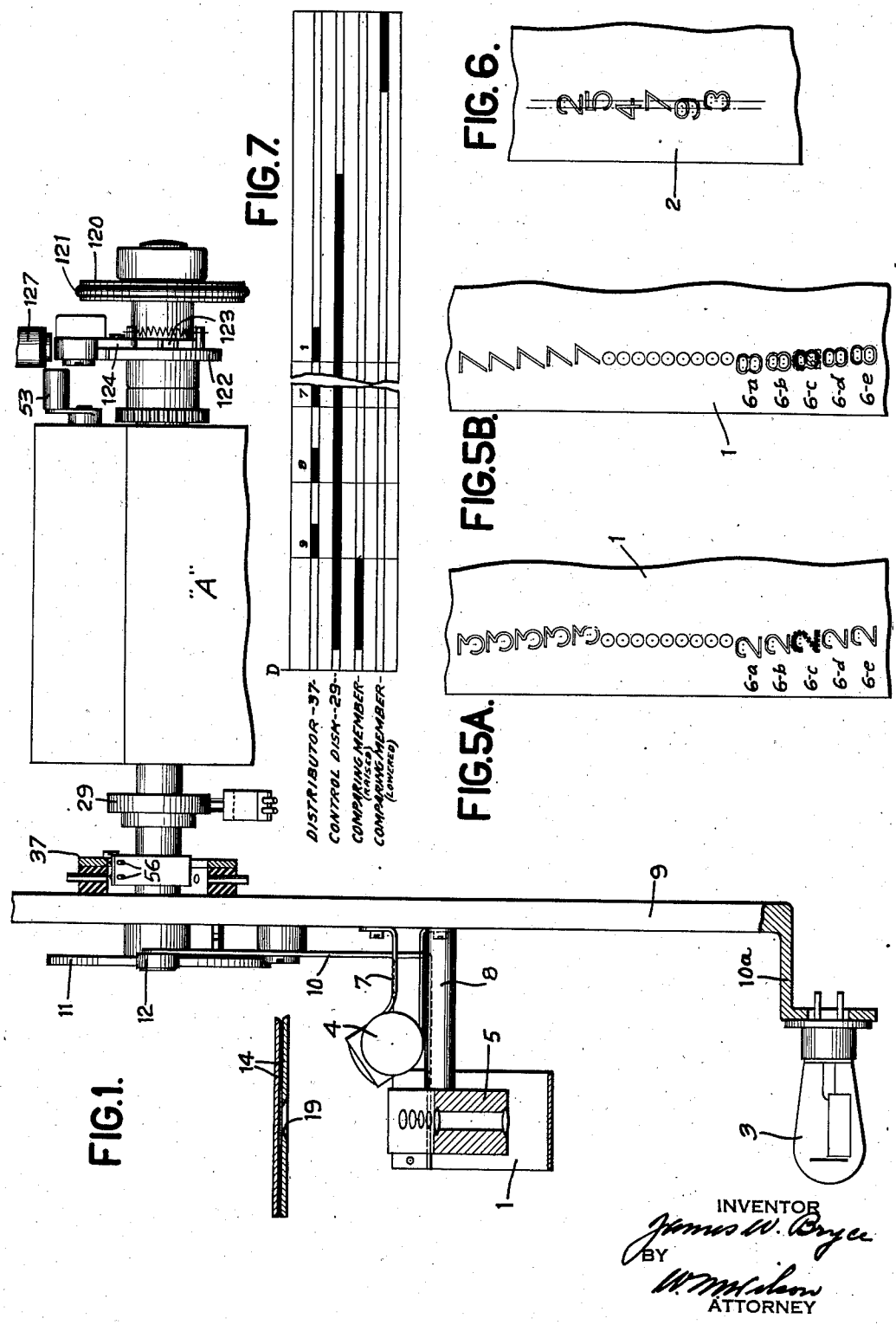
May 6, 1941. J. W. BRYCE 2,240,546

READING MACHINE

Filed Oct. 29, 1936 4 Sheets-Sheet 1



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May 6, 1941. J. W. BRYCE 2,240,546

