

Nov. 2, 1943.

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2,333,463

APPARATUS FOR RECORDING STATISTICAL RECORDS

Original Filed June 17, 1938 3 Sheets-Sheet 1

FIG.1A.

OBLITERATING MAGNET

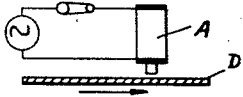


FIG.1B.

RECORDING MAGNET

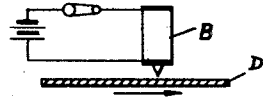


FIG.1C.

READING MAGNET

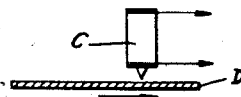


FIG.2.

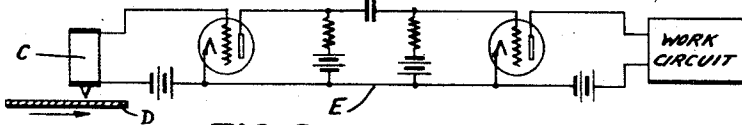


FIG.3.

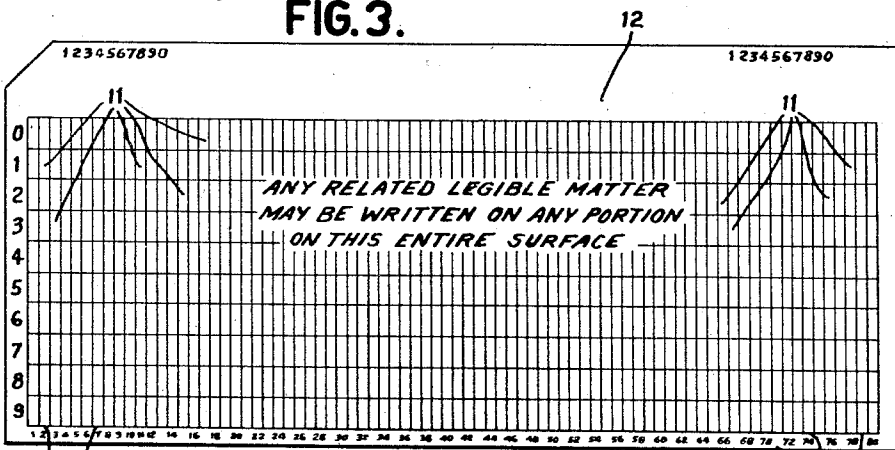


FIG.4.



FIG.5.



FIG.6.

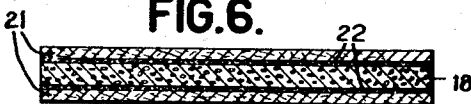


FIG.7.

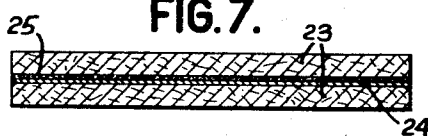


FIG.8.

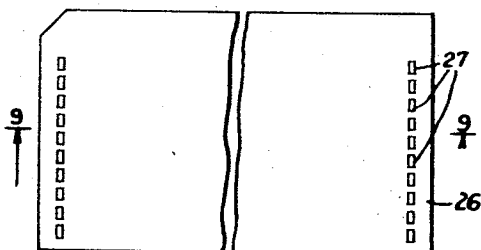


FIG.9.



