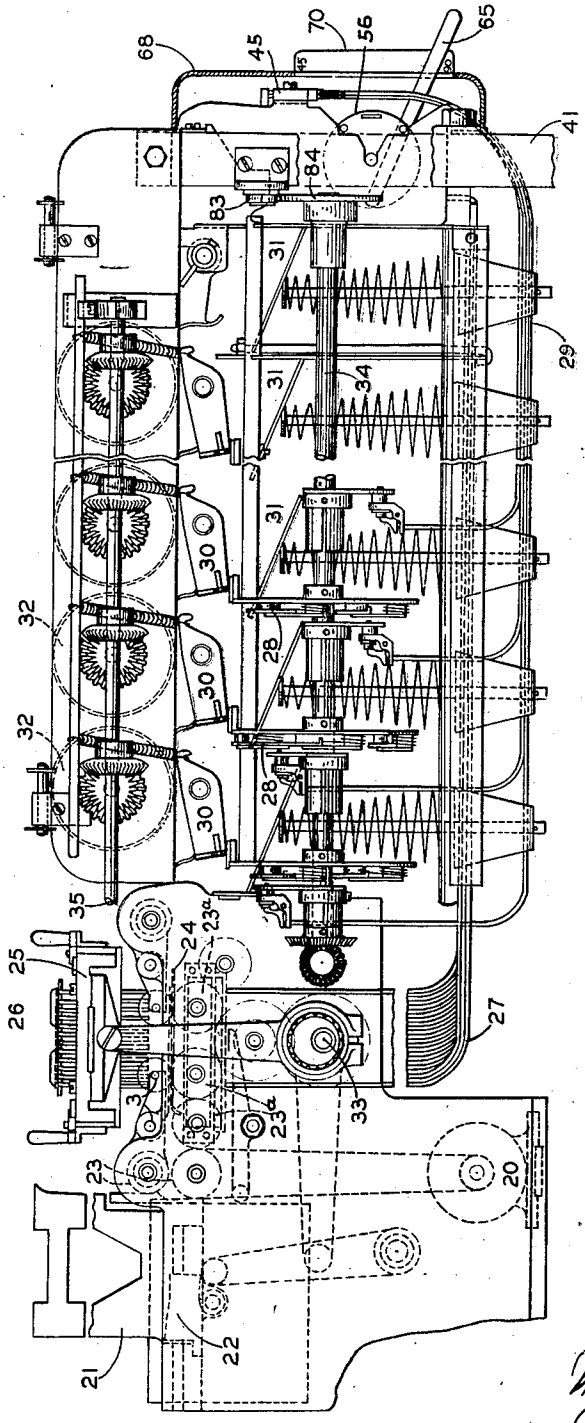

Fig. 1.

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June 16, 1936. W. W. LASKER 2,044,120

SORTING MACHINE

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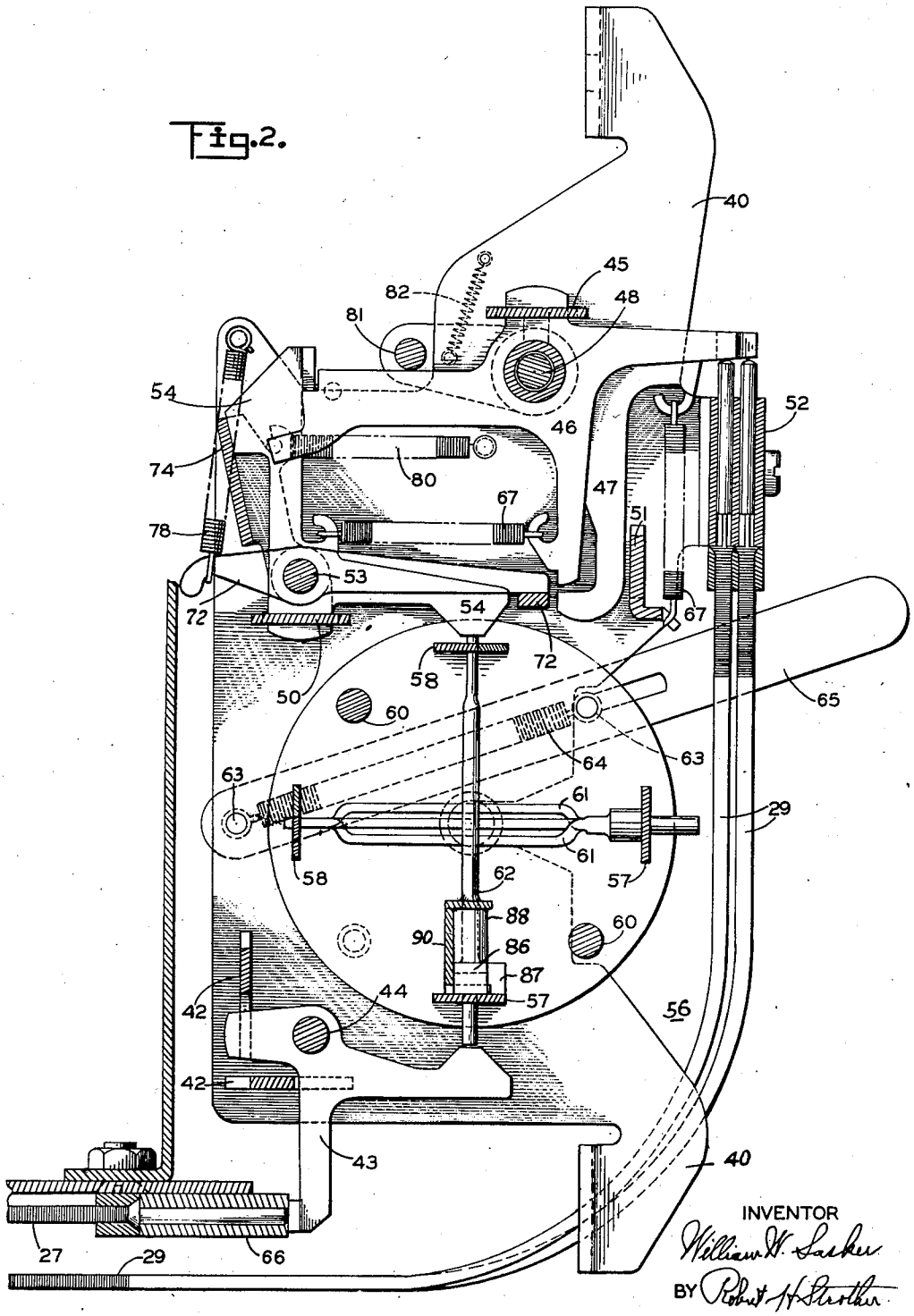
Fig. 2.