READING MACHINE

Filed Oct. 29, 1936 4 Sheets-Sheet 2

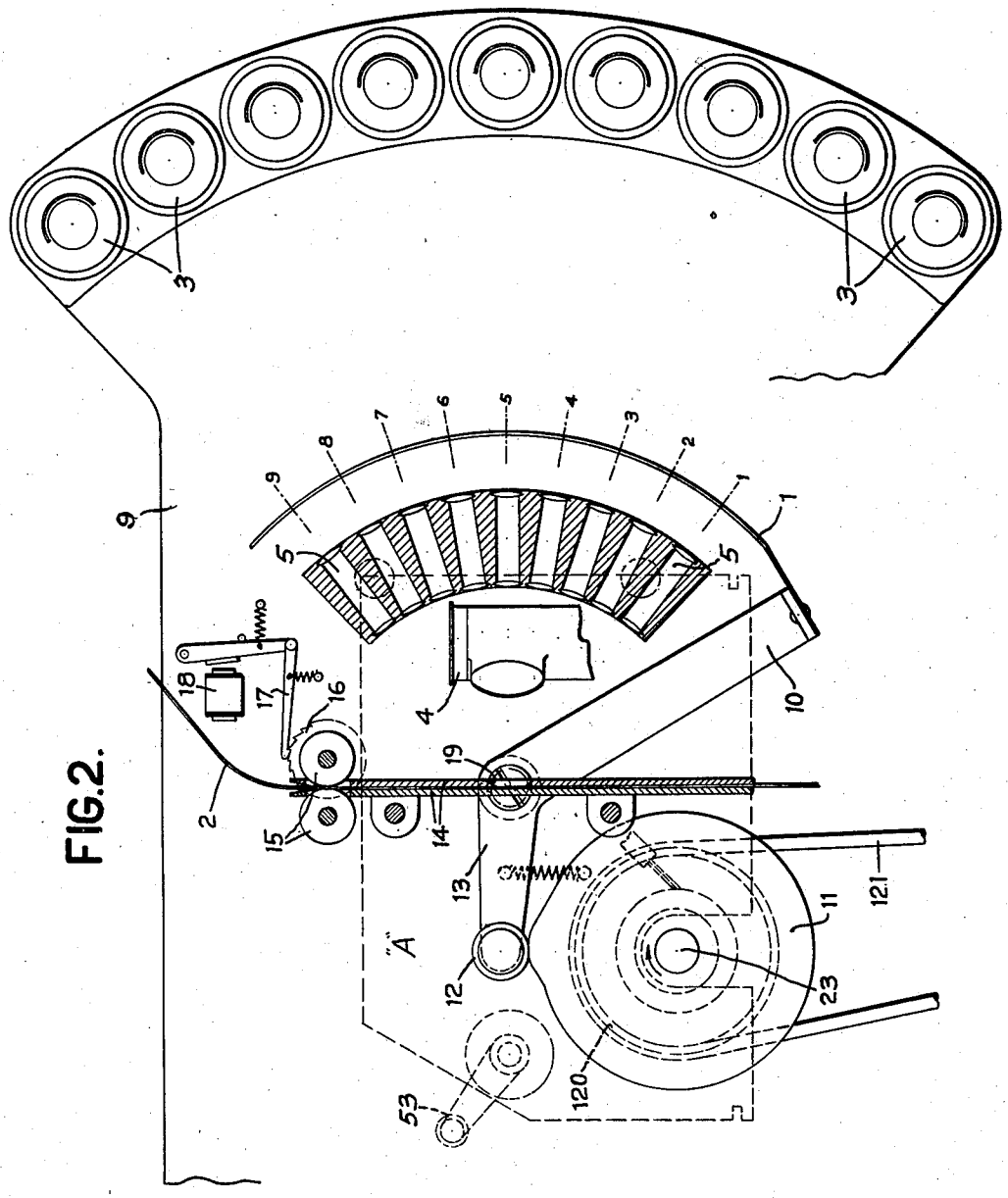


FIG.2.

