

June 22, 1937.

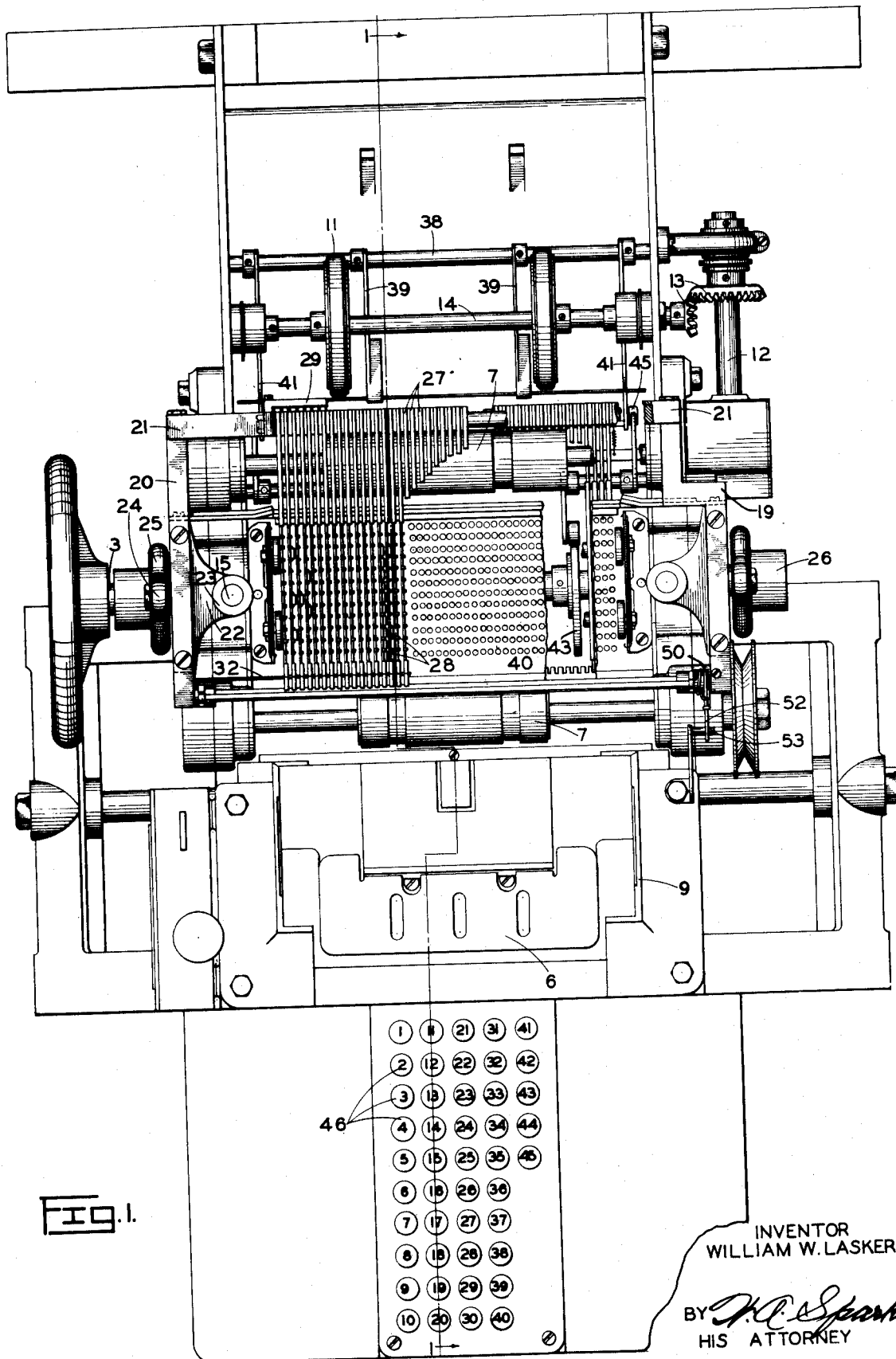
W. W. LASKER

2,084,850

SORTING MACHINE

Filed Jan. 18, 1935

5 Sheets-Sheet 1



June 22, 1937.