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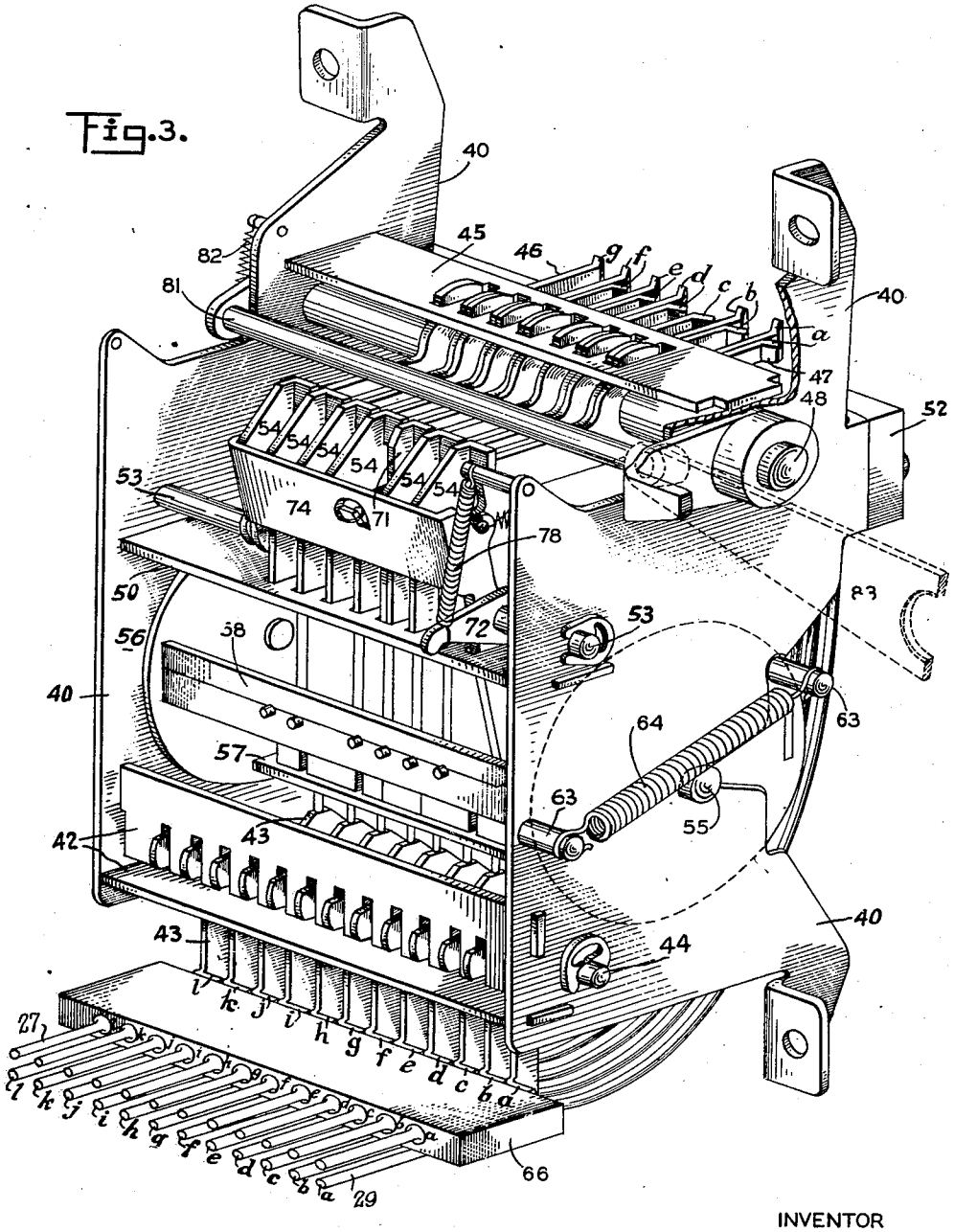
June 16, 1936. W. W. LASKER 2,044,120

SORTING MACHINE

Filed June 30, 1931 8 Sheets-Sheet 3

Fig. 3.



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SORTING MACHINE

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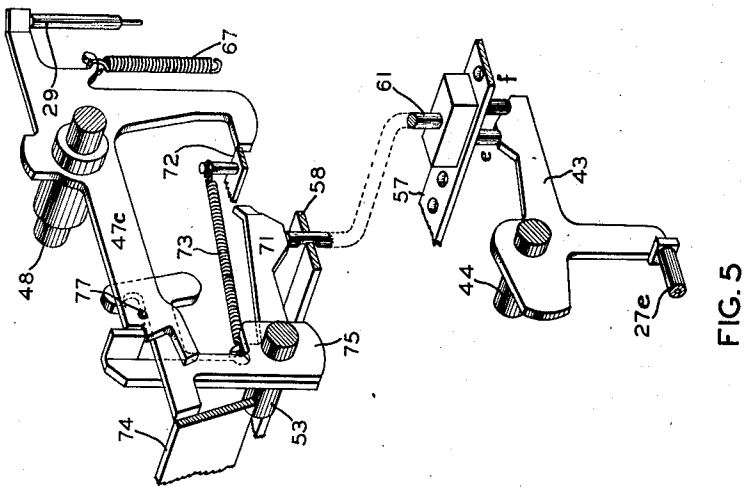

FIG. 5

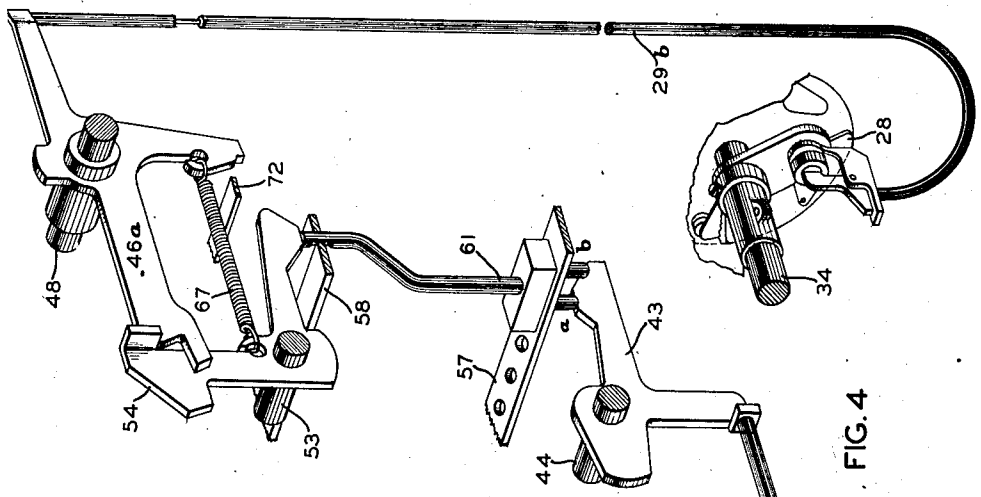

FIG. 4

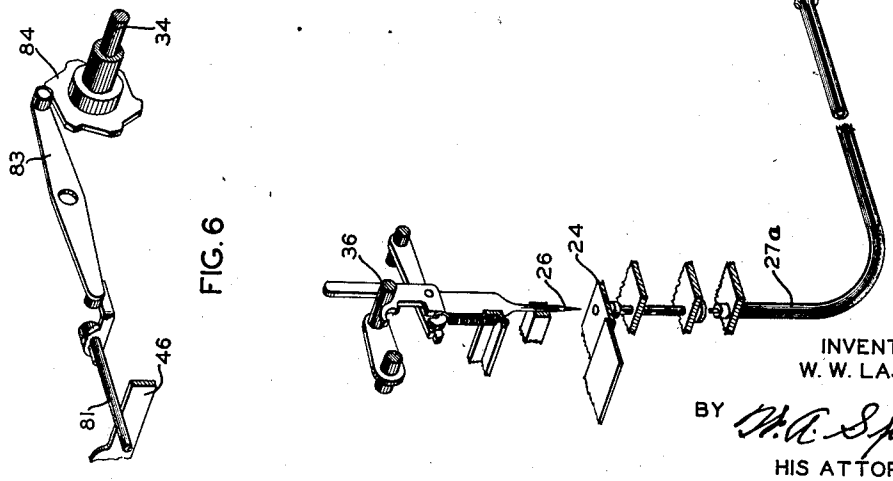

FIG. 6

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June 16, 1936. W. W. LASKER 2,044,120

SORTING MACHINE

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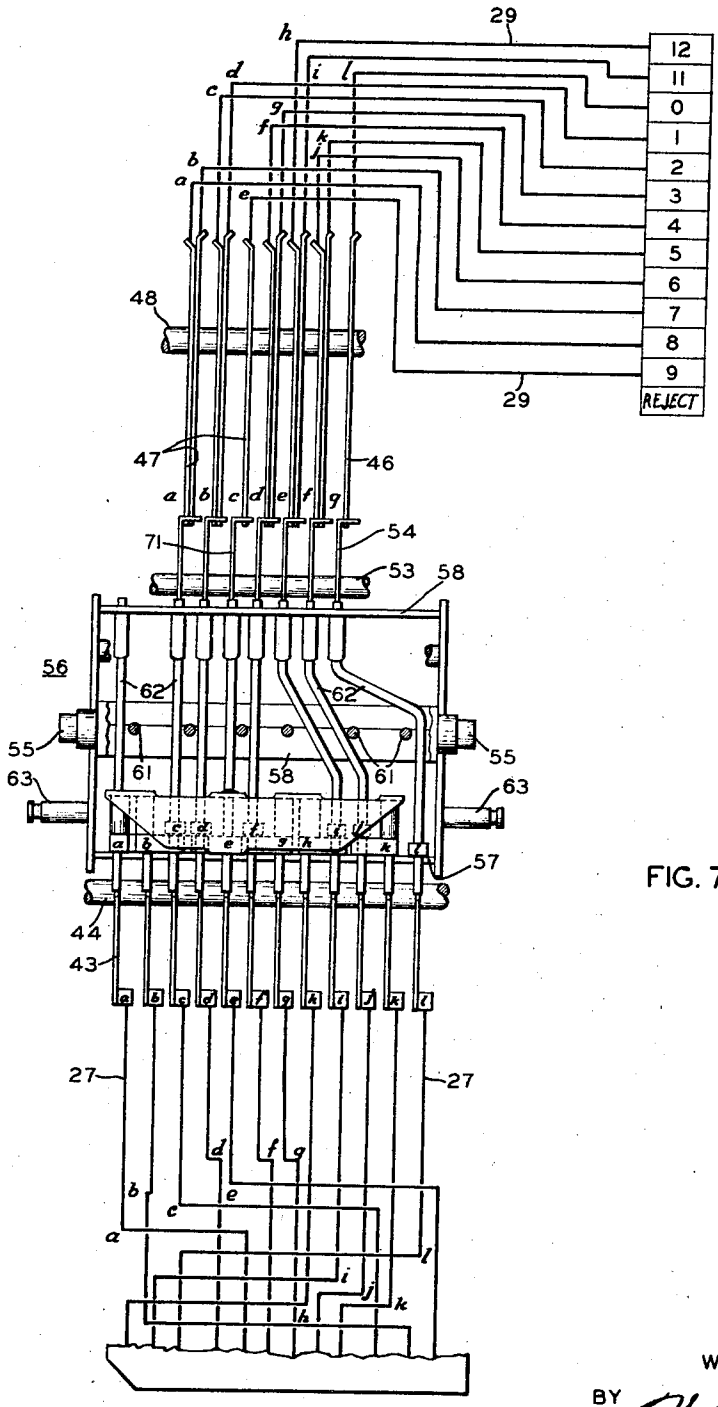