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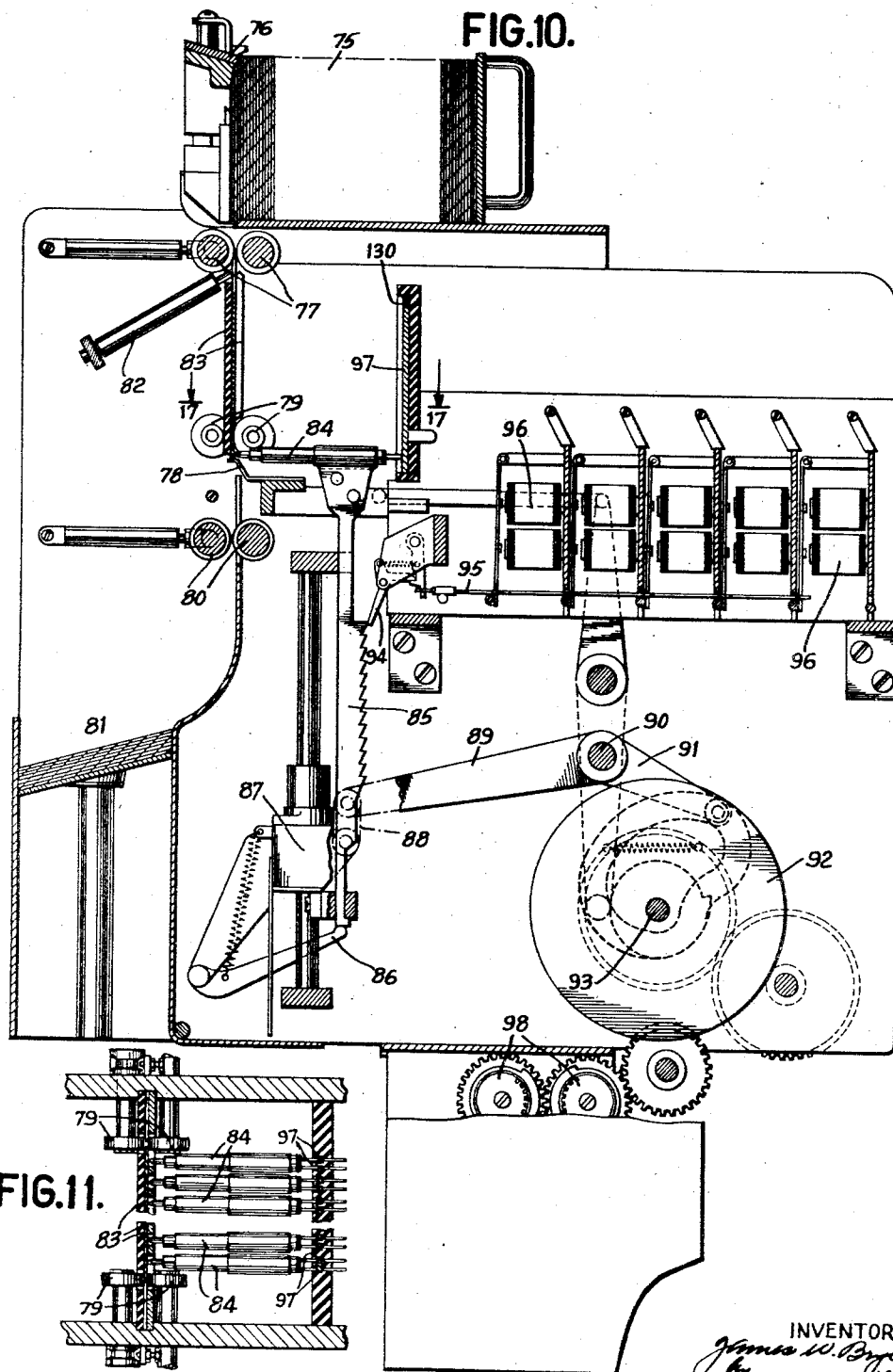
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APPARATUS FOR RECORDING STATISTICAL RECORDS