W. W. LASKER

2,084,850

SORTING MACHINE

Filed Jan. 18, 1935

5 Sheets-Sheet 2

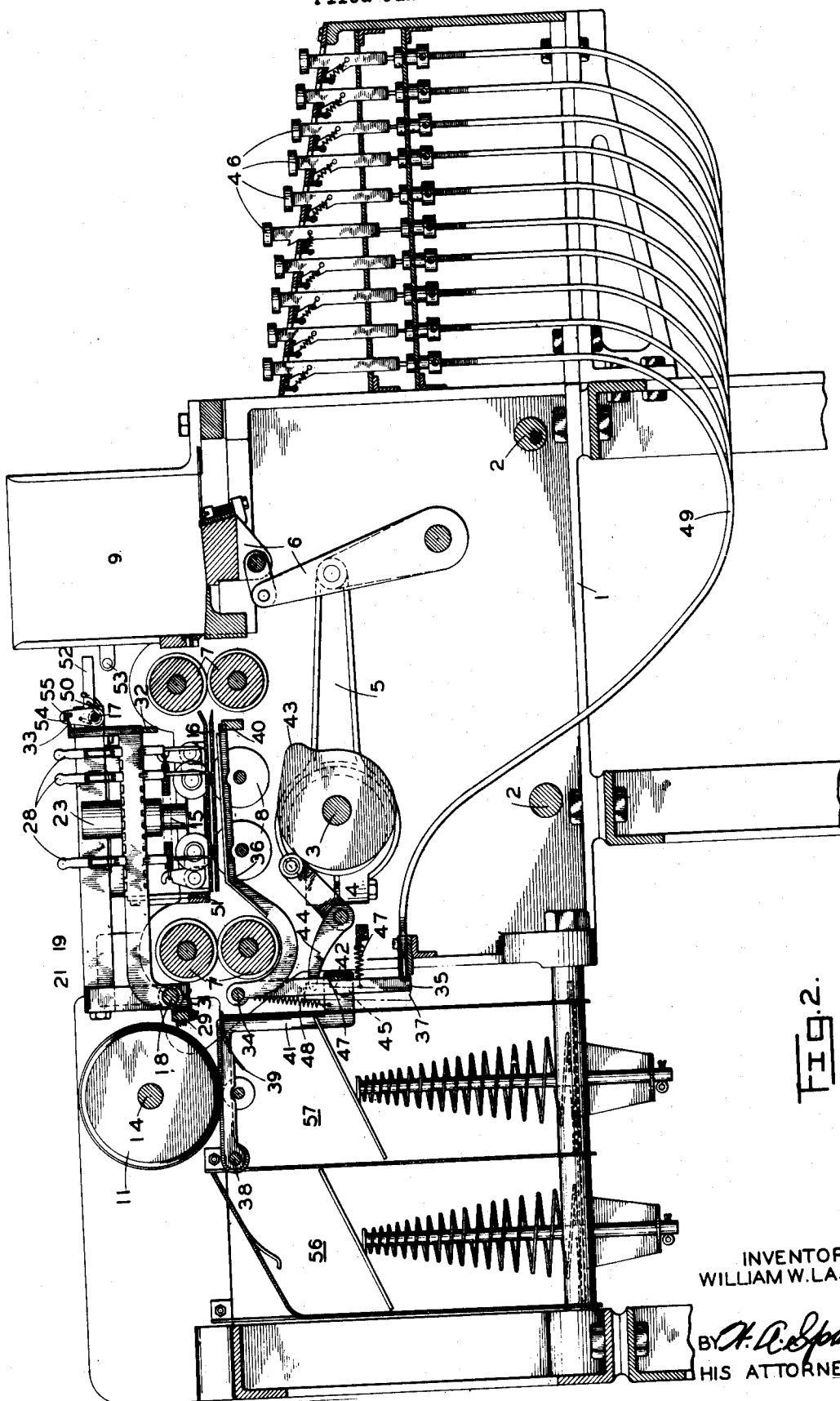


FIG. 2.

INVENTOR
WILLIAM W. LASKER

BY *H. A. Sparks*
HIS ATTORNEY

June 22, 1937.

W. W. LASKER

2,084,850

SORTING MACHINE

Filed Jan. 18, 1935

5 Sheets-Sheet 3

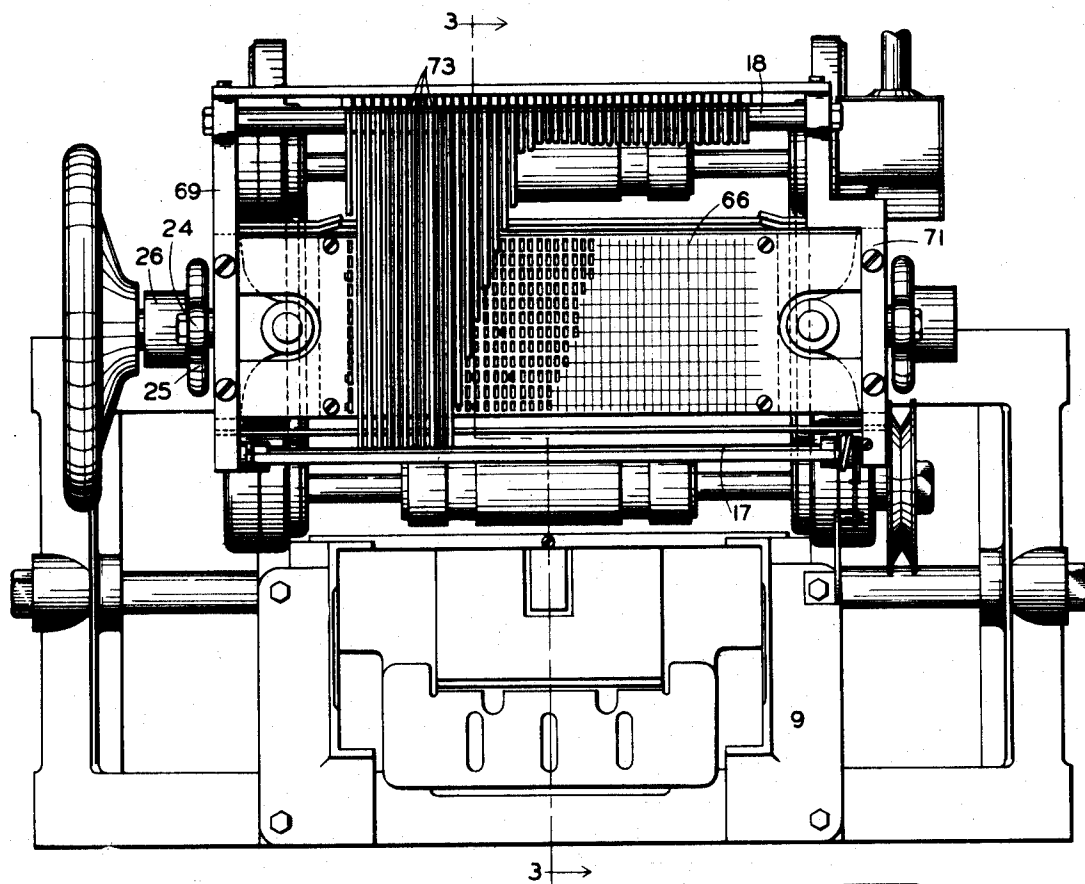


FIG. 3.

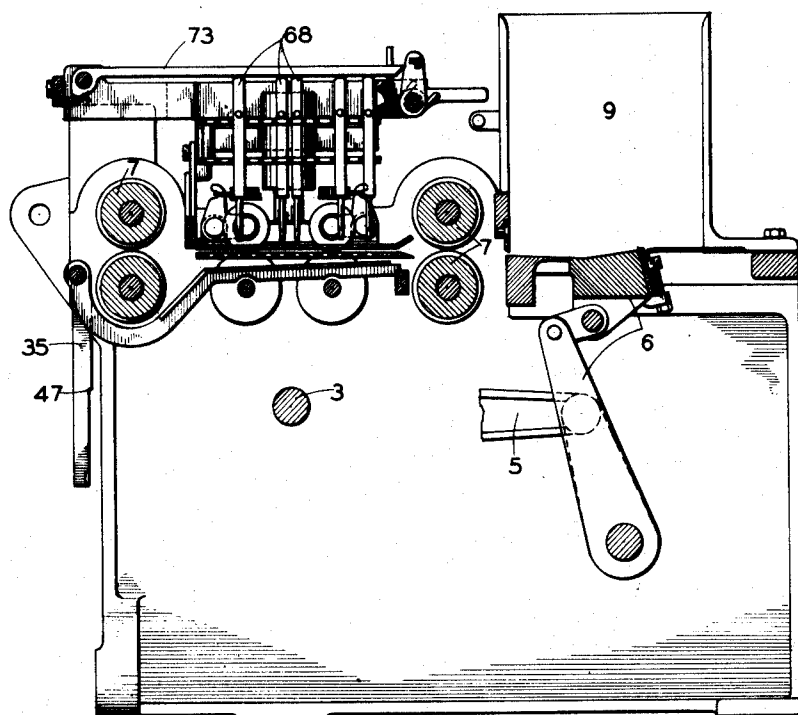


FIG. 4.

INVENTOR
WILLIAM W. LASKER

BY *H. A. Sparks*
HIS ATTORNEY

June 22, 1937.