FIG. 7

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June 16, 1936. W. W. LASKER 2,044,120

SORTING MACHINE

Filed June 30, 1931 8 Sheets-Sheet 6

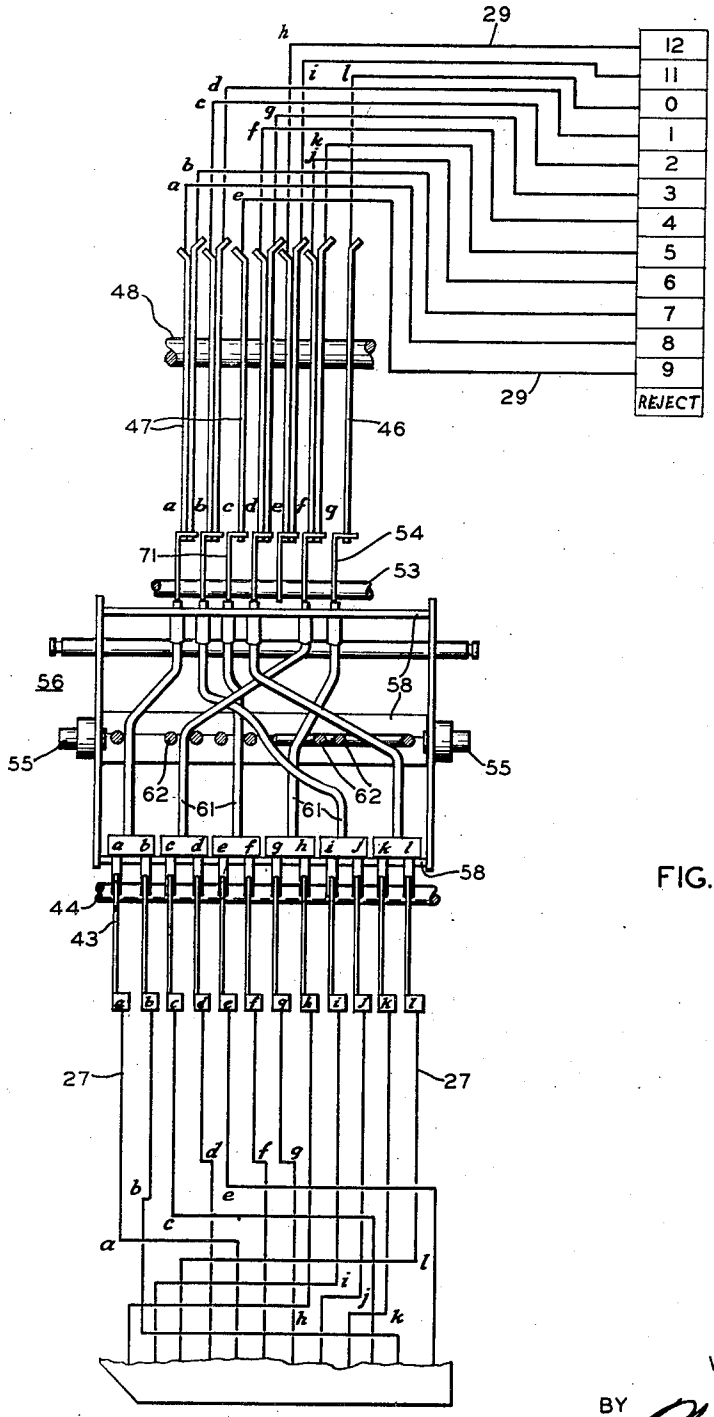

FIG. 8

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June 16, 1936. W. W. LASKER 2,044,120

SORTING MACHINE

Filed June 30, 1931 8 Sheets-Sheet 7

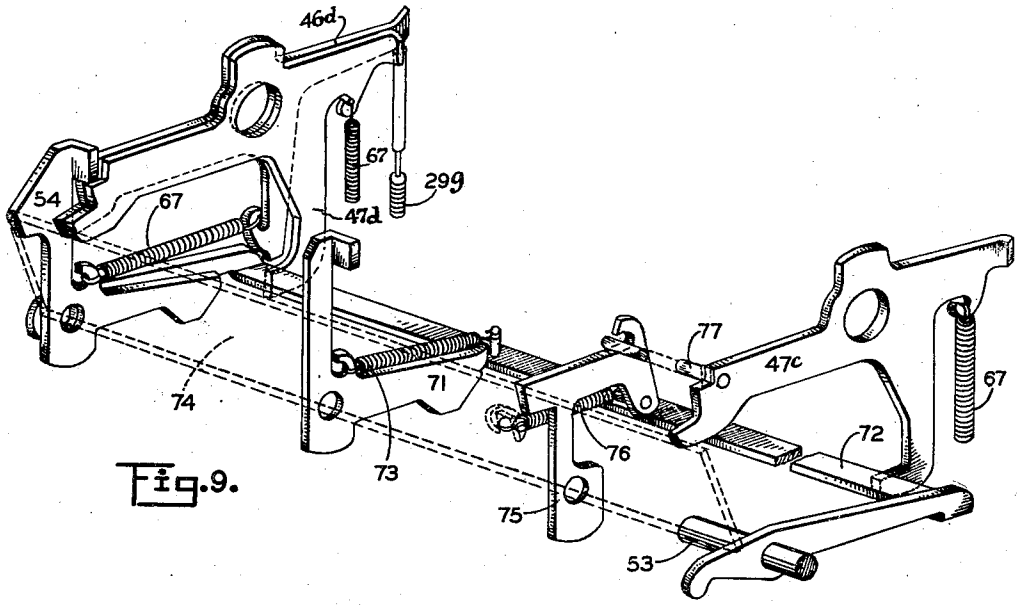

Fig.9.

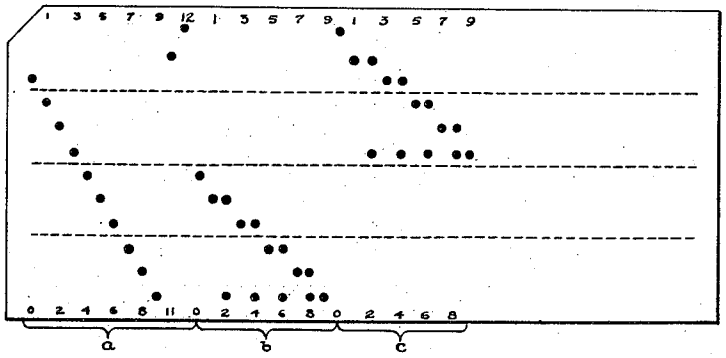

Fig.11.