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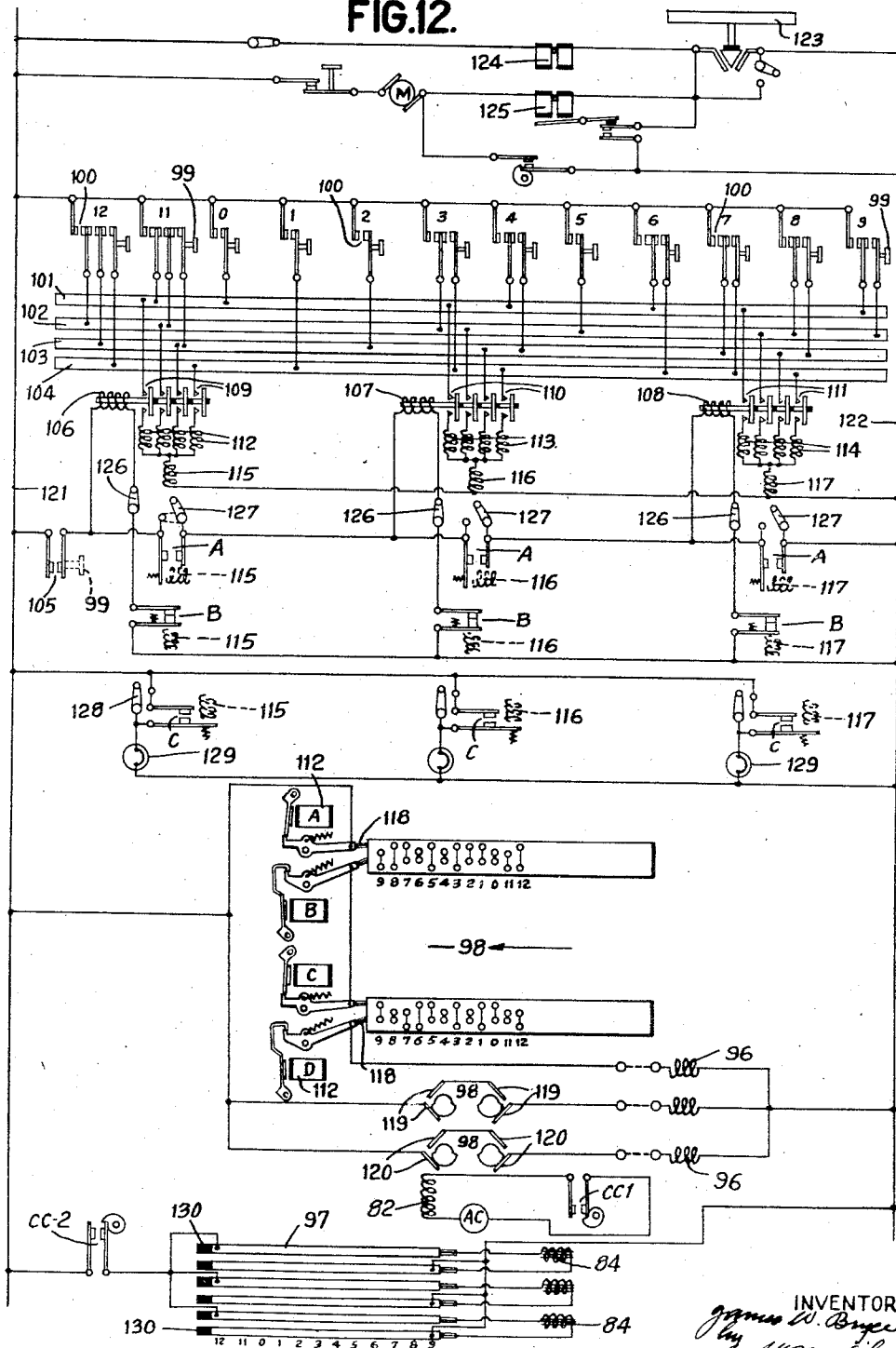
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APPARATUS FOR RECORDING STATISTICAL RECORDS

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FIG. 12.



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APPARATUS FOR RECORDING STATISTICAL RECORDS

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Original application June 17, 1938, Serial No.
214,401. Divided and this application March
19, 1941, Serial No. 334,156

1 Claim. (Cl. 234—1.5)

This invention relates to apparatus for recording data on statistical record elements, and is a division of the co-pending application Serial No. 214,401, filed June 17, 1938.

An object of the present invention resides in the provision of an improved record element recording apparatus wherein individual recording magnets are positioned differentially, which magnets are held in close proximity to, and opposite various index point positions of, a stationary magnetizable record element, and are energized momentarily, and simultaneously, to record the desired data in the form of discretely magnetized areas at the different index point positions.

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

In the drawings:

Figs. 1—A, 1—B, and 1—C show diagrammatically the obliterating, recording, and reading means for detecting magnetic conditions on a record.