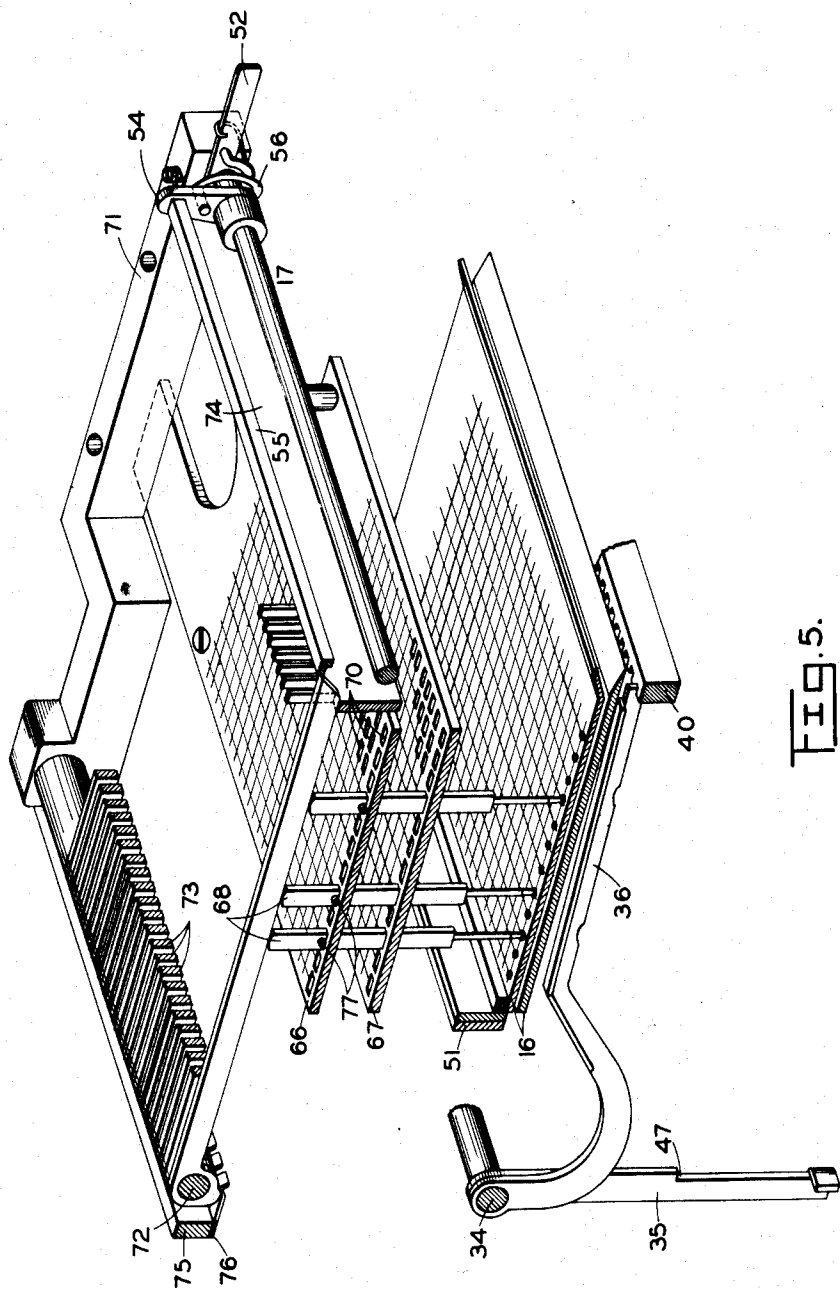
W. W. LASKER

2,084,850

SORTING MACHINE

Filed Jan. 18, 1935

5 Sheets-Sheet 4



INVENTOR
WILLIAM W. LASKER

By *W. A. Sparks*
HIS ATTORNEY

June 22, 1937.

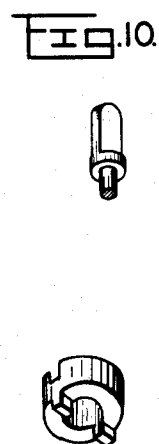
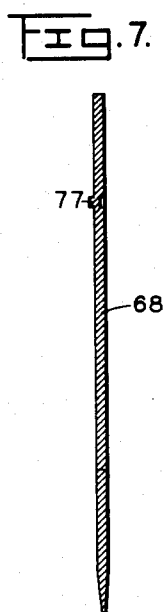
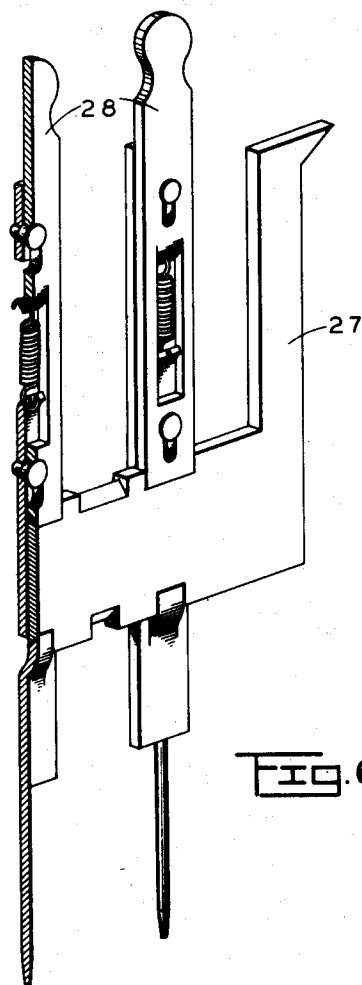
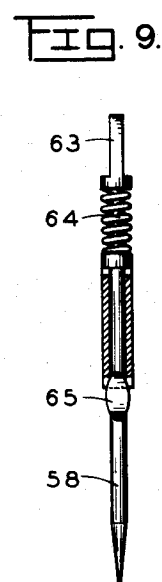
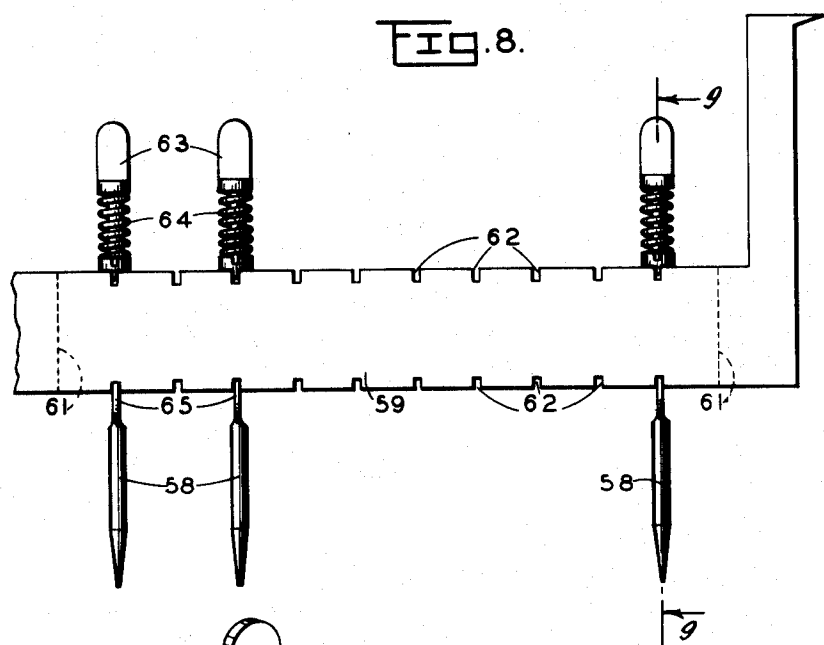
W. W. LASKER