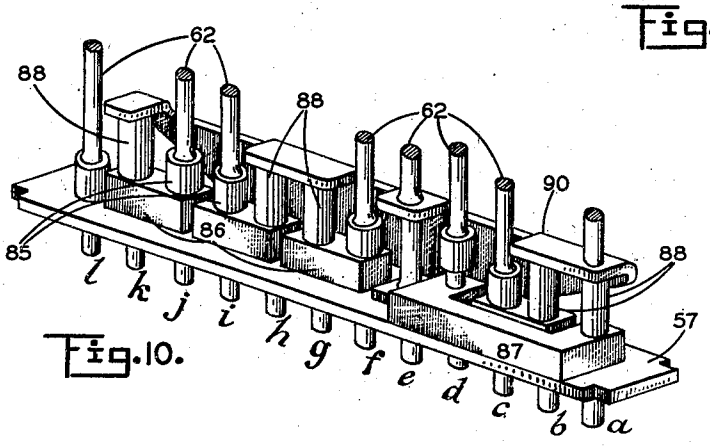

Fig.10.

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SORTING MACHINE

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STRAIGHT PERFORATION SUBSTITUTIONS							
SENSING PINS	WIRES 27	LEVERS 43	INTERPRETER WIRES 62	FIRING LEVERS UNLATCHED	FIRED	WIRES 29	POCKETS 31
12	h	h	e-h-i	46e-47e-47c	47e	h	12
11	i	i	i	46e-47e	46e	i	11
0	l	l	l	46g	46g	l	0
1	d	d	d	46b-47b	46b	d	1
2	a	a	a-d-e	46b-47b-47c	47b	c	2
3	f	f	f	46d-47d	46d	g	3
4	g	g	e-f-g	46d-47d 47c	47d	f	4
5	j	j	j	46f-47f	46f	k	5
6	k	k	e-j-k	46f-47f-47c	47f	j	6
7	c	c	c	46a-47a	46a	b	7
8	b	b	b-c-e	46a-47a-47c	47a	a	8
9	e	e	e	47c	47c	e	9

Fig. 12.

DOUBLE FIELD COMBINATION PERFORATION SUBSTITUTIONS							
SENSING PINS	WIRES 27	LEVERS 43	INTERPRETER WIRES 61	FIRING LEVERS UNLATCHED	FIRED	WIRES 29	POCKETS 31
12	h	h	g-h	46g	46g	l	0
11	i	i	i-j	46b-47b	46b	d	1
11+3	i-f	i-f	i-j-e-f	46b-47b-47c	47b	c	2
0	l	l	k-l	46d-47d	46d	g	3
0+3	l-f	l-f	k-l-e-f	46d-47d-47c	47d	f	4
1	d	d	c-d	46f-47f	46f	k	5
1+3	d-f	d-f	c-d-e-f	46f-47f-47c	47f	j	6
2	a	a	a-b	46a-47a	46a	b	7
2+3	a-f	a-f	a-b-e-f	46a-47a-47c	47a	a	8
3	f	f	e-f	47c	47c	e	9
4	g	g	g-h	46g	46g	l	0
5	j	j	i-j	46b-47b	46b	d	1
5+9	j-e	j-e	i-j-e-f	46b-47b-47c	47b	c	2
6	k	k	k-l	46d-47d	46d	g	3
6+9	k-e	k-e	k-l-e-f	46d-47d-47c	47d	f	4
7	c	c	c-d	46f-47f	46f	k	5
7+9	c-e	c-e	c-d-e-f	46f-47f-47c	47f	j	6
8	b	b	a-b	46a-47a	46a	b	7
8+9	b-e	b-e	a-b-e-f	46a-47a-47c	47a	a	8
9	e	e	e-f	47c	47c	e	9

Fig. 13.

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Patented June 16, 1936 2,044,120

UNITED STATES PATENT OFFICE

2,044,120

SORTING MACHINE

William W. Lasker, Brooklyn, N. Y., assignor to Remington Rand Inc., New York, N. Y., a corporation of Delaware

Application June 30, 1931, Serial No. 547,822

29 Claims. (Cl. 209—110)

This invention relates to card sorting machines for general purposes and more particularly to machines for grouping perforated cards used in accounting and statistical analyzing systems. The invention as herein illustrated is directed to improvements in sorters of the Powers type.

Sorting machines of the Powers type have, up to the time of the present invention, possessed the ability to sort perforated cards according to only one code, and that one the code for which the machine was designed. Types of such machines are those disclosed in the patents to Lasker 1,315,370, dated Sept. 9, 1919, 1,476,161, dated December 4, 1923, and 1,643,386, dated Sept. 27, 1927. Hence some machines sort only cards which are perforated according to the old and well known 45-column system, others sort only cards punched according to the equally well known 90-column system and still others perform only according to some other specific code system. In no case has manipulative change from one code to another been possible.

The present invention is directed to improvements in sorting machines, whereby manipulative means permit a single sorting machine to sort cards perforated according to a plurality of types of code.

One of the objects of this invention is to modify a well known perforated card sorting mechanism so that it will accurately segregate the cards regardless of whether they are punched according to the single perforation code or according to the combination perforation code.

Another object of this invention is to provide means whereby cards perforated in a plurality of fields of the card may be sorted according to the perforations in any preselected field.

Another object of this invention is to provide a simple manipulative means to change from straight code sorting to combination code sorting.

Another object of this invention is to provide means for sorting according to any one of several combinational code perforations.

Another object of this invention is to disclose the basic mechanical principles whereby sorting according to either straight or combination code may be effected regardless of the locations of the perforated field.

Another object of the present invention is to suggest basic principles for an extremely wide range of equivalent modes of accomplishing the general results above enumerated.

The improvements are embodied in a machine for sorting data record cards, perforated according to a plurality of codes, and involve the combination of card sensing means, pockets for the reception of said cards, which pockets are under control of gates, and a plurality of optionally selectable coupling mechanisms therebetween, whereby the gates are controlled by a series of substitutions according to the indices perforated in the cards.

Other objects and structural details of the invention will be apparent from the following description when read in connection with the accompanying drawings, wherein:

Fig. 1 is a fragmentary sectional view taken from the right side of a usual form of the well known Powers sorting machine with the invention embodied therein.

Fig. 2 is a sectional view taken from the same position as Fig. 1 showing an attachment which is applied to the sorting machine and illustrating an embodiment of the invention comprising a series of interponents placed at a break in the Bowden wires which operate the card gates.

Fig. 3 is an isometric view showing the front and side of the mechanism in Fig. 2 set for 45-column sorting.

Fig. 4 is an isometric view of a typical train of connections showing the 90-column interpreter mechanism of this invention interposed in the Bowden wire between a sensing pin and a card gate trigger.

Fig. 5 is a view similar to Fig. 4 illustrating the interponent mechanism for the 9 sensing pin.

Fig. 6 is a reduced scale isometric view of the firing lever restoring mechanism.

Fig. 7 is a conventionalized diagram of the connections which are necessary for sorting cards perforated according to the so called 45-column system (single hole code).

Fig. 8 is a diagram similar to Fig. 7 for sorting cards perforated according to the so called 90-column system (two hole code).

Fig. 9 is an exploded isometric view of a portion of the firing lever controlling latches showing particularly the 9's control mechanism.

Fig. 10 is an isometric view of the connections between the interpreter wires for 45-column sorting as seen from the right and front of the machine.

Fig. 11 is a reduced view of an ordinary punched card showing 45-column perforations in zone "*a*", lower field 90-column perforations in zone "*b*", and upper field 90-column perforations in zone "*c*".

Fig. 12 is a table showing the step by step substitutions used in single hole code sorting.

Fig. 13 is a table showing the substitution steps used in sorting cards perforated according to a two hole code.

The reference numerals herein are assigned as follows: Those below 20 are reserved to indicate the row number of the possible perforations and the digits which may be indicated thereby, the numerals 20 and above indicate elements in the mechanism.

The following definitions of terms will apply throughout this specification.

Field is that portion of a card which lies between two lines, either real or imaginary, drawn parallel to the long edges of the card.

Zone is that portion of a card which lies between two lines, either real or imaginary, drawn parallel to the short edges of the card.

Hence, in bank accounting, using 90-column cards, the amount of a deposit could well be described as being in the "deposit zone" of the "upper field."

General description

One method of representing items by perforation is to let each perforation represent a single digit and let the columnar location of each perforation be indicative of the digit represented. This method of perforation has a disadvantage of being cumbersome for it is difficult to provide for more than forty-five columns on the usual punched card blank without undue crowding of the columns of perforations. A card in which each digit is represented by a single perforation is called herein a 45-column card. An increase to double the number of available columns can be effected by using combination perforations. As an example of combination perforations the odd digits may be represented by a single perforation and the even digits by two co-columnar perforations. A convenient way of representing the even digits is to associate any single odd digit perforation with the perforation which would represent 9 to represent the next higher consecutive even digit. By using cards with twelve positions in each column and representing the even digits by combination code the desired doubled capacity can be secured without disturbing the usual columnar spacing of the now well known card. A card with multiple perforations equivalent to that just described will be called a 90-column card.