Fig. 2 shows an amplifier system including magnetic reading means in the input circuit.

Fig. 3 shows a detailed view of a control element.

Figs. 4 to 9 show detail sections of different forms of control elements.

Fig. 10 shows a cross sectional view of one type of record preparing device.

Fig. 11 shows a detail section of the device shown in Fig. 10.

Fig. 12 is a circuit diagram of the control circuits for the device shown in Figs. 10 and 11.

Control records

The control records to be described and shown in Figs. 3 to 9 must fulfill certain requirements in order to be adaptable to accounting system processes. The records, of course, must comprise suitable magnetizable substances which, when subjected to controlling magnetic fields and removed therefrom, retain suitable remanent fluxes therein which will be effective to create or initiate current impulses when presented to suitable detecting or sensing devices.

The magnetizable material may be incorporated in or form part of the control record in various ways, for example, (1) the said material may be in the form of a metallic wafer or strip, or individual wafers or strips; (2) or may be in the form of metal powder or filings suitably fixed

upon a carrier or base; (3) or a form of colloidal metal and sprayed or coated upon a carrier or base as a metallic coating; (4) or a form of coating or layer of material deposited on a carrier by an electrolytic process; (5) or may be in the form of a granular material such as filings and mixed in suitable paper used as a carrier; (6) or a form of finely divided metal powder incorporated in the pulp before manufacturing the paper carrier or base.

Irrespective of the method employed to form the control records, it is imperative that the records produced be capable of withstanding the stresses to which they are subjected by the rapid and repeated handling of the records in the various accounting machines. It is necessary that the records have sufficient rigidity and durability to be adapted for and capable of being electro-mechanically segregated, sorted and tabulated and withstand the exigencies of repeated operations.

It is also necessary to form the control records so as to be provided with at least one surface to readily receive legible matter such as various characters or marks formed by writing, printing, or typewriting. This requisite is quite important in view of the fact that the magnetic influences impressed on the control records are not visually discernible and therefore the appearance and configuration of the control records remain unchanged; that is, the records appear exactly the same after recording the data thereon as they appeared before recording of the data was effected. In this manner, it is possible to identify the various discrete magnetic influences impressed on the records. Not only is it possible to identify the various recordings by the corresponding characters written or printed on the surface of the records, but also the entire surface, or any part thereof, is free to be used for reception of additional data which it might be desired to include thereon. The latter feature is possible since the surface of the record is not altered or mutilated for the purpose of recording the particular data.

It is evident, too, that subsequent entries of the legible characters may be made upon the surface of the record from time to time. This makes it possible to delete or strike out any of the printed or written characters as desired or add thereto, particularly in view of the fact that the magnetic influences impressed on the records may be obliterated and substituted by new recordings from time to time. Sufficient space on the surface of the card should be available to re-

ceive the additional printed or written recording identifying matter in the event it is desired merely to strike out the irrelevant legible matter.

With reference now to the figures, particularly Fig. 3, the control record D represents, in the present instance, a control element of standard size, that is, similar in size to the records for use with accounting machines of the well known Hollerith type, and comprising magnetizable material and having a surface capable of receiving legible characterizations.

The surface of the control record D in the figure is shown to be divided into a plurality of individual index point positions. In practice, it is to be understood that the said index point positions need not be indicated as shown in the figure and that the illustration used is merely for descriptive purposes, since it is impossible to show graphically the magnetic influences impressed in the various control areas.

It is seen that a plurality of columnar areas 10 are provided along the minor axis of the control record D and that each columnar area is subdivided into a plurality of code or index point positions 11, each position representing a certain value or characterization. For example, each columnar area, as shown, is divided into ten positions, the values of which increase in value from the top to the bottom of the record. In this respect, the index point positions are arranged and identified similarly as is the customary and well known arrangement of the Hollerith record. It is to the specific positions 11 where the discrete magnetic influences are directed and impressed in accordance with the data desired to be recorded. It is evident, therefore, that the statistical information or data are arranged in the form of arbitrary indications coded according to their positions on the record.