SORTING MACHINE

Filed Jan. 18, 1935

2,084,850

5 Sheets-Sheet 5



INVENTOR
WILLIAM. W. LASKER

BY T. A. Sparks
HIS ATTORNEY

UNITED STATES PATENT OFFICE

2,084,850

SORTING MACHINE

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

Application January 18, 1935, Serial No. 2,346

7 Claims. (Cl. 209-110)

This invention relates to perforated card systems, and particularly to a new mechanism for sensing; and to a new mechanism for sorting perforated cards.

5 This patent application is a continuation in part of my previous application, S. N. 674,820, for Tabulating systems, filed June 8, 1933.

In the prior art of card tabulating systems, it has only been possible to record on a card simple
10 arithmetical numbers (or letters); each column of perforations being adapted, by means of one or another type of code, to indicate a single arithmetic digit or a letter. In consequence, the ordinary 45-column card would record 45 digits or
15 alphabetic characters.

The present invention is adapted to extend substantially the range of types of data recordable on a record-card, and to provide an improved machine for interpreting the recorded
20 data. With the apparatus according to this invention quantitative analysis of qualitative data may be conducted in terms of the statistical method.

This invention further includes a two pocket
25 sorter, which contains sensing pins, which are individually removable and adaptable to sense any possible combinations of holes. Also included in this sorter is button-controlled columnar disabling means. This sorter is adapted to be set up for a definite combination of perforations and to guide all cards, having the set-up
30 combination punched therein, into one pocket, and any cards not containing said combination into the other (reject) pocket.

35 Accordingly, an object of the present invention is to record essentially qualitative data in a record-card system and to classify or analyze it quantitatively.

Another object is to analyze cards, which have
40 been punched to represent replicas of graphical data.

Another object is to record and interpret qualitative data statistically upon a record card, as for example, code perforations representing
45 density in picture transmission, replicas of families of curves, etc.

Another object of this invention is to greatly increase the capabilities of the usual punched card machinery for analyzing, classifying and
50 interpreting statistics which have not been heretofore susceptible to automatic analysis, classification and interpretation.

Another object of this invention is to apply a punched card system to hospital case records and
55 similar complicated observations.

Still another object of this invention is to compare, by a simple procedure, a list of observed facts with lists of facts observed in other instances and to separate from the list all those records which are comparable within determined
5 limits.

Still another object is to sort out, from a group of cards, all cards having a desired combination of punchings, irrespective of the presence or absence of still other punchings.
10

Another object of this invention is to provide a machine which is adapted to sense record cards having a plurality of perforations therein.

Another object of this invention is to provide a machine which is adapted to sense record cards
15 having a plurality of perforations in a plurality of columns.

Another object of this invention is to provide a machine which is adapted to sense record cards having a plurality of perforations in a plurality
20 of columns and which is also adapted to direct desired cards into one pocket, and undesired cards into another pocket.

Other objects and structural details of this invention will be apparent from the following description when read in connection with the accompanying drawings, wherein:
25

Fig. 1 is a top plan view with certain parts removed and broken away for clearness, showing one form of my invention.
30

Fig. 2 is a sectional view on line 1-1 of Fig. 1.

Fig. 3 is a top plan view of another form of my invention with certain parts removed and broken away.

Fig. 4 is a sectional view on line 2-2 of Fig. 3.
35

Fig. 5 is an isometric, sectional view of the sensing and tripping mechanism shown in Figs. 3 and 4, with parts removed and broken away.

Fig. 6 is an enlarged sectional isometric view of the removable sensing pins shown in Figs. 1
40 and 2.

Fig. 7 is a sectional view of the sensing pin shown in Figs. 3 and 4.

Fig. 8 is a plan view of another form of sensing pin which may be used in my invention.
45

Fig. 9 is a sectional view on line 3-3 of Fig. 8.

Fig. 10 is an isometric view of part of the sensing pin shown in Fig. 8.

Fig. 11 is an isometric view of another part of the sensing pin mechanism shown in Fig. 8.
50

Sorter

Referring to the drawings, the sorter of my invention is an improvement over and is incorporated with much of the mechanism of the
55

sorter disclosed in my Patent No. 1,476,161, issued December 4, 1923; that is, the side frames, the supporting frames, the card picker mechanism, the card feed and driving mechanism, etc.

5 All references to forward or front parts of the machine will be directed to that part of the machine whereat the record-card magazine 9 is mounted.

10 A pair of side frames 1 are spaced apart by rods 2 and carry the various driving mechanism among which are included a main shaft 3, having mounted thereon an eccentric 4 which in turn operates a connecting rod 5 to cause the reciprocation of the card picker mechanism 6, of any conventional design, for successively advancing cards, one at a time to the feed rolls 7. The feed rolls 7 and skid rolls 8 are positively driven by gears.

20 On the end, opposite the geared end of the upper, rearmost, feed roll shaft 7 (upper left-hand roll in Fig. 2) is fixed to worm gear (not shown) which drives the large feed rolls 11 (Fig. 1) through a worm wheel (not shown) fixed to shaft 12, through beveled gears 13 and shaft 14.

25 A pair of vertically extending guide posts 15 are fixed (one on each side of the machine) to the side frames 1 and act as guides for the vertically reciprocating sensing mechanism of my invention. For sensing data recorded by holes punched in several vertical columns, as well as one or more lateral columns, I find it desirable to use a vertically reciprocating mechanism carrying a multiplicity of removable sensing pins adapted to sense data recorded by punching in a record-card which is held by a conventional card stop 51 temporarily between a pair of sensing plates 16 having holes therein, corresponding to all the possible punchings of a record-card.

30 In the present invention the sensing unit is a complete mechanism, which can be substituted for the one now in use in the above cited Lasker patent, and includes a pair of parallel supporting rods 17 and 18 supported rigidly by a pair of supporting members 19 and 20. The rod 18 is connected to said member 19 through a pair of L-shaped members 21. Members 19 and 20 are, in turn, fixed to a pair of brackets 22, having inwardly projecting arms, each of which carries a sleeve 23 slidably mounted on a post 15. Each of the brackets 22 is provided on its outer face with a projection to which is connected one end of connecting rod 24, the other end of which carries an eccentric strap 25 surrounding an eccentric 26 fixed to main shaft 3. It will be seen 35 that, when shaft 3 is rotated, the sensing mechanism will be reciprocated relatively to the plates 16.