The digits occurring in arithmetic are symbols representative of quantities and similarly the perforations in a punched card may also be regarded as symbols. These symbols are related to the digit symbols by some conventional rule or codifying system. It therefore follows that the perforation in a card is really a substitution. When a punched card is read by a sensing mechanism certain elements are displaced, such displacements characterize digits and may, hence, be called symbols. Such displacements are necessarily related to the positions of the perforations, by the law or codifying action of the sensing device and therefore the mechanical displacement is in mathematical terms, a substitution. Manifestly, the digits themselves, at least theoretically, could have been represented in the first instance by the sensing mechanism displacements instead of by perforations in the intermediate punched card. Further, such displacements are an invariable result of the combination of the law or system by which the card was perforated and the law or system of the mechanism of the sensing device. Since the sensing mechanism usually controls the displacement of other elements it would automatically generate another mechanical substitution which might have been utilized (theoretically, if not practically) to represent a digit in the first instance by a combination of the rules which resulted in a perforation of the card and the rules which govern the action of the sensing mechanism displacement. Similar conditions hold in any punched card device for all displacements, which according to the law of operation, correspond to digits. In the case of a sorter the final substitution is the mechanical "displacement" of mechanism for the opening of a gate to receive a sensed punched card into a pocket or receptacle predetermined by the holes in the card itself. Each of the various substitutions above mentioned may be derived from any representation of digits by an orderly sequence of combinations of the intervening rules. Such substitutions may be (and frequently are) represented by an orderly series of interchanges of symbols whether the substitution so represented is a perforation or a mechanical displacement.

This outline of the application of substitution theory to the translating of punched cards appears to meet the requirements of the theory of substitutions. The number of substitutions for any given code is obviously limited, for the code is always composed of a limited number of symbol representations. Obviously, any code must always be interpreted by its rule, and it can be changed when, and only when, it is transformed to another code. Different codes can be mutually translated into each other, each with its own interpretations, and such mutual translations must be accomplished by an ordered sequence of operations, which is determined by the interpretations of the codes themselves. All these statements are true irrespective of the representation of the code such as perforations, mechanical displacements, electrical impulses, etc. In mathematical terms each code and each code transformation possess the group property. See Mathewson in his text on "Elementary Finite Groups", page 6.

Such a series of substitutions may conveniently include a norm or standard form. That is, given a certain code, the substitutions may be so made as to reduce it to a simple standard code from which the substitutions may be continued to yield the desired final code. Such a substitution to a norm is particularly convenient since it permits of the conversion from substantially any given code to substantially any other given code, and the procedure may, if desired, be regarded as two complete substitution cycles, the norm being merely a substitution of the original data, condition two.

The device of the present invention is, therefore, particularly adapted to receive a series of cards having perforations therein according to a given code, indicating certain data or information, and to deposit them in pockets which are marked to correspond to the indices perforated in the cards.

The machine

The matrix into which the present invention is to be embodied will now be briefly described.

Referring to the drawings, the cards to be sorted are stacked and weighted in the maga-

zine 21 (Fig. 1). The cards are fed one at a time from the bottom of the stack by a suitably located, power driven, harmonically operated picker 22 to the first of a series of pairs of power driven feed rolls 23. These feed rolls convey the card to the second pair of feed rolls. into position between a pair of matched perforated plates 24, where it is momentarily arrested by a temporarily interposed card stop. The said card stop is mounted to move synchronously with the harmonically moving power driven sensing pin box supporting cross head 25. Shortly after the movement of the card is arrested by the card stop, the sensing pins 26, which are mounted on the cross head 25, descend sufficiently to read the perforation (or perforations as the case may be) in the column to which the sensing pins 26 have been previously adjusted. Any sensing pin 26 (or pins as the case may be) which passes through a perforation in the card is automatically locked so as to be immovable with respect to the descending cross head 25. Continued descent of the cross head will cause positive actuation of the core of the corresponding Bowden wire 27 to position (through mechanism to be described more fully hereinafter) a rotating disk supported trigger 28. The positioning of any trigger 28 opens a card gate 30 corresponding to the perforation, or perforations, which have been sensed during the downward movement of the cross head 25.

The lower of the first pair of feeding rolls 23 is driven, preferably, by a belt from a suitable prime mover such as 20. The lower horizontal row of feed rolls 23 are positively connected through a gear train so as to rotate synchronously in the same direction. The shaft 33 is driven by a pinion mounted on the shaft which supports one of the idlers of the feed roll train, and carries an eccentric for oscillating the picker, and a pair of eccentrics for reciprocating the cross head. The triggers 28 are suported on disks rigid with the shaft 34 which is driven in any suitable manner from shaft 33. Also a suitable gear train drives shaft 35, which shaft drives the upper of the pairs of transporting rolls 32. When the cross head 25 has travelled upwardly a distance sufficient to withdraw the card stop from the front edge of the sensed card, the feed rolls 23*a* eject the card to a position where it will be engaged by the first of the pairs of transport rolls 32 (except that it happens the holes in the card have caused the gate 30 of the "12" receptacle to open). The transport rolls 32 carry the sensed card onward, usually at progressively decreasing speed, until it reaches the opened card gate 30 of the pocket or receptacle 31 which corresponds to the interpretation of the hole in the punched card, as has been described in the preceding paragraph.

The sensing pins 26 may have the form illustrated in Fig. 4 which corresponds to that of Fig. 5 in cited Lasker Patent 1,476,161, which is such that any one, or any group, can be locked over the sensing pin disabling bar 36. Hence, when sorting according to perforations in the upper field of a 90-column card those sensing pins 26 which correspond to the six possible perforations of the lower half of the card are disabled. Similarly, the pins corresponding to the upper half of card field are disabled when sorting in the lower half of the card. When sorting is done according to the perforations of a 45-column card none of the sensing pins will be disabled, except as is described in the Patent 1,476,161 to Lasker.

An alternative form corresponding to that shown in the patent Koch 1,234,348 of July 24, 1917 is conventionally shown in Fig. 1, which consists of a pair of notched blades, either of which may disable the corresponding set of sensing pins.

Having thus far described the matrix to which my improvements are applied, I will now describe the mechanism of this disclosure in detail.

Codes and cards

Referring to the perforated card illustrated in Fig. 11 it will be noted that the first twelve columns, constituting zone "*a*" are perforated to represent consecutively the digits from 0 to 9 inclusive and also those perforations usually designated as 11 and 12 which is the usual 45-column practice. The next ten columns (zone *b*) show perforations in the lower field of the card corresponding to the consecutive array of digits 0 to 9 inclusive, thus a 0 corresponds to the usual 4, 1 corresponds to the usual 5, combined perforations of the usual 5 and 9 correspond to 2, the usual 6 corresponds to 3, the usual 6 and 9 correspond to 4, etc. The last ten columns (zone *c*) show in the upper field a repetition of indicated perforations of the preceding zone with a corresponding variation in the usual values for the perforations. Thus, 0 corresponds to the usual 12, 1 to the usual 11, 2 to a combination of the usual 11 and 3, etc., where the 9 corresponds with the usual 3.

As stated above, an object of this invention is to provide a simple mechanism which will cause the sorting machine to function in substantially the usual manner whether sorting is according to the single perforations indicated in zone "*a*" or according to the combination perforations in either zone "*b*" or zone "*c*". It is thus seen that the sorter as improved by this invention is in reality three different machines in one.

Interponent unit

The gist of my invention consists, in part, of a series of interponents placed at a convenient break in the usual Bowden wire card gate controls of a sorting machine. Such interponents comprise a series of bell crank levers 43 (Figs. 2–5) for operating the one or the other of two sets of interpreter wires 61—62 for releasing firing latches 46—47 to operate the trigger setting ends of the Bowden wires 29. The elements comprising the interponent assembly are supported and carried by a pair of rigidly connected side frames 40 (Fig. 3) which has turned over ears by which the entire assembly may be secured by suitable means, such as screws, to the main frame member 41 of Fig. 1. The side plates 40 are rigidly held in spaced relation to each other by a pair of bell crank guiding combs 42, the firing lever spacing bar 45, the perforated bell crank spacing bar 50, and the spring anchoring comb 51. These plates 40 are further held in rigid relation to each other by the heavy cross bar 52 which has the additional functions of serving as terminal block and guide for plungers which through the medium of Bowden wires 29 actuate the triggers which control the card gates 30. The side plates 40 support the ends of a rod 44 upon which are journaled the bell cranks 43; a rod 53 upon which are journaled the spring urged latches 54; and the rod 48 on which are

journaled the pairs of hubbed firing levers 46, 47. The side plates 40 are provided with notches which serve as open bearings for the pintles 55 which support the partially rotatable interpreter cage 56.