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READING MACHINE

Filed Oct. 29, 1936 4 Sheets-Sheet 3

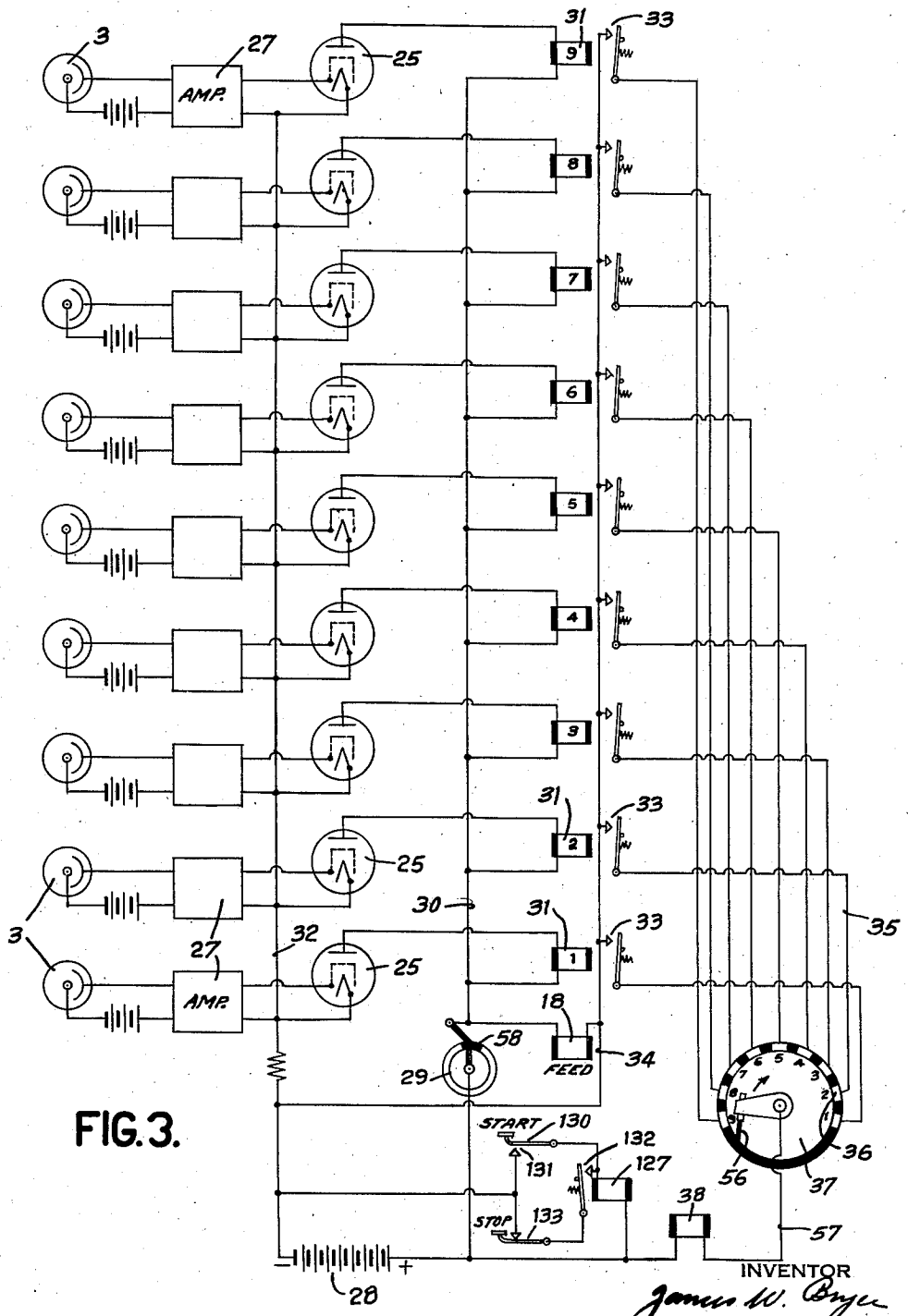


FIG. 3.