Pivoted on rod 18 is a multiplicity of bars 27 (one for each column of a record-card). Bars 27 are adapted to carry any desired number of adjustable, removable, sensing pins 28, up to the maximum number of holes in a column.

40 A bar 29 carried by L-shaped members 21 has fixed thereto a comb spring 31, the individual tines of which are bent (as shown in Fig. 2) and act as detents to resiliently hold the individual bars 27 downward against the universal supporting comb bar 32 upon which the front ends of said bars 27 rest. At their forward end bars 27 project upwardly and then forwardly to form a latching nose 33.

Loosely pivoted upon a universal rod 34 is a plurality of spring-held card-pocket-gate-latching levers 35. Fixed to each latching lever 35 is a tripping arm 36 which extends beneath a col-

umn of holes in sensing plates 16, and is guided by a universal comb bar 40. The dotted outline 37 indicates the ineffective normal position of levers 35.

Fastened to a rockable shaft 38 is a pair of card-guiding arms 39. Also fixed to shaft 38 is a pair of spring-held offset arms 41, the other ends of which are connected by a universal latching bail 42, which extends across all of the latching levers 35. A cam 43, fixed to shaft 3, is adapted to actuate cam arms 44 once during each revolution of said shaft 3, to operate upon a pair of rollers 45 (one not shown) fixed to offset arms 41, to restore the spring-held card guiding arms 39 to their normal position, if they have been 15 shifted.

The operation of my invention is comparatively simple. As has been stated above, my invention includes a device adaptable to select a card (or a group of cards) having a plurality of holes in a plurality of columns representing complex data. To accomplish this selection, a plurality of removable sensing pins 28 are attached to bars 27 at points relative to the location of holes in the desired card (or cards). To set up pins 28 upon bars 27 merely requires the rocking of said bars 27 against the tension of their detent springs 31. (A large scale sectional isometric drawing of the type of pins 28 used in Figs. 1 and 2 is shown in Fig. 6).

A plurality of spring-held controlling buttons 46 (one for each vertical column of a card) is provided to actuate a plurality of Bowden wires 49 adapted to hold levers 35 in an ineffective position when desired.

This plurality of controlling buttons is assembled as a removable unit and in this instance is attached to the front of the machine although it may be mounted at any other desired location on the machine.

40 After the desired number of pins 28 has been set up, the button 46, controlling the levers 35, of the desired columns, are released, thereby allowing the corresponding springs 47 to draw said levers 35 forwardly against universal bail 42, Fig. 2. The first revolution of shaft 3 will cause the rocking of cam arms 44 by cam 43, thereby drawing offset arms 41 carrying bail 42 downwardly until said bail 42 reaches a position slightly below the holding notches in the now effective latching levers 35. As cam 43 continues to rotate, bail 42 is allowed to return upwardly under the tension of springs 48 (one not shown) until said bail engages said holding notches 47. The machine is now ready for operation.

55 A stack of punched cards which are thought to contain the desired information is placed in the card feed magazine 9 and through the usual sorter feeding means is fed successively through the machine. Each card is fed into the sensing chamber 16 and is stopped by the card stop 51 carried by brackets 22, of the sensing unit hereinabove described, said sensing unit continues to descend and pins 28 enter holes in the upper plate 16. As the sensing unit continues to descend, these pins 28 mounted upon any one bar 27, which all find holes in the card being sensed, continue downwardly in parallel movement relative to the rest of the sensing unit, whereas in any column in which a pin 28 (or a plurality of pins 28) has been set up, and one or more of said pins 28 do not find a hole, that pin or pins 28 being attached to a bar 27, will cause that bar 27 to rock upon its supporting shaft 18 and consequently lift the latching nose 33 of that bar 27. As the 75

sensing unit continues farther in its downward travel, an arm 52, loosely pivoted upon rod 17, contacts a cam member 53 rigidly mounted on the main frame of the machine. Rigidly mounted on opposite ends of rod 17 is a pair of vertically extending arms 54, which support a universal locking bar 55. The loosely pivoted arm 52 is resiliently connected to one of the arms 54 by a fairly strong spring 50. This locking mechanism is resiliently connected to the member 19. As may clearly be seen from Fig. 2, still further downward movement of the sensing unit will cause the rocking of locking bar 55 to a position over the nose 33 of any bars, which are still in parallel synchronous relation to the sensing unit. It will also be seen that any noses 33, which have been rocked upwardly, by the failure of any of their pins 28 to find holes in the card being sensed, will be above locking bar 55, and, consequently, only those pins 28 carried by bars 27, which have been locked by said bar 55, will be positively driven downwardly through the holes in the card and sensing chamber to engage their corresponding tripping arms 36 to release their latching levers 35.

If but one bar 27 fails to complete its relative synchronous downward travel the corresponding latching lever 35 of that one bar 27 will not be tripped and, consequently, card-guiding arms 39 will not be caused to rock and that card, when released by card stop 51, will be fed right through to the reject pocket 56. However, if all of the effective latching levers 35 are released, springs 48 will rock offset arms 41 to rock the shaft 38 to rock card-guiding arms 39, to guide the sensed card into pocket 57. As hereinabove disclosed, pocket 57 will be closed by cam 43 on its first revolution.

Another form of sensing pin 58 and carrying bar 59, which may be substituted for pin 28 and bar 27, is shown in Figs. 8 and 9. This bar and pin arrangement includes a bar 59 having a slot milled therein. The limits of said slot are indicated by the reference character 61.

A plurality of slots 62 are milled transversely across the top and bottom of bar 59 at such points as to be adaptable to position any sensing pins 58 which it may be desired to set up. The design of pins 58 is obvious from Figs. 8, 9, 10, and 11. To adjust pin 58 merely requires the manual pushing of the main pin element 63 against spring 64, and twisting said element through one-quarter of a revolution. This twisting will place the flattened portion 65 in a position which will allow the removal of said pin.