The inte preter cage 56 (Figs. 2, 3, 7 and 8) consists of a pair of end disks held in rigid relation to each other by four perforated bars 57 and 58 and a pair of cross rods 60 thus making a rigid cage for supporting and guiding the sets of doubly off-set interpreter wire 61 and the laterally off-set interpreter wires 62. Each of the perforated bars 58 is constructed of two parts so as to facilitate the assembly of the interpreter wires 61, 62 which are flattened near their upper ends as shown in Figs. 7 and 8 thereby holding the wires in their correct positions. The end plates of cage 56 and the frames 40 are provided with studs 63 for anchoring the springs 64 (Figs. 2 and 3) which serve to hold the cage in its bearings. Journaled on one of the frame supported studs 63 is a small hand lever 65 provided with a slot through which extends one of the cage supported studs 63, thus providing the means for rotating the interpreter cage 56 so that either of the sets of interpreter wires 62 or 61 may be placed between the bell crank levers 43 and latches 54 as most clearly shown in Fig. 2. In order to protect the mechanism shown in Figs. 2 and 3 when it is mounted on the sorter, a formed sheet metal cover 68 (Fig. 1) is provided which may be attached in any suitable manner. The cover 68 is provided with a long narrow slit through which the adjusting lever 65 extends and a scale 70 which indicates whether the cage 56 is set with interpreter wires 62 in position to interpret 45-column cards, or with interpreter wires 61 in position for interpreting 90-column cards.

Sorting

As shown in Fig. 1 each sensing pin 26 controls a Bowden wire 27 each of which has a predetermined lay. These wires are supported immediately beneath the card receptacles, and terminate in a suitably supported terminal block 66 (Figs. 2 and 3). Each of the cores of Bowden wires 27 terminates in the usual plunger for acting on its individual bell crank 43. A typical train of the mechanism of this invention is shown in Fig. 4. There it is seen that downward movement of a locked sensing pin 26 will displace the core of Bowden wire 27 to rock the loosely pivoted bell crank 43 anti-clockwise and elevate a corresponding interpreter wire 61. Hence the spring urged latch 54 is rocked anti-clockwise releasing a firing lever 46, which is rocked clockwise by the comparatively strong spring 67, thus shifting the core of the corresponding Bowden wire 29 to set the usual pin for the tripping trigger 28. When the trigger arrives at approximately its highest position during the continuous rotation of shaft 34, it will open the card gate 30 (Fig. 1) to receive the correspondingly sensed card which arrives at the opened gate shortly thereafter. The trigger setting Bowden wires 29 are provided with the usual plungers slidably mounted in the terminal block 52 whence they are extended under the frame of the machine to their respective trigger operating terminal. The train of mechanism shown in Fig. 4 is typical of that corresponding to zero or any odd digit during 90-column sorting in either the upper or lower field.

In the case of the digit 9 this train is slightly modified, as is best shown in Figs. 5 and 9, where it appears that the mechanism is like that described above, up to and including the interpreter wire 61, which in this case operates a release latch 71. Member 71 is loosely journaled on the shaft 53 and has an extension which overlies the universal bail 72 (Figs. 5 and 9). Release latch 71 and bail 72 are connected by a comparatively strong spring 73 which causes the bail to move upwardly in unison with said extension. The rear edge of the bail 72 is normally held in the path of the lower hooked ends of the firing levers 47 so as to prevent their operation even though one or more of their latches 54 may have been released.

In the case of the 9 digit operation just described, the corresponding firing lever 47c will be free to operate under the action of its strong spring 67 since the bail 72 is constrained to move with the member 71. Hence the card gate corresponding to a 9 perforation will be properly operated through its particular Bowden wire 29.

At times during 90-column sorting two Bowden wires 27 operate simultaneously, the one actuating a train of mechanism such as that shown in Fig. 4 and the other actuating a train such as shown in Fig. 5. In this event, some heretofore undescribed elements modify the operation as will now be described. The forwardly extending nose of the latch 54 is in contact with the spring pivoted universal bail 74, (Figs. 2, 3, 5 and 9), and is journaled at its ends on the rod 53. Journaled also on said rod is a special latch 75 adjacent to release latch 71 which latch 75 is resiliently connected to the said bail 74 by a light spring 76 (Fig. 9) and therefore members 74 and 75 move in unison. The 9's firing lever 47c is provided with a short laterally extending pin 77 which is engaged by a hook on the upper edge of the special latch 75 when the latter rocks anti-clockwise with the shutter 74. Hence, rocking of any trigger 54 by any interpreter wire 61 (except the 9) causes the special latch 75 to lock the 9's firing lever 47c against operation. As shown in Fig. 3, the majority of the latches 54 latch two firing levers against operation; the one, 47, is provided with a downwardly extending hook, the other, 46, is without such hook.

The release of a firing lever 46 corresponding to an odd digit, and of the special 9's firing lever 47 have been described in the paragraphs immediately above. In the case under consideration there is a combination of these two operations. Bail 72 rises with the operation of the 9's interpreter wire releasing firing levers 47c for operation and blocking firing levers 46 because it now lies in the path of their extreme lower ends.

Summarizing, an odd interpreter wire (except 0 and 9) rocks a latch 54 to potentially release two firing levers, 46 and 47. If the 9's interpreter wire 61 is not operated the bail 72 remains at normal and blocks the members 47 against operation, but, if the 9's interpreter is operated bail 72 is elevated by the movement of the special latch 71 and the members 47 are released while the members 46 are blocked against operation. Hence, even though two firing levers are unlatched by an interpreter wire one and only one will fire due to the selective blocking action of bail 72.

Single perforation code interpreters

In order to preserve the described inter-relation of the firing levers and their latches, the 45-column interpreter wires are specially connected. These connections are diagrammatically illustrated in Fig. 10. The interpreters operated by

the 6, 12, 4, 8 and 2 sensing pins are stubs which do not directly operate on latches 54, (see also Figs. 5 and 7). Each of the remaining seven interpreter wires is directly operative upon its corresponding latch 54. Rigidly attached to each of the stub interpreter wires 88 is a laterally extending arm 86 for operating an adjacent interpreter wire 62. An off-set arm 87 is rigidly attached with the interpreter wire operated by the 2 sensing pin to operate the interpreter wire associated with the 1 sensing pin. In Fig. 10 the collars 85 are shown conventionally and indicate that the interpreter wires 62 may be operated either by the arms 86 or 87, or by the corresponding lever 43. The interpreter wire 62, associated with the digit 9, is fixed to the yoke 90, and a projection on said yoke is slidable with respect to the interpreter wire 62 associated with the digit 2. Projections on the yoke 90 overlie all of the stub wires 88, so that the operation of any stub interpreter wire 88 usually causes the operation of its associated wire 62 and in addition thereto the wire associated with 9. The set of connections shown in Fig. 10 insures the correct selection of the firing lever 46 or 47, which lever is then released and actuates the opening of the card gate which corresponds to the perforation sensed.

Combination perforation code interpreters

In the description of the matrix of this invention it was shown that when sorting in either field of the card the sensing pins 26, corresponding to the other half of the card, are locked out by the bar 36. When half the sensing pins are disabled it therefore follows that only the other half can act upon the interpreter wires 61. An inspection of Figs. 4, 5 and 8 shows that any interpreter wire 61 may be operated by either of a pair of adjacent bell cranks 43 because the lower end of each interpreter wire 61 is bifurcated. The lay of the Bowden wires 27 is such that those which are six spaces apart at the sensing pins actuate adjacent members 43. Thus the terminals of the Bowden wires operated by the 2 and 8 sensing pins are adjacent. Those corresponding to the 7 and 1 sensing pins also are adjacent, etc.

If the lever 65 shown in Fig. 1 is shifted to the 45-column position shown in Fig. 2 the 45-column interpreter wires 62 will be interposed between the bell crank levers 43 and the latches 54 and 71. Due to the above described inter-relation between the firing levers 46 and 47 and the latches 54 and 71 a change from sorting of combination code to sorting of straight or usual code will involve some special, yet simple, problems.