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READING MACHINE

Filed Oct. 29, 1936 4 Sheets-Sheet 4

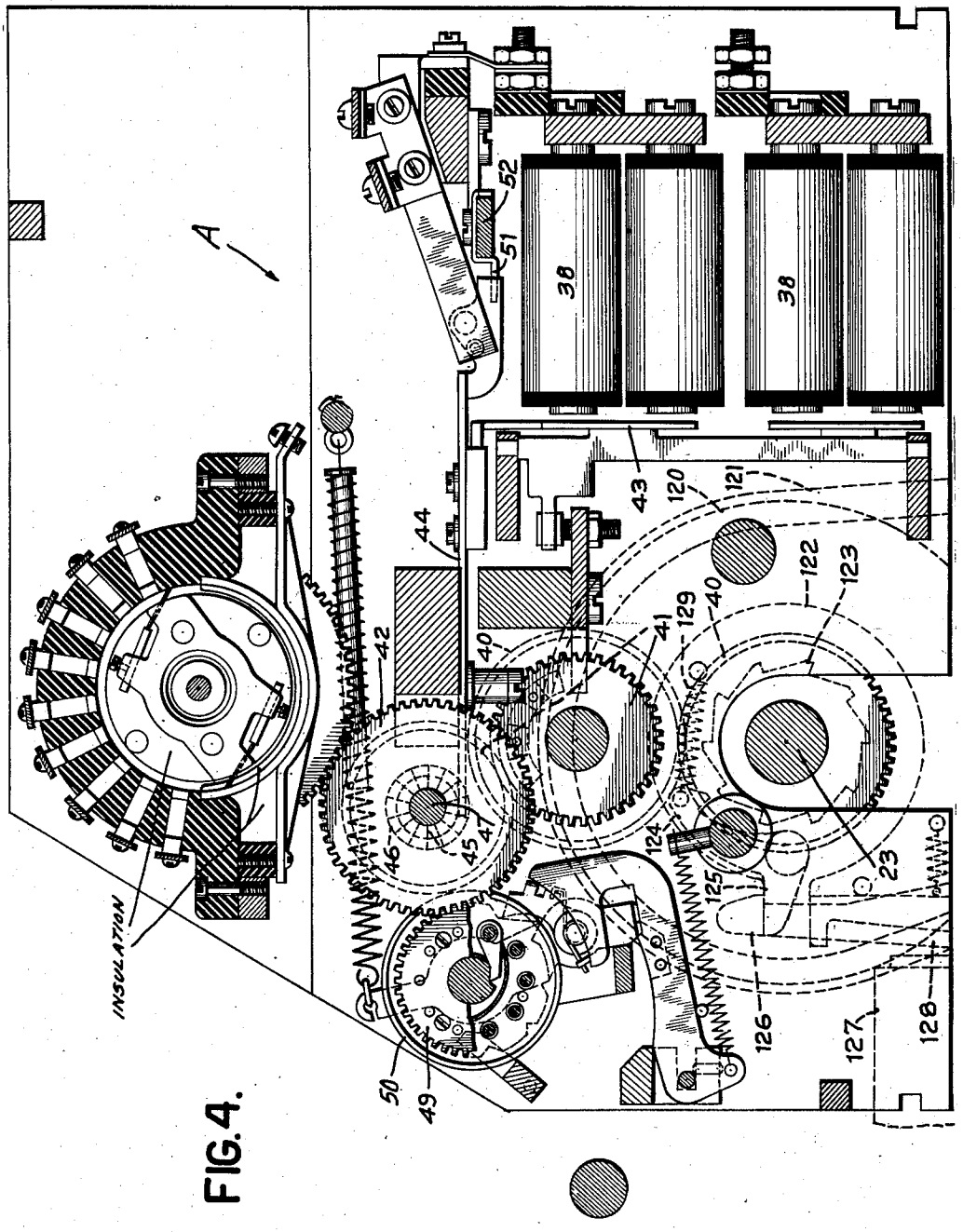


FIG. 4.

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Patented May 6, 1941 2,240,546

UNITED STATES PATENT OFFICE

2,240,546

READING MACHINE

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Application October 29, 1936, Serial No. 108,192

9 Claims. (Cl. 235—61.11)

This invention relates to reading character or indicia representations directly and converting such data to current indications for controlling purposes. More specifically, an object of the present invention relates to improvements in machines which are provided with arrangements adapted to create light ray images of such representations so as to cause by a comparing mechanism certain actions to be instituted thereby effecting the reading of such characters or indications.

Another object of the present invention relates to the provision of means for reading printed or formed characters by ray responsive means and to the provision of compensating means for reading the characters in the event that the said characters are not in perfect alinement or properly positioned on the character record retaining means or medium.

The present invention will be disclosed in certain preferred embodiments to illustrate the general principle thereof, whereby printed matter or data prepared by the usual typing, printing, or similar machines are read or scanned by means including light sensitive responsive devices, such as photo-cells, transforming the printed data to current values or indications to control certain types of translating, registering, or indicating devices. Broadly, the type of reading system just mentioned is well known at present and a common method of effecting this result is to compare the characters or indications of the record medium with like characters or indications borne by a comparing mask or member until complete agreement of the characters is indicated; however, it has been found that when the usual printed or formed matter or data is to be read by the systems proposed, which are known by those skilled in the art, such known systems are impractical and of no value owing to the fact that compensating means for mis-alinement of the characters is not provided. It is well known that the characters printed, for example, by the usual typewriting or printing devices are not all allocated in the same plane, or that the spacing thereof may be irregular and varying, or in other words, the characters or indications are irregularly disposed on the record medium. In forming record sheets, there is no assurance that the spacing of the characters will be perfectly regular and that the position of the characters will always be in perfect vertical and horizontal alinement. Unless the characters on the record sheet are formed accurately and perfectly, that is, properly alined and equally spaced, and regularly disposed thereon, the present known reading systems would be inoperative due to the lack of compensating means for incorrect alinement or irregular disposition of the characters on the record sheets.

It was mentioned that one feature of the present invention is the provision of an improved reading machine and one including compensating means in such character reading systems whereby indications or characters formed on a record medium but not perfectly alined or spaced may be read, instantaneously, irrespective of the disposition of the indications or characters thereon, to control associated indicating or manifesting devices.

The present invention is an improvement and modification of the reading system disclosed in a copending application, Serial No. 107,819, dated October 27, 1936. The system described in the said application, briefly and broadly, comprises a movable scanning device to compare the characters of the record sheet with like characters of the scanning or comparing device. The comparing member or device has disposed thereon all the characters which may appear on the record sheet. In addition thereto, a plurality of similar characters are disposed thereon which are slightly offset in a predetermined plane. The characters of the comparing member are offset in one direction and the said member is adapted to be rotatable in another direction, in this manner effecting scanning and alining of the character to be read in both the horizontal and vertical planes; that is, in the event the characters are disposed so as to be mis-alined in either plane, the device is effective to read said characters. The rotary comparing member is interposed between the record sheet and light responsive devices, so that upon agreement of the characters of the record sheet and comparing member, the light responsive devices are arranged to be operated, due to the modification of the light rays by the coincidence of the characters, to indicate such a condition. Upon operation of the light responsive devices, electronic elements are adapted to be activated to control associated mechanisms. The electronic elements comprise electrical discharge tubes of the type in which the discharge is started by a momentary application of a signal condition thereto, the discharge continuing independently of the applied signal condition until interrupted by an associated control means. In one form the electrical discharge tube may comprise a gas discharge path which is electrostatically controlled. A conven-