The magnetic material may be in a form or state that it will not readily receive writing or printing, and it is obvious that such a surface must be provided so as to enable the identification of the records and interpretation of the data impressed thereon. The term "writing surface" is meant to include a surface which will readily take impressions from a pencil, pen, typewriter, hand stamp, printing press, or other kindred instrument. In Fig. 3, the entire plan surface of the control record is capable of receiving such legible impressions, and, as indicated on the record, the legible indications may be arranged at the head of the columns to interpret the code impressions in the corresponding columns. In addition to the columnar code indications, the remaining surface of the record is available and capable of receiving legible impressions, since the magnetic influences impressed on the record in the various positions do not alter the configuration of the record, and the legible impressions in no way disturb or alter the effects of the magnetic impressions.

It should be mentioned at this time, that in addition to the different positions 11, a space 12 is provided available for the reception of additional magnetic impressions which can be used for various control purposes or in combination with the impressions disposed in the positions 11 to expand the number of code combinations on the records. It is well known that for certain control purposes "11" and "12" index point positions are provided on a control record and in such cases where this is desirable it is possible to impress the discrete magnetic influences to be utilized for control purposes in the "11" and "12" positions

for any columnar area 10, in the space 12 designated on the record in the figure.

Referring now to Figs. 4 to 9, different forms of control records comprising magnetizable material will be described, and it is to be understood that each record described hereinbelow can be conditioned in the manner just described and the arrangement of the magnetic influences and legible impressions can be made in accordance with the description set forth in conjunction with the record D in Fig. 3.

In Fig. 4, the record is shown to comprise a carrier or base 13 which may be of paper stock prepared from coniferous chemical pulp free from ground wood, although other material, preferably non-magnetic, may be used as a support or backing as long as it is strong and durable and capable of withstanding the stresses to which it is subjected. A wafer or foil of magnetic material 14 is shown secured to the carrier 13 by any suitable bond or cementitious material 15, such as glue. In order to protect the foil or wafer of magnetic material, and also to provide a writing surface for the record, a layer of suitable paper 16, such as mentioned hereinbefore, is provided and secured to the magnetic wafer 14 by a layer of cementitious material 17.

It should be mentioned at this time that it has been found that magnetic lines of force, when suitable coils are used and the proper voltages are applied thereto (depending upon the materials used in the record), will travel through non-magnetic material and cementitious layers generally without hindrance or interruption.

Referring now to Fig. 5, a record is shown to comprise a sheet of suitable non-magnetic material 18 such as paper, which is impregnated with granular magnetic material, generally indicated at 19, such as iron filings. Or, if preferred, the carrier 18 may be made by depositing finely divided metal powder in the paper pulp so as to be incorporated therein before the manufacture of the magnetizable paper stock. The impregnated paper may then be treated and coated on both sides with layers of ink retaining varnish 20. The layers of varnish serve two purposes; (1) to protect the impregnated carrier 18, and (2) to provide a writing surface on the record.

In Fig. 6, the impregnated sheet 18 is shown to be covered with layers of suitable plain paper stock 21 secured to the impregnated stock by cementitious material 22. One of said layers of plain stock 21 should be capable of receiving printing or legible character marks.

In Fig. 7, one of the plies of paper stock 23 is coated with a metallic coating 24 and secured to the other by cementitious material 25. To this end, suitable metal powder or filings may be suspended in any suitable binder and sprayed or coated on one of the plies of paper stock. Colloidal iron may be used and sprayed thereon as a metallic coating.

In Figs. 8 and 9, still another modification is shown to comprise two plies of suitable paper stock 26, having discrete magnetizable portions 27 at all the index point positions formed on one of the said plies of paper stock. These portions may be coated on the paper stock similarly to the coating 24 described in conjunction with Fig. 7. A stencil plate may be used to cover the paper stock when the coating of the magnetizable material is to be applied thereto, or the portions 27 may be printed thereon similarly as ordinary printed matter. The magnetizable portions are

positioned to correspond to the positioning of the index point positions 11 (Fig. 3). The plies of stock 26 are then secured by the cementitious material 28.