Firing lever selection

From the above description it will be noted that release latch 71 and bail 72 move in unison due to the resilient connection through spring 73. For the proper operation of this device it is necessary normally that the special latch 71 be urged to a position such that 9's firing lever 47 is latched against operation. This is most readily accomplished by the use of a spring 78 (Figs. 2 and 3) attached to a forwardly extending projection of one of the supporting side arms of the universal bail 72. Also, the resiliently connected elements comprising universal bail 74 and special latch 75 must be urged to a position such as to normally prevent operation of the 9's firing lever 47c. This is readily accomplished by a light spring 80 (Fig. 2) extending from a stud rigid with a side plate 40 and a hook on one of the supporting arms of the universal bail 74.

When any of the firing levers 46 or 47 have been released, it is necessary to provide mechanism for restoring it to its normal latched positions. This is accomplished by universal rod 81, best shown in Figs. 2, 3 and 6, which is supported at its extremities by suitable arms rigid with the supporting rod 48. In order to lighten the work performed by spring 67, the restoring rod is normally urged upwardly by a pair of springs 82 (Fig. 2). The rod 81 is positively forced downwardly against the tension of springs 82 and 67 by a cam operated lever 83, which is supported on a stud carried by the main frame, and eccentrically mounted to permit minute adjustment. One end of lever 83 overlies the elongated supporting arm of the restoring rod 81. Alternatively, the lever 83 may be extended to the midpoint of said rod. The restoring arm 83 is positively operated by a cam 84 (Figs. 1 and 6) mounted on the trigger disk carrying shaft 34. In order to avoid delicate timing relations between the spacing latch 75 and the 9's firing lever 47c more than one interpreter wire is elevated, recourse is had to holding the restoring bail 81 in restoring position until about the time that the sensing pins 26 have reached approximately their lowermost positions, at which time the restoring lever 83 is suddenly released thereby insuring, if the exigency of the case requires, the disabling of the released 9's firing lever 47c by the special latch 75.

The described operations occur when sorting according to the combination perforations in either the upper half or the lower half of the card shown in Fig. 11.

Any attempt to describe each and all of the connections and operations of the hereinbefore briefly described parts for every sensing combination would unduly prolong this specification without adding clarity thereto. As indicated at the beginning of this specification the different combinations which are possible are limited only by the possible number of simple substitutions. The tables of Figs. 12 and 13 are merely symbolical representations of letter to letter substitution groups and are presented as typical substitution systems.

Referring to Fig. 12, there appears in the first column a series of numbers. These are representative of the twelve possible perforations in a column of a card and are arranged according to the usual manner of naming these positions. The second column shows by letters the connections through wire 27 to terminal block 66 (Fig. 3). That is the sensing pin in the "12" position terminates at "*h*" in block 66. The third column also shows a series of letters identical to those in the second column. The table is then read thus: Sensing pin 12 actuates wire 27*h* to cause the movement of lever 43*h*. The fourth column, headed "Interpreter wires 62" shows a series of letters which indicate the specific interpreter wires that are moved by the actuation of the preceding element of mechanism. Thus pin "12" actuates in turn wire 27*h*, lever 43*h* and through members 86 and 90 (Figs. 7 and 10) interpreters 62*e*, 62*h*, and 62*i*. The fifth column shows the firing lever combination which is affected by the activity of the next preceding member, namely, interpreter wire 62. In the particular instance these are levers 46*e*, 47*e* and 47c (Figs. 4, 5 and 9). Column six shows the

numbers of the effective, that is "fired" levers. In the illustrative example, using sensing pin 12, mechanism associated with 9's firing lever latch 71 blocks levers 46e and 47c leaving 47e active. The series of letters in column seven indicate the respective wires 29 which are actuated by the release of a firing lever, in the present illustration, "h". The eighth column shows the number of the card pocket which is controlled.

In a similar manner, the performance of the various elements in sensing a 90 column, or double capacity, card and selecting the appropriate pocket 31 may be read on Fig. 13. As an illustration let it be assumed that a card is perforated in the upper half, or zone, and in positions 11 and 3. Wires 27i and 27j are displaced and rock levers 43i and 43j. These cause the interpreter 61i with its tied-in interpreter 61j and interpreter 61f with its tied-in wire 61e to be elevated (see Fig. 8). Interpreter 61i—j causes the unlatching of firing levers 46b and 47b and interpreter 61e—f causes the unlatching of 47c, whereupon, mechanism associated with 9's firing lever latch 71 and previously described withholds levers 46b and 47c permitting 47b to be released. This latter lever actuates wire 29c to open the gate which controls the 2's pocket 31.

If it be assumed that the perforations are in positions 5 and 9 which are in the so-called lower zone, the entries in the two and three columns are different from those in the previous illustration, while the values in the remaining columns are identical. It may be noted, however, that the movements of 27i (line 3) and 27j (line 13) are tied-in on the same interpreter wire 61 (see Fig. 8) and that 27e and 27f are also tied-in. The result of the actuation of the chain of mechanism indicated in line 13 will then produce the same result as was caused by the actuation of the mechanism indicated in line 3.

We have then, in each of the Figs. 12 and 13, a system of substitution such that, although the perforations in the card are indicative of different digits through the system of codification, they are of like meaning, and they will be received in the same pocket 31.

While there are above described but a limited number of embodiments of the invention, it is possible to produce still other embodiments without departure from the inventive concept above disclosed, and it is, therefore, desired that only such limitations shall be imposed on the appended claims as are stated therein, or required by the prior art.

What I claim as new and desire to secure by Letters Patent is:

1. In a machine of the class described, means for sensing data upon records made in accordance with a plurality of codes, an oscillatable assembly comprising an interpreting device including dual sets of elements operable by said data sensing means for interpreting sensed data in accordance with any of the said plurality of codes, card gates controlled by said interpreting device, and manual means for alternatively setting said oscillatable assembly to bring one or the other of said dual sets of elements into operative position.

2. In a machine of the class described, a reciprocatory sensing mechanism, card gates controlled thereby, and interponents between said sensing mechanism and card gates, which interponents comprise a set of displacement transmitting elements actuated by said sensing mechanism, dual sets of displacement transmitting members rockably mounted and alternatively operable by said last named elements and additional displacement transmitting elements for selecting said card gates.

3. In a machine of the class described, a reciprocatory sensing mechanism for reading any of a plurality of codes, card gates controlled thereby, and interponents between said sensing mechanism and said card gates, which interponents include sets of displacement transmitting elements, a rockable interpreter cage comprising dual sets of elements for transmitting displacements in accordance with a given one of said plurality of codes.

4. In a machine of the class described, a reciprocatory sensing mechanism including optionally active sensing pins, card gates controlled thereby, interponents between said pins and said card gates, which interponents include a set of interpreter actuating levers, dual sets of rockably mounted alternatively operative interpreter elements and sets of firing levers actuated by said interpreter elements for selecting said card gates.

5. In a machine of the class described, a reciprocatory sensing mechanism for sensing perforations in records, card gates controlled thereby, interponents between said sensing mechanism and said card gates, which interponents include sets of displacement transmitting elements, a rockably settable interpreter cage containing plural sets of alternatively operative interpreters, a set of interpreter actuating levers and plural sets of firing levers, said cage and levers being between the said sets of displacement transmitting elements.

6. In a machine of the class described, a reciprocatory sensing pin mechanism including a plurality of optionally active sensing pins, a displacement transmitting element associated with each sensing pin, an interpreter displaced by the last named elements, means whereby one sensing pin may displace a plurality of interpreters, sets of firing levers controlled by said interpreters, and means controlled by the said interpreters for releasing only one firing lever of one of the sets of firing levers.

7. In a machine of the class described, a series of optionally active sensing pins and a corresponding series of card gates controlled thereby, sets of interponents between said pins and said gates, which interponents comprise sets of displacement transmitting elements, an interpreter unit having plural sets of interpreter elements mounted therein and oscillatably disposed between said sets of displacement transmitting elements and manipulative for alternatively placing one or the other of said sets of interpreter elements in operative position.

8. In a machine of the class described, a series of optionally active sensing pins, a corresponding series of card gates controlled thereby, plural sets of displacement transmitting interponents between said pins and said card gates, a set of interpreter actuating levers and plural sets of firing levers between said sets of displacement transmitting interponents, an interpreter cage mounted on pintles and containing plural sets of interpreters between said sets of levers, and a single manipulative device for alternatively rocking said interpreter cage to place one interpreter of a said set of interpreters in position to be operated by one of said active sensing pins.