ient form of discharge tube for such systems comprises a gas filled thermionic tube of such construction that when the anode is connected to positive battery and a certain potential is applied to the grid the tube will be activated and current will flow from the anode to the cathode. As soon as the plate current begins to flow, the grid is instantly surrounded by a sheath of positive ions and has no further effect in controlling the plate circuit; hence removal of the grid potential will not stop the plate current, once it is started, but it can readily be stopped by removing the plate voltage. The function of the grid may, therefore, be likened to a trigger. The amount of power required to start the tube is exceedingly small. A form of the thermionic tube having these characteristics set forth is disclosed in the Langmuir Patent No. 1,289,823 and commonly referred to as "thyratron" tubes. Operation of the tubes described then is adapted to cause the associated apparatus such as relay or control devices to be operated until the anode circuit of the discharge tube is opened. Several types of associated mechanisms are shown to be applied to the system in the said application, such as accumulator devices of well known statistical machines and devices such as adding machines, typewriters, and the like employing individual key levers for controlling purposes.

The present invention differs from the invention just described and disclosed in the aforementioned application, in that, instead of providing rotary comparing means and sensing the different characters disposed thereon progressively, the comparing means is provided to be positioned or oscillated between predetermined limits to provide for reading mis-alined characters and in addition thereto means are provided to sense all the characters disposed on the comparing means concurrently. The comparing means is provided with the characters which may appear on the record medium and also a plurality of offset characters to compensate for irregular disposition of the characters on the record medium. The reading of the characters is effected by projecting a plurality of images corresponding to the characters to be read upon the comparing means, each image projected to a different character; therefore, as the comparing means is positioned to compensate for the irregular disposition of the characters, correspondence of the characters read and certain of the characters on the comparing means is effected. A light responsive device for each character image projected is provided; therefore, upon agreement of the said characters, the light responsive devices are rendered effective to trigger gas discharge tubes of the type described hereinbefore. The tubes remain operative until the anode circuits thereof are opened which is near the end of the machine cycle. Control elements are rendered operative due to the current flow in said anode circuits, and may be employed to control any suitable indicating devices.

Various other objects and advantages of the invention will be obvious from the following particular description of one form of mechanism embodying the invention or from an inspection of the accompanying drawings; and the invention also constitutes certain new and useful features of construction and combination of parts hereinafter set forth and claimed.

In the drawings:

Fig. 1 shows a plan view of the reading machine.

Fig. 2 shows a vertical section of the comparing mechanism.

Fig. 3 shows a circuit diagram for the invention.

Fig. 4 shows a vertical section of one type of controlled device.

Figs. 5A and 5B show a type of comparing member.

Fig. 6 shows a record sheet having irregularly disposed characters thereon.

Fig. 7 shows a timing chart as applied to the present invention.

Referring now to Figs. 1, 2, 5A and 5B, a comparing mask or member 1 is shown interposed between a record sheet 2 and a group of photo-cells 3 so that a light source 4 is adapted to illuminate the record sheet and by means of the condenser system to project the images of the characters on the record sheet upon the comparing member so that the light rays impinge upon the photo-cells. The comparing member has disposed thereon all the characters which may appear on the record sheet and as shown in Figs. 5A and 5B a plurality of similar characters 6—*a* to *e* are slightly offset from each other in the vertical plane, the purpose of which will be understood as the description progresses.

A method of reading characters irregularly disposed on the record sheet by comparing the characters thereon and the characters on the comparing member concurrently is shown specifically in Figs. 1 and 2. The light source 4 and lens system 5 are suitably mounted on arms 7 and 8 respectively which are supported by the member 9. The photo-cells 3 are also mounted on an extended section 10*a* of the member 9. The mask 1 is mounted on the arm 10 which is pivotally mounted on member 9 and adapted to be positioned or rocked vertically by means of cam 11 cooperating with the cam roller 12 attached to one end of the extension 13 of arm 10. The cam 11 is fixed to shaft 23 which is adapted to be rotated by any suitable means, one method as indicated by the belt 121 and pulley 120 through the agency of a clutch mechanism shown in Fig. 4.

The record sheet 2 is positioned between the guide plates 14 and fed therethrough by the rollers 15, one of which is actuated step by step by ratchet wheel 16 and controlled by the record feed magnet 18 and pawl 17 so that upon energization and deenergization of the said magnet the record sheet is fed a distance equivalent to the spacing between the characters disposed thereon. A sensing or reading position is provided and is shown in the form of an opening 19 in one of the guide plates 14.