It is seen from the foregoing description how control records suitable for use in present day accounting systems can be formed, said records having suitable characteristics such as rigidity, durability, etc. in order to render them capable of being electro-mechanically segregated, sorted, and tabulated; said records comprising (1) suitable magnetizable material so that magnetic influences directed to certain areas thereof are retained by the records, and (2) that a suitable writing surface is provided on the records, the entire surface of which may be utilized for the reception of the legible characterizations.

Recording apparatus

Referring now to Figs. 10, 11, and 12, the recording apparatus shown therein is arranged to store the data represented by the different characters which are selected from a keyboard, and later are recorded in the form of discrete magnetic impressions upon the record elements; the impressions are recorded simultaneously, whereas the selected data to be recorded are set up column by column in the storing device. This device is similar in some respects to the record preparing device shown and described in detail in the U. S. Patent No. 2,016,705, issued to J. W. Bryce. Magnetic impression means, which may be differentially positioned with respect to the magnetizable record element, are provided; the record feeding mechanism and the like are shown fully in the said Bryce patent, so for this reason, the following brief description is deemed to be sufficient to understand the operation of the present type of recording device.

The record elements comprising magnetizable material are fed from a hopper 75 by means of the conventional picker mechanism 76 to feed rollers 77 which advance each record element to a recording position where its movement is interrupted by a stop 78 and thus held in position until the recording is completed. Rollers 79 then engage the record element, advancing it to rollers 80 which deliver it to a discharge hopper 81. A magnet 82, suitably secured to the frame of the machine, is disposed at the entrance of the record guide member 83. This magnet will be referred to as the obliterating magnet and is adapted to create a magnetic field along the entire length of the record. In this manner, as the record is fed, the entire record will be presented to the magnetic field created by the magnet 82.

Individual recording magnets 84 are provided, one for each columnar area of the record in which it is desired to record the data characterizations, and are adapted to be differentially positioned with respect to the various columnar areas to represent the different characterizations in each column. The individual magnets are mounted on individual selector bars 85 which are vertically slidable in suitable frame members and are normally drawn upward by spring-pressed fingers 86. The crosshead 87 cooperating with the selector bars is elevated by link 88 and lever 89 secured to shaft 90. An arm 91, also secured to shaft 90, is provided with a follower roller riding in a groove in box cam 92 fixed on shaft 93.

It will be understood that as the crosshead 87 rises all the bars 85 are elevated in unison, thus positioning the associated recording magnets 84.

To differentially determine the movement of the selector bars, pawls 94 are provided, and cooperate with the ratchet teeth in bars 85. The said pawls are released by the call wires 95 which connect to the proper armatures of the control magnets 96. A pair of individual conducting strips 97 are provided for each recording magnet 84 so that the said magnets can be energized at any of the different columnar positions.

Provision is made in the form of a commutator mechanism generally designated 98 for controlling the selector bar control magnets 96. An individual commutator mechanism is provided for each columnar area desired to be recorded. The said mechanism is controlled by the bank of individual keys 99, each key operating one or more contacts 100 which are connected to the different conducting bars 101 to 104. In addition to operating the associated contacts 100, each key 99 is adapted to operate the common contacts 105, which in turn control the energization of the control solenoids 106, 107, etc. A control solenoid is provided for each columnar area desired to be recorded and comprises four groups of contacts 109, 110, etc., each group connected to each of the conducting bars 101 to 104 and to the magnets 112, 113, etc. Each set of magnets 112, 113, etc., is connected to a single control relay 115, 116, etc. The magnets 112, 113, etc., are effective to control the positioning of the brushes 118, 119, etc., of the commutator mechanisms 98. The purpose of the mechanism 98 is to initiate timed impulses to control the energization of the associated selector bar magnets 96 whenever the positioned brushes 118 complete a circuit through the associated commutator conducting rings. A complete description of the commutator mechanism is set forth in the Bryce patent and reference can be made thereto for further details. The times at which the impulses are initiated represent the original data set up in the storing device, namely, magnets 112, 113, etc. In the Fig. 12, several of the commutator mechanisms and storing magnets are shown diagrammatically for several columnar positions or areas. It will, of course, be understood that there is an individual unit (commutator mechanism and associated control magnets) for each columnar area of the record and that the disclosure has been limited to several units to avoid repetition of similar parts.