Another form of my invention is shown in Figs. 3, 4, 5, and 7. In this second form the principle is exactly the same as that of the first; the difference occurring only in the type of sensing pin, the sensing pin carrier, and the means utilized to effect the positive drive of the sensing pins against the tripping arms 36. The differences in construction are best shown in Fig. 5 in which is shown a pair of plates 66 and 67, which are rigidly held together in spaced relation to each other. The uppermost plate 66 is longer than the lower plate 67 and is forked on each end to clear the sleeve 23 of brackets 22 to which brackets 22 said upper plate 66 is mounted. Plates 66 and 67 have a plurality of concentric holes 70 therein which are adapted to support and guide a plurality of sensing pins 68. The number of concentric holes 70 in plates 66 and 67 is determined by the number of possible holes which may be punched in the record cards which are to be sensed and sorted. Also mounted to brackets 22 are two bars 69 and

71, the bar 71 being slightly offset for clearance from side frame 1. Carried between the rearward extremities of bars 69 and 71 is a rod 72 adapted to carry a plurality of spaced rockable locking bars 73. The forward ends of locking bars 73 are supported and positioned by a comb bar 74 mounted between the forward ends of bars 69 and 71. Also mounted to bars 69 and 71 is a bar 75 to which is mounted a comb spring 76, the individual tines of which spring are so shaped as to act as detents for resiliently holding locking bars 73 down against universal comb bar 74.

To set up pins 68 in this form of the invention, the bars 73 corresponding to the columns which are to be sensed, are lifted manually and pins 68 are dropped into the concentric holes 70 corresponding to the desired holes in a punched card. Pins 68 are held in place by their own weight and are positioned by extrusions 77. The locking bars 73 are then snapped down and buttons 46 are set as in the first disclosed form of the invention. The machine is now ready for operation.

As may be seen from Figs. 4 and 5, any pins 68 which have been set up and which do not find holes, will cause the locking bar 73, corresponding to that column in which said pin (or pins) does not find a hole, to be rocked upwardly as the sensing mechanism descends. The action of bars 73 is obviously the same as that of bars 27 in the first disclosed form of my invention, that is, when the sensing mechanism reaches a predetermined level, arm 52 contacts cam member 53 causing the rocking of arms 54 to position locking bar 55 over any bars 73 which have remained in parallel relation with the reciprocating sensing mechanism, and under any bars 73 which may have been lifted by any pins 68 which did not find holes in the card being sensed. From this point on, this second form of the invention functions in a manner exactly similar to that disclosed in the first form. Because of the exact duplication of parts, the disabling mechanism including buttons 46 and Bowden wires 49, as well as the card receiving mechanism, have been omitted from Figs. 3 and 4.

System

Punched card systems usually consist of a series of separate machines, which for the purpose of this invention may be pointed out by their functions generally. A punch is used to initiate the representation of data on the cards. It is usual to have memorandum data before the punch operator, who copies the data in much the same manner as a stenographer transcribes notes. The keys of the punch can be operated in any combination simultaneously as in the case of the familiar stenotype. (See, for example, lines 40-63, inclusive, page 4 of U. S. Patent No. 1,682,451, granted August 28, 1928). Ordinarily, the internal mechanism of the punch is such that a predetermined arrangement of perforations (called codes) will be automatically punched when the operator touches the keys. The details of the punch mechanism are fully set forth in my copending application, Serial No. 654,812, filed February 2, 1933. In some instances the punch may be automatically controlled from a remote station, and the amounts to be perforated will be automatically verified before the card is actually perforated as is set forth in my copending application, Serial No. 635,186, filed September 28, 1932. The cards when perforated by the punch, especially when in code, are difficult to interpret by the average operator. It is, therefore, desir-

able to provide an interpreter, which will automatically transcribe into printing the characters represented. When desired, the interpreter can be used to transcribe the information into an interpretation different from the code inherent in the punch. The details of the mechanism of the interpreter are fully set forth in my copending application, Serial No. 637,401, filed October 12, 1932. After the cards are punched and interpreted, it is usual to sort or arrange them into classes or categories by means of a sorter, which can automatically read and interpret the code perforations of the card. Sorters may be arranged to operate according to a plurality of codes, and, consequently, any card may be properly and automatically sorted according to the interpretation of any code. The details of a suitable sorter are fully set forth above, or a type of sorter, as shown in my copending application, Serial No. 547,822, filed June 30, 1931, may be used.

Sometimes it is desirable to duplicate previously perforated cards in whole or in part, and at times it may be desirable to combine the data of several cards upon a single card, or it may be desirable to transform some or all the information on one card to relate data. These functions are performed by the duplicating punch, the details of which are fully set forth in my copending applications, Serial No. 616,926, filed June 13, 1932, and Serial No. 680,922, filed July 18, 1933.

The interpretation, tabulating and converting of cards is greatly facilitated by the use of multiple translators. Multiple translators are ordinarily used in the tabulator and converting punch. Examples of these devices are fully illustrated and described in the cited applications for the recited machines. The multiple translator permits various interpretations and transfers of card fields, and, hence, makes the system extremely flexible. The sorter also has a multiple translator for interpreting the various codes of the cards to be sorted. The sorter multiple translator is in the nature of a rotatable cage containing systems of interpreters as is fully set forth in the cited application, Serial No. 547,822.

If it is desired to preserve the cards for future reference, they may be filed after sorting or analyzing, in suitable cabinets.

Frequently it is desirable to duplicate a set of cards for differing purposes. Examples are:—

1. Construction of an interpreted master file. That is, a set of cards where one or more fields are interpreted for filing according to some well known system such as the familiar Dewey system, or by differing factors.

2. Construction of a set of cards all of whose fields are made up of the fields from a plurality of different cards. An example would be a set of cards for filing according to different diseases such as tuberculosis, dysentery, etc.

3. Construction of statistical reports of treatments in a hospital, power factors, existence of particular chemical processes derived from plural cards, etc.

4. Construction of a master file for duplicating spoiled or damaged cards which are in constant use.

5. Construction of a set of cards to be used with tabulators or sorters where the installation is equipped with punches operating according to a code differing from that code for which the remainder of the equipment is adapted to best operate.

6. Other uses of duplicate sets or partial dupli-

cate sets of cards will be apparent to those skilled in the art. In any event these duplicate sets or duplicate interpreted sets may be constructed with the machines above described and when constructed the order in which they are to be filed can be determined by any of the methods herein-after outlined if the filing is done in accordance with combination perforations which can be variously interpreted, otherwise they may be filed in accordance with the usual principles.

In the punching operation the requisite data is punched according to one or more codes, in the proper indicated fields, and the special perforations indicating such operations as total, list total, grand total, control, etc., are usually punched into separate cards, or, if they are to occur on regular data cards, they may be perforated under control of manually or automatically adjustable gags, as is fully described in my copending application Serial No. 588,863, filed January 25, 1932, now Patent No. 1,985,101 granted December 18, 1934. A convenient mode of identifying perforations is by the use of an umbral notation. For example, let the Roman characters XII, XI, X, I . . . IX represent the rows on a standard card, and the Arabic digits 1, 2, 3, 4, 5 . . . 45 represent the columns. Any perforation can then be represented by a Roman and an Arabic character. Thus IV, 21 represents a perforation in the 21st column on the IV row. If this is a numerical perforation, it represents the digit 4. Similarly for all other possible perforations. A single character, either Roman or Arabic represents any perforation in the identified row or column, respectively.