A plurality of lens systems 5 are arranged between the record sheet and the comparing member so that a plurality of images corresponding to the character to be read are projected concurrently on the said member. The number of images generated by the lens system is equal to the number of different characters disposed on the comparing member. In this manner it is seen that the character to be read on the said record sheet is compared concurrently with all the characters appearing on the comparing member.

Referring to Figs. 5A and 5B, five similar characters 6—*a* to *e* are shown to be provided for each different character disposed on the comparing member. This number may be increased or decreased as seen fit. The similar characters 6—*a* to *e* for all the different characters are shown to be staggered slightly in the vertical plane. The

purpose of this arrangement is to provide a method of matching the characters of the comparing member with the characters on the record sheet even though the characters on the sheet are not in perfect alinement or regularly disposed thereon. It will be obvious that with this method of reading characters, even though they are displaced or misalined in the horizontal plane, it is possible to match the characters thereon due to the arrangement of the offset characters on the comparing member. It will be evident too since the comparing member is positioned or rocked vertically that the matching of the characters displaced or mis-alined in the vertical plane is effected.

It has been mentioned that the comparing member 1 is positioned or moved by means of cam 11, the configuration of which is such that the comparing member is moved upwardly at the beginning of the machine cycle to present the five offset characters 6—*a* to *e*, for the different characters, to the individual bundle or rays of light projected by the lens system 5, so that all of the offset characters are compared with the images of the character on the record sheet to effect correspondence of the characters. It is seen that by means of the individual images of the character, concurrent analyzation or comparison of the character to be read with all the different characters disposed on the comparing member can be effected; and it is seen by virtue of positioning the comparing member to present the offset characters disposed thereon in the planes of the images that matching or correspondence of the characters can be effected, even though the characters of the record sheet may be irregularly disposed thereon as shown, for example, in Fig. 6.

When the characters on the comparing member and the characters on the record sheet match or correspond (see Figs. 5A and 5B), the minimum amount of light is permitted to be impinged on the associated photo-cells. In this description it is assumed that the characters on the comparing member are either transparent or merely openings in an opaque mask. Referring now to Fig. 3, the photo-cell and amplifier circuits are so arranged that when the minimum amount of light falls upon the photo-cell 3, the grid of the electrical discharge tube 25 of the type described hereinbefore is triggered to permit current flow in the anode circuit thereof. These types of controlling circuits are well known and it is deemed not necessary to describe them further. Let it be assumed that the "2" character on the record sheet is matched with one of the "2" characters on the comparing member (Fig. 5A) to permit the minimum amount of light to fall upon the corresponding photo-cell thereby operating the corresponding photo-cell circuit and amplifier unit to trigger the grid of the corresponding discharge tube 25 to permit current to flow in the plate circuit thereof which is as follows: the positive terminal of battery 28, control distributor 29 (secured to shaft 23), conductor 30, coil of relay 31, anode and cathode of tube 25, conductor 32 to battery 28. Current flows in the circuit traced until the anode circuit is opened, irrespective of the duration of the grid condition of the tube. The discharge tube control distributor 29 permits the anode circuit to be established practically the entire machine cycle (Fig. 7) a complete cycle is equivalent to a complete revolution of the main drive shaft 23; therefore, due to the current flow in the plate circuit just described, relay 31 is energized and remains energized until the control distributor 29 opens the said circuit.

Energization of the relay 31 operates its associated contacts 33 to connect one side of the battery 28 by conductors 34 and 35 to a conducting segment 36 of the distributor 37, so that when the associated brush 57 (secured to shaft 23) is advanced to the segment connected to said battery, which in the assumed example is the segment "2" of the distributor, a circuit is completed by means of conductor 57 through the coil of magnet 38 which is connected to battery 28, thereby energizing said control magnet.

The energized relay or magnet 38 may represent any desired type of controlling element to control any suitable indicating or registering means representing the condition just described, namely, the correspondence of the characters on the record sheet and comparing member. A particular type of controlled device will be explained which may be used in the reading system described. The magnet 38 represents, in the example to be set forth, the control element of a well known statistical machine. The application in this instance may be such that it is desired to enter an amount in an item entering means or accumulator in accordance with the character disposed on the record sheet.

Referring now to Fig. 4, the operation of the item entry means, generally designated A, will be briefly described. This unit is well known in the art and requires no detailed description; for a detailed description reference may be made to Patent No. 1,967,617. Magnet 38 may be energized at various points in the cycle of the machine (see Fig. 7), depending upon the timed interval of the matching of the characters of the record sheet and the comparing member. Energization of the magnet 38 attracts the armature 43 to displace the attached lever 44, causing the latching members 45, slidably mounted on shaft 47, to engage the member 46 integral with gear 42 which is loosely mounted on the shaft 47. Gear 42, when thus coupled to shaft 47, is rotated thereby through the gearing thereto from the main shaft 23 and indicated generally as gears 40 and 41; and gear 42 also causes the rotation of gear 49 to displace the accumulator index wheel 50.