The operation of the device will now be described with particular reference to a specific example. Let it be assumed that the characters 3, 5, 8 are to be magnetically recorded in three columnar areas of the record. Depression of the "three" key is effective to close the associated contacts 100 and the common contacts 105 to establish the following circuits: one side of the line 121, contacts 105, coil of the solenoid 106, contacts B of relay 115 to the other side of the line 122, energizing the said solenoid to connect the set of magnets 112 to the conducting bars 101 to 104. Due to the closed contacts 100 associated with the operated key, magnets 112 connected to the bars 102 and 104 and the common relay 115 are energized. Energization of the said magnets 112 is effective to position the associated brushes 118 of the commutator device 98, so that when the commutator device is set in motion, a correctly timed impulse is initiated to energize the control magnet 95 to position the corresponding recording magnet 84 so that at a later time the magnet is effective to create a constant magnetic

field directed to the "three" index point field of the corresponding column.

Energization of the relay 115 causes the associated A and C contacts to be closed, and the B contacts to be opened thereby deenergizing the solenoid 106, and closing a circuit from the contacts 105 to the solenoid 107. Therefore, it is seen that upon operation of the "five" key, the solenoid 107 is operated, permitting the magnet 113 connected to bar 102 to be energized and also the common relay 116. Magnet 113 conditions the corresponding commutator device 98 so as to be effective to initiate a single timed impulse to control the operation of magnet 96 upon operation of the said commutator. Operation of relay 116 causes the solenoid 107 to be deenergized, and extends the circuit from contacts 105 to solenoid 108, so that upon the operation of the next key, namely, the "eight" key, the said solenoid is energized. Energization of the solenoid 108 permits the magnets 114 connected to the bars 102 and 103 to be energized and also relay 117. Energization of the magnets 114 conditions its corresponding commutator mechanism 98 so as to initiate a properly timed impulse to energize the magnet 96 upon operation of the said mechanism.

Upon completion of the character storing operation, key 123 is operated to energize the magnets 124 and 125, the operation of which is effective (1) to initiate the feeding of a record to the recording position, (2) to start the positioning of the bars 85, and (3) to initiate operation of the commutator mechanisms 98 which in turn are then effective to initiate impulses to energize the circuits to the control magnets 96 at differential times, in accordance with the setting of the brushes 118, 119, etc., so as to interrupt the upward movement of the recording magnets, namely at the 3, 5, and 8 index point positions.

During the time the record element is fed to the recording position, the CC—1 contacts are operated to connect the alternating current source to the obliterating magnet 82 so that the said magnet is effective to create an alternating magnetic field which is impressed upon the element as it is fed past the magnet, thus obliterating all previous magnetic recordings on the record and restoring the magnetizable material thereof to a non-magnetized state, in this manner restoring the record to a condition so as to be receptive to a new recording after the record element is advanced to the recording position.

After all the recording magnets 84 are positioned in accordance with the setting of the commutator mechanisms, the cam operated contacts CC—2 are closed to permit the recording magnets to be energized thus impressing constant magnetic fields upon the said individual index point positions or areas of the record. The contacts CC—2 are operated only for a period sufficient to impress the individual magnetic fields upon the record element. Upon removal of the magnetic fields from the record element, the

magnetizable material thereof retains the recordings in the form of discrete magnetic impressions, said impressions differentially positioned upon the record in accordance with the data originally set up upon the keys 99. Upon completion of recording the data upon the record, the record is discharged in the hopper 81, and the control elements of the machine are restored to normal, so that additional records may be prepared in the manner just described.

It should be mentioned that by opening the switches 126 and closing the switches 127 and 128, any desired columnar areas can be skipped during the operation of the character storing devices. Opening of switch 126 is effective to render the corresponding solenoid 106 inoperative, and closure of switch 127 shunts the normally open contacts A of relay 115 to continue the circuit from the contacts 105 to the next solenoid desired to be energized upon subsequent operation of the keys 99. Closure of switches 128