Punched card systems, as pointed out hereinabove, usually consist of means for punching data upon cards, sorting them, filing them, interpreting them and analyzing or tabulating them. These functions are usually performed by more or less automatic machinery. Heretofore these systems have been greatly limited by the paucity of data representable on the cards. One object of the present system is to greatly expand the utility of perforated card systems to uses heretofore considered impractical.

The method of tabulating cards, as outlined above, is advantageously applicable to Electric Utility Corporation load analyses from such points of view as the load power factor, etc. For instance, a series of record cards may be perforated to indicate the character of the connected load, whether lights, synchronous motors or induction motors, etc. It may also be perforated to indicate the load classes in which it will be grouped according to the size of the connected load. It may also be perforated to indicate either the actual peak load, the ratio between the peak load and the average load, the monthly power consumption, etc.

The cards perforated, as above described, may then be sorted as briefly described in the previous portion of this specification, this sorting will then associate the cards for similar installations. A careful checkup of the average power factor of representative installations in each group will then indicate the average power factor applicable to all of the installations in a given group, which information may be utilized in the course of the rate making activities to indicate the differential applicable to a given customer, based upon the power factor of his connected load.

It will be noted that each and all of the automatic machines may be set or adjusted to interpret any of a plurality of codes, and that some

of the machines can simultaneously operate according to a plurality of codes. Obviously, the code interpreters can interpret any code by any code interpreting device or mechanism, and obtain results which are analyses or interpretations of an "unknown" code in the light of particular code interpreters. This inherent function of the various machines is extremely useful in case the perforations in a card simulate graphs or a complicated codification of complex data.

This invention relates to methods and means for automatically arranging, tabulating, analyzing, copy and interpreting concrete numbers or their isomorphic representations in sequences, or ordered arrays according to a predetermined interpretation or a transformation thereof.

For purposes of illustration, let us assume that a series of cards have been perforated with every possible combination of holes in the first six rows of a single column. Obviously, there will be 64 cards (counting the blank or unperforated card). The distribution will obviously be as follows:

- 1 card with no perforation
- 6 cards with a single perforation
- 15 cards with two perforations
- 20 cards with three perforations
- 15 cards with four perforations
- 6 cards with five perforations
- 1 card with six perforations

64 cards total

Let it be assumed that a large mass of data has been recorded and classified according to the principles set forth above, into a master file. Let it be further assumed that fresh data is to be compared with that already recorded and classified. The first step is to sort the new data according to the rule of the filing system so that the new data could be filed with the old data. Obviously the machinery will arrange the new data in exactly the sequence required for filing, and, therefore, any new data will be placed alongside the old data, or the old data which is most closely related to the new data and, therefore, comparison is reduced to visually comparing adjacent cards of the master file. Even the comparison of the adjacent cards can be made automatically by tabulating them according to the formula of interpretation as has been described above.

All individuals are characterized by their anthropometric measurements, therefore, an individual is measured according to the system of the master file, and a card punched corresponding thereto. Therefore, if the new card (or cards) are compared with the master file, the identity of the measured person (or persons) is readily and automatically established. Such a use is obviously of great importance for criminal identification and likewise for other and similar uses.

One such similar use is the recording and classification of patterns for weaving. The characteristics and forms of the various curves of the design are commonly represented by holes punched in cards. Obviously, then, to interpret this record and reduce the interpretation to its printed or interpreted form by any of the briefly described means for so doing, would furnish an interpreted copy of the pattern to be woven.

An obvious extension of the example of combination perforations is to use the entire column of twelve locations or codifying information. In

this case there will be the following arrangement of various possible combinations.

- 1 card with no perforations
- 12 cards with one perforation
- 66 cards with two perforations
- 220 cards with three perforations
- 495 cards with four perforations
- 792 cards with five perforations
- 924 cards with six perforations
- 792 cards with seven perforations
- 495 cards with eight perforations
- 220 cards with nine perforations
- 66 cards with ten perforations
- 12 cards with eleven perforations
- 1 card with twelve perforations

4096 total differing arrangements of perforations in a single column.

It is thus seen that a series of perforations, or codes, such as described, permits the coding of over 400 times as much information as when the card is restricted to a single perforation for each digit of the decimal system. This enormous increase in effective capacity permits the codification and recording of complex data such as hospital case records, anthropometric measurements, weather data, replicas, families of curves or graphs including their singularities (or particular characteristics), etc. Further, such cards can be classed or sorted and interpreted automatically by machinery as has been indicated in the case of the example specifically recited hereinabove. Cards perforated in accordance with the described combination codes, or cards representing curve replicas are hereinafter called cards perforated according to an extended code.

An inspection of the total number of possible perforation combinations for each of the examples, shows that said total is an integral power of 2, and that the differing series of different combinations or permutations for a given number of perforations, is an identifiable binomial coefficient.

Again it is evident that an extended code may occupy more than one column, for it is then merely an aspect of a factored code. Thus clinical data, as will appear hereinafter, is ordinarily placed in two columns, the two columns are, therefore, merely duodecimal factors of a biduodecimal code. When the code represents replicas of families of curves, all the columns of the card can be viewed as extended code factored into as many factors as there are columns on the card.

The system and method of the present invention can be readily applied to chemical research and classification of chemical compounds. It is well known that one mode of classification and indexing chemical compounds is by the molecular formula. Thus, CH_4 , C_2H_2 , C_2H_4 , C_3H_4 , C_3H_6 , C_3H_8 , etc., are the formula for the series of hydrocarbons arranged according to one scheme of classification. In general, all the hydrocarbons can be represented by the formula C_nH_m where n and m take integral values (m sometimes takes negative values). Thus, if $n=1$ and $m=-1$, the compound is methane, if $n=6$ and $m=3$, the compound is benzene, if $n=16$ and $m=11$, the compound is pyrene, etc. Again NH_3 , N_2H_2 , N_2H_4 , N_3H_4 , etc. is a corresponding series of nitrogen compounds, and a similar general formula could be obtained which is N_nH_m . In any case, all substituted derivatives can be listed as subclasses under each member of these series. The chemical classification problem is, therefore,

merely one of arranging numbers in a consecutive sequence as defined by the general formulas $C_nH_{2(n-m)}$, $NaH(n+m)$, etc. Again, organic chemical compounds can be viewed as definite combinations of radicals. Typical organic radicals are: methyl, ethyl, propyl, etc. phenyl, xyl, toluyl, carboxyl, carbonyl, benzyl, hydroxyl, formyl, acetyl, glyceryl, etc. Each radical has (usually) a definite valence and hence all the chemical compounds can be classed or arranged in sequences in substantially the same manner as in the case of the hydrocarbons where the elementary substances are replaced by radicals, that is, compounds containing radicals can be "indented" under the examples of the general formula. The radicals are frequently substituted and, therefore, subclasses or categories are automatically generated as in the case of the substituted hydrocarbons so that substituted radicals can form a second "indentation". In some instances the relative positions of the radicals are important, as for example, the ortho, meta, para, cis, trans, etc. locations. Such form a second subclass under the chemical substitution subclass. Again the *d*-, *l*-, *r*-, etc. forms may form additional sub-classes or more specialized "indentations". All sub-classes of the complex chemical compounds with their proper indentations of the entire Patent Office class 230, with their relations to each other may be confined to a single column on a card and constitutes a well known classification of the entire series of carbon compounds. If desired a second classification (the general formula type explained above) could be made of the same compounds in another column (or columns), and a third classification in a third column, etc. As an example, the compounds could be classed according to the presence or absence of certain substitutions in the organic radicals if such should be desired.