If, as assumed, the characters "2" are in correspondence, the segment "2" on the distributor 37 and brush 56 complete a circuit through magnet 38 when the brush is advanced to engage the said segment. Magnet 38 is energized at this point in the cycle to cause the index wheel to be rotated, and said index wheel continues to rotate until entry of the character has been effected. Upon entry of the character in the accumulator, the clutch element 45 is declutched by a finger 51 carried on a bar 52. This operation of the accumulator is well known and fully explained in the cited patent and therefore needs no further description. The usual resetting means for the accumulator is indicated generally at 53 and may be manually operated. Near the end of the machine cycle, the control distributor 29 by means of the insulated segment 58 (Fig. 3) causes the plate circuit described to be opened, thereby restoring the tube 25 to a normal non-conducting condition and thereby deenergizing the relay 31.

It is seen that near the beginning of the machine cycle, the magnet 18 is connected directly across the battery 28 by means of the control

distributor 29 and near the end of the cycle is deenergized thereby to operate the said magnet to perform preparatory functions of the machine such as, for example, operating the record feeding device described hereinbefore to present the next character thereon to the sensing position.

It should be mentioned at this time that it is preferred to start all the controlling elements of the system in unison such as the comparing member, control distributors and the accumulating or similarly controlled device, that is, to start the said control elements from a normal starting position D, as indicated in Fig. 7.

For this reason as mentioned hereinbefore, the control elements are actuated by the main driving shaft 23. The cam 11 is secured thereto and also the various control distributors 29 and 37. The controlled device, namely, the accumulator, is actuated by the said shaft through the gearing 40 and 41. Referring to Fig. 4, a driving element such as pulley 120 and a clutch operating member 123 integral therewith are rotatably mounted on shaft 23 and continuously rotated by any suitable means through the means such as belt 121. A suitable supporting member 122 for the dog 124, which is pivotally mounted thereon, is fixedly secured to shaft 23. The member 122 and dog 124 have protruding fingers such as indicated by reference character 125 and are adapted to be engaged by the stop 126 which is an extension of armature 128 when the parts are in position as indicated in the figure. When the clutch magnet 127 is energized to attract its armature 128, the stop 126 releases the member 122 and dog 124 so that by means of spring 129, the dog is caused to engage the clutch member 123 which is continuously rotated thereby causing the shaft 23 to be rotated.

With reference to Fig. 3, the machine is started by depressing the start key 130 to close the associated contact 131 connecting the magnet 127 directly across the battery. Energization of the said magnet causes the contacts 132 to be closed to establish a locking circuit for the magnet through the normally closed contacts of the stop key 133, maintaining the magnet energized until the stop key is operated to open the contacts in the locking circuit. Energization of magnet 127 causes the clutch to connect the driving member 123 to the member 122 by dog 124 to rotate the shaft 23. Upon operation of the stop key 133 the magnet is deenergized so as to position the stop 126 in the path of the fingers 125 causing the dog 124 to be disengaged from the clutch member 123 causing the controlling elements of the machine to be stopped in the normal home position.

It has been shown that upon operation of the start key 130, shaft 23 is caused to be rotated, and that the cam 11 then causes the comparing member 1 to be positioned upwardly to the extent that the entire group of similar characters 6—*a* to *e* for all the different characters are presented in the paths of the corresponding individual images of the character to be read. Thus correspondence of the characters on the record and said member is effected. The comparing member is returned to the normal position as shown in the figure at the end of the cycle (Fig. 7). Upon correspondence of the said characters a corresponding photo-cell 3 is operated to trigger the associated discharge tube 25 thereby energizing the corresponding control relay, which permits the control magnet 38 to be energized at the proper interval in the timed cycle.

It is understood then that the character disposed on the record sheet is compared with all the different characters on the comparing member at the same time and that the movement or positioning of the comparing member, to present the similar groups of characters on the said member at one time to the individual images corresponding to the character on the record sheet, is provided to compensate for any irregular placement or disposition of the character on the record sheet. A number of irregularly disposed characters are shown on the record sheet 2 in Fig. 6 and as indicated by the dotted lines, the characters should all be positioned therein to be regularly disposed on the sheet and in addition thereto should be equally spaced. The reading systems known today are entirely limited to read characters disposed in the margin lines shown, that is, only characters which are regularly disposed, whereas the description just set forth shows how characters irregularly disposed on the record sheet may be read by the comparison method and that the character on the record sheet can be compared with all the characters on the comparing member at one time to control various indicating means in accordance with the character read.