9. In a machine of the class described, a series

of reciprocatory optionally active sensing pins and a corresponding series of card gates to be selected thereby, sets of displacement transmitting interponents between said pins and said gates, an oscillatable interpreter cage between said sets of displacement transmitting interponents, and a single manipulative means to position said cage, to render each of said gates actuable according to the activity of said sensing pins.

10. In a machine of the class described, a series of optionally selectable sensing pins and a corresponding series of card gates controlled thereby, sets of displacement transmitting interponents between said pins and said gates, an oscillatable interpreter cage between said sets of displacement transmitting interponents, and a single manipulative means for oscillating said interpreter cage and thereby optionally selecting which of said sensing pins shall be rendered active or inactive.

11. In a machine of the class described, a series of optionally active sensing pins and a corresponding series of card gates selectable thereby, groups of displacement transmitting interponents between said pins and said gates, said groups being arranged in sets, a rockably mounted interpreter cage between said displacement transmitting interponents, and a single manipulative means associated with said cage to cause each of said pins to select a gate appropriate to the setting of said interpreter cage.

12. In combination with a plurality of sets of optionally active reciprocatory sensing pins, a set of card gates controllable thereby, and dual sets of displacement transmitting interponents between said pins and said gates, a rockably mounted interpreter cage between said sets of displacement transmitting interponents, and a single manipulative means for rocking said interpreter cage to optionally control all the gates by all the pins of a selected set or control all the gates by all the pins of all the sets.

13. In combination with a plurality of sets of optionally active reciprocatory sensing pins, a set of card gates selectable thereby, and sets of displacement transmitting interponents between said pins and said gates, optionally selectable sets of interpreters rockably mounted between said sets of displacement transmitting interponents, a single manipulative device for selecting said sets of interpreters and means whereby any selected set of pins control said gates through one of the said sets of interpreters.

14. In combination with a set of optionally active record sensing pins, a set of card gates controllable thereby and plural sets of displacement transmitting interponents between said pins and said gates, a unit between said sets of displacement transmitting interponents which unit comprises a set of interpreter actuating levers, plural sets of interpreters, plural sets of firing levers and latches therefor, means controlled by said interpreters whereby firing levers are all unlatched and additional means under control of said interpreters whereby only one of said latches operates to open a card gate.

15. In a machine of the class described, plural sets of optionally active record sensing pins and a set of card gates controllable by any of said sets of pins, sets of displacement transmitting interponents between said pins and said gates with a set of interpreter actuating levers, plural sets of optionally selectable interpreters, plural sets of firing levers and latches therefor between said sets of displacement transmitting interponents, means controlled by said interpreters for unlatching said firing levers, additional means controlled by said interpreters for controlling the selection of a single firing lever, means independent of the set of active sensing pins for controlling the opening of a card gate, and optionally operable manipulative means for selecting the set of pins to be made active.

16. In a machine of the class described, plural sets of optionally active sensing pins and a set of card gates to be selected by any set of said pins, a series of mechanical displacement transmitting interponents between said pins and said gates, which interponents generate a series of mechanical substitutions, and a single optionally operable rockable manipulative means for determining the character of the said substitutions.

17. In a machine of the class described, plural sets of optionally active sensing pins for sensing perforations according to differing codes, a set of card gates to be selected by any of said sets of pins, a series of mechanical displacement transmitting interponents between said pins and said gates for generating a series of substitutions and oscillatable optionally operable manipulative means for determining the character of the said substitutions whereby any setting of said manipulative means insures that said substitution is identical to the code.

18. In a machine of the class described, in combination with plural sets of optionally active sensing pins for sensing perforations according to differing codes, a set of card gates to be selected by any set of said pins, of a series of mechanical displacement transmitting interponents, including plural sets of interpreters between said pins and said gates, means for causing the said interponents to generate differing series of substitutions, and oscillatable manipulative means for determining the series of substitutions to be generated.

19. In a machine of the class described, the combination of plural sets of optionally active sensing pins for sensing perforations in a record, a set of card gates to be selected thereby, a series of mechanical displacement transmitting interponents between said pins and said gates, which interponents generate a series of substitutions, and a manipulative oscillatable device which associates a set of said sensing pins with said gates and concomitantly determines the substitutions which correspond to the displacement transmitting interponents.

20. In a machine for sorting data, record cards which are perforated according to one of a plurality of codes, optionally selectable sensing pins, elements for the transmission of the sensed data and card gates equal in number to the number of possible perforation positions which gates are selected by said sensing pins through said transmission elements, in combination with oscillatory manipulative means, to condition a single sorting machine for sorting according to a plurality of code perforations.

21. In a machine for sorting data, record cards perforated according to a plurality of codes, the combination of card sensing means, pockets equal in number to the number of possible perforation positions in a card for the reception of said cards, which pockets are under control of gates, and a plurality of coupling mechanisms under control of a rockable manipulative device, whereby said gates are selected by a series of substitutions according to the indices perforated in said card.

22. In a machine controlled by perforations in a card, the combination of a set of sensing pins, one for each index position on the card, a set of card gates to be selected, and displacement transmitting means between said sensing pins and said card gates whereby a number of transmitting members less than the number of said card gates may select any of said card gates according to a combination code, said displacement transmitting means comprising a switching device, and translating members associated therewith which translate a single impulse from each of a number of sensing pins equal to the number of said card gates into combination code, and transmit said impulse to said selecting means, which thereupon selects the one of said card gates appropriate to the sensing pin operated.

23. In a machine controlled by perforations in a card, the combination of a set of sensing pins, one for each index position on the card, a set of card gates to be selected, and displacement transmitting means between said sensing pins and said card gates whereby a number of transmitting members less than the number of said card gates may select any of said card gates according to a combination code, said displacement transmitting means comprising a switching device, and translating members associated therewith which translate impulses from a number of sensing pins equal to the number of said card gates into straight code, and transmit said impulses to said selecting means, which thereupon select the one of said card gates appropriate to the single sensing pin operated.

24. In a machine controlled by perforations in a card, the combination of sensing pins adapted to perform according to either straight or combination code, mechanism operated thereby to select card gates, said mechanism comprising dual sets of displacement transmitting elements, and a switching device therebetween which may be turned on its mountings and thereby set according to the code in which the cards are perforated.

25. In a machine controlled by perforations in a card, the combination of sensing pins, one for each index position on the card, means for segregating said sensing pins into groups appropriate to combination codes, card gates equal in number to the number of index positions and a switching device comprising translating means for actuating said gate by said sensing pins mounted on pintles and forming part of said actuating means for selecting a card gate appropriate to the indicia perforated in the card.

26. A manually rockable translating device, comprising dual sets of translating members, one of said sets being adapted to receive impulses according to a known code from a number of sources greater than the number of translating members, to translate said impulses to a basic code and to re-translate said impulses to the original code and actuate impulse transmitting elements, the other of said sets being adapted to receive impulses according to a different code from a number of sources equal to the number of translating members, to translate said impulses to the same basic code and re-translate said impulses to the code of said first set to actuate said impulse transmitting elements.

27. In a code impulse transmitting system, a set of translating members adapted to receive impulses according to a known code and translate said impulses to a basic code, another set of translating members adapted to receive impulses according to a different code and translate said impulses to said basic code, a suitable rockable mounting for said sets of translating members to permit the optional selection of either of said sets of translating members, sets of levers operable by said translating members for transmitting the impulses received from said translating members and a universal means associated with said levers for selecting a single lever of one of said sets.

28. In a machine which operates according to coded data perforated in cards, mechanism for sensing said data; lead wires for the transmission of said data to a translating device, said translating device comprising a set of elements less than the number of lead wires and adapted to translate data coded according to a known code to a basic code, a set of elements equal in number to the lead wires and adapted to translate data coded according to a different code to a basic code and a rockable mounting for said sets of elements to permit the setting of said translating device according to the code in which said cards are perforated; lead wires for the further transmission of said data; sets of levers for the control of said last named lead wires; and means under control of said translating device to select a single one of said second lead wires and render it effective for the transmission of the data received from said sensing mechanism.

29. A device for transmitting coded impulses comprising a plurality of spring actuated levers arranged in pairs, latches for restraining said levers, means for effecting the selection of a pair of said levers and universal means associated with said levers for releasing in the selected pair one lever which is appropriate to the coded impulses received.

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