An examination of the above cited chemical compounds reveals that many classes may be broken up into sub-classes, categories, etc. Let it be assumed that a card has been made out for each and every compound and that each card contains data (which may be printed or written) for completely identifying such compound. Such interpretation may be effected by an interpreter as outlined hereinabove. If the assumed set of cards are perforated in a single column in accordance with the above table, then, by the sorting method above described, the said cards could be automatically classified according to the system outlined in the United States Patent Office classification manual, including the entire system of "indentations", by successive runs through a usual type of sorter by disabling certain consecutive pins after each sorting run, or by the sorter above described as will be obvious. Again, a second column may contain another mode of classification of the cards, and may be arranged in a sequence in accordance with either system. In any case, the breaking down of large classes (by a series of "indentations") for constructing consecutive arrays for a filing system is merely a series of transformations for attaining a sufficiently specialized grouping.

The above set of cards may be fed through a tabulator (or an interpreter) provided with printing slugs having interpretations for the above cited compounds, which may be punched in said cards. A series of runs of the cards through a tabulator with appropriately designed multiple translators will analyze the cards into a printed

list with the appropriate classification with all the required "indentations" as has been described hereinabove.

Other uses such as the searching out of clinical data, searching for references of the Patent Office, etc., will be readily understood from the foregoing.

While I have described what I consider to be a highly desirable embodiment of my invention, it is obvious that many changes in form could be made without departing from the spirit of my invention, and I, therefore, do not limit myself to the exact form herein shown and described, nor to anything less than the whole of my invention as hereinbefore set forth, and as hereinafter claimed.

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

1. In a punched card sorting machine of the class described, in combination, a pair of supporting frame members, a sensing chamber having a pair of spaced perforated plates supported by said frame members, a plurality of card feed and skid rolls supported by said frame members and sensing chamber, a card magazine adapted to hold a plurality of cards supported by said frame members, a card picker mechanism adapted to feed cards consecutively to said feed rolls, a drive shaft supported by said frame members, an eccentric mounted upon said drive shaft, a link mechanism connecting said eccentric to said picker mechanism, a pair of connecting rods mounted upon a pair of eccentrics fixed to said drive shaft, a pair of vertically extending guide posts fixed to said frame, a perforation sensing mechanism slidably mounted upon said vertically extending guide posts and which sensing mechanism includes a plurality of bars and a plurality of removable pins which may be set up upon said bars to sense any possible combination of perforations in a card simultaneously, a plurality of tripping levers adapted to be tripped by said sensing pins, a control unit mounted on said frame members adapted to control the effectiveness of said tripping levers, a universal bar adapted to lock certain of said rockable bars which are effective and thereby cause a positive drive of said effective bars, a punched card receptive unit including a card feeding means, a reject pocket, a pocket for desired cards, rockable means for guiding desired cards into their respective pockets, means relative to said tripping levers, for operating said card guiding means, and cam operated means for automatically rendering said card guiding means ineffective.
2. In a punched card machine of the class described, a reciprocating sensing mechanism comprising in combination a pair of perforated plates forming a sensing chamber, card stop members cooperating therewith, mechanism for feeding cards thereto, a sensing mechanism comprising a plurality of horizontal swingable arms positioned over said sensing chamber, a set of removable sensing pins adapted to cooperate with one or more of said arms, and with said sensing chamber, a plurality of auxiliary swingable levers positioned below said sensing chamber adapted to be actuated by such of said sensing pins as pass through said sensing chamber, a plurality of card receiving pockets and mechanism operable by said lower positioned arms for controlling the delivery of a card to one or another of said card pockets, in accordance with the result of the sensing operation determining whether all of the said sensing pins pass or do not pass

through said holes in a card in said sensing chamber.

3. In a punched card machine, a sensing chamber having two plates in which are concentric holes, a pair of swingable arms, one above said sensing chamber and the other below said sensing chamber, a plurality of removable sensing pins, means whereby said sensing pins may be set at predetermined locations on the upper one of said arms, means whereby said lower arm will not be actuated by said pins unless all of said pins which may be set up on said upper arm find and pass through holes in a record card in said sensing chamber.

4. In a punched card machine of the class described, a sensing mechanism comprising a sensing chamber, a vertically reciprocatory pair of relatively spaced plates having columns of concentric rectangular holes therein, a plurality of removable sensing pins which may be placed in any combination of any of said concentric holes, a plurality of rockable bars adapted to overlie any of said plurality of sensing pins in any of said columns in which they may be set up, rockable means for locking any of said bars overlying any of said columns of set up pins in which columns all of said pins find holes in a card in said sensing chamber during their downward movement, to impart positive downward movement to said columns of sensing pins which have all found holes.

5. In a punched card machine, a spring-pulled card guiding unit, a plurality of columns of sensing pins, a plurality of latching levers, one

for each column of a punched card, which levers are adapted to hold said card-guiding unit down against the tension of its spring, a group of manually settable button mechanisms, one for each of said plurality of latching levers, a plurality of Bowden wires, one for each of said button mechanisms, adapted to be operable by said button mechanisms to render any of said latching levers representing any of said columns ineffective.

6. In a punched card machine of the class described, the combination of a plurality of members respectively adapted to cooperate with each of the columns of a data card and having removable sensing pins as a part thereof, a plurality of card pockets, a card gate adapted to be controlled by said column responsive members, and means for locking out of action undesired ones of said column responsive means comprising manually settable button mechanisms.

7. In a machine of the class described, in combination, a card sensing chamber having rows of perforations therein corresponding to the rows of hole positions in a data record card, a plurality of removable sensing pins adapted to cooperate with perforations in a plurality of columns in a data card, lever members positioned over said removable sensing pins, locking means for holding said lever members in depressed position when all of the pins under any given lever member find perforations in a data card, and levers positioned below said data card adapted to be actuated by said sensing pins to control the position of a card gate.

WILLIAM W. LASKER.