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

What is claimed is as follows:

1. In a reading device of the character described controlled by a record medium having various characters disposed thereon, means for determining the identity of a character on the medium comprising the combination of a comparing member having all the different characters to be read disposed thereon, and of means for comparing simultaneously the said character with all the different characters on the member for identifying the true character significance of the character to be read, and means controlled by the determining means to indicate the identity of the character upon determination of its true character significance.

2. In a reading device of the character described controlled by a record medium having various characters disposed thereon, means for determining the identity of a character on the medium comprising the combination of a comparing member having all the different characters to be read disposed thereon, and of means for comparing simultaneously the said character with all the different characters on the member for identifying the true character significance of the character to be read, a work circuit, and means controlled by the determining means for influencing the work circuit upon determination of the true character significance of the character to be read.

3. In a reading device of the character described controlled by a record medium having various characters disposed thereon, means for determining the identity of a character on the medium comprising the combination of a comparing member having all the different characters to be read disposed thereon, and of means for comparing simultaneously the said character

with all the different characters on the member for identifying the true character significance of a character to be read, a work circuit, means controlled by the determining means for influencing the work circuit upon determination of the true character significance of the character to be read, and means for rendering the last mentioned means effective selectively at a differential time depending upon the identity of the character read.

4. In a reading device of the character described controlled by a record medium having various characters disposed thereon, means for determining the identity of a character on the medium comprising the combination of a comparing member having all the different characters to be read disposed thereon, and of means for comparing simultaneously the said character with all the different characters on the member for identifying the true character significance of the character to be read, indicating means and control means therefor, and means controlled by the determining means for controlling the control means upon determination of the true character significance of the character to be read thereby controlling the indicating means to indicate the identity of the character read.

5. In a reading device of the character described controlled by a record medium having various characters disposed thereon, a comparing member having all the different characters to be read disposed thereon, means for producing a plurality of images of the character to be read for projecting simultaneously each one of the said images upon the different characters on the comparing member, means for determining a condition of correspondence between one of the characters on the comparing member and one of the character images projected thereupon, and means controlled by the determining means upon correspondence of one of the images of the character to be read and one of the characters on the comparing member for indicating the identity of the character read.

6. In a reading machine of the character described controlled by a record medium having various characters disposed thereon, which characters may be irregularly disposed thereon in different positions other than the normal positions where they should appear, means for reading each character formed on the medium to determine the true character significance thereof, said reading means including the combination of a comparing member bearing comparing characters for identifying the regularly disposed characters on the medium, of means for comparing each character to be read simultaneously with all the said different comparing characters for identifying the true significance of the said character to be read in the event this character is disposed in the normal position on the medium upon comparison of like characters, of additional sets of comparing characters formed on the member for identifying the irregularly disposed characters on the medium, and of means including the mentioned comparing means for effecting comparison of the character to be read with each additional set of comparing characters for identifying the true character significance of the character to be read in the event the character is disposed in a position on the medium other than the said normal position upon the comparison of like characters, a work circuit, and means controlled by the reading means for influencing the work circuit when correspondence is effected between the compared like characters.

7. In a reading device of the character described controlled by a record medium having various characters disposed thereon, which characters may be irregularly disposed thereon in different positions other than the normal positions where they should appear, means for reading each character formed on the medium to determine the true character significance thereof, said reading means comprising the combination of a comparing member bearing a plurality of sets of different characters, each set comprising all the characters appearing on the medium and each character of each set formed on the comparing member in an offset position with respect to similar characters of the other sets, certain of the said characters formed on the member being adapted for identifying the regularly disposed characters on the medium and the remaining characters formed thereon being adapted for identifying the irregularly disposed characters, of means for comparing the character to be read simultaneously with all the characters of one of said sets of characters, said comparing means including means for effecting comparison of the said character to be read successively with the remaining sets of characters on the member for determining the true character significance of the character irrespective of its disposition on the medium; and means controlled by the reading means when correspondence is effected between one of the characters of one of said sets disposed on the comparing member and one of the character images projected thereupon for indicating the identity of the character read.

8. In a reading device of the character described controlled by a record medium having various characters disposed thereon in different positions other than the normal positions where they should appear, a comparing member bearing a plurality of groups of characters which appear on the medium, the said characters of each group being identical and arranged in a predetermined relationship with respect to each other, the predetermined relationship of the said characters in each group determining the extent of irregularity of the disposition of the characters on the medium which can be compensated for by the said groups of characters formed on the comparing member, means for producing images of the character to be read and projecting simultaneously the said images upon one of the characters of each group, means for bringing the remaining characters of each group progressively into cooperative relationship with the said projected images, and means for indicating a condition of coincidence of one of the characters of the said groups disposed on the comparing member and one of the character images projected thereupon, thereby indicating the identity of the character to be read regardless of its disposition on the medium.

9. The invention set forth in the preceding claim characterized by the provision of means for rendering the last mentioned means effective selectively at a differential time depending upon the identity of the character read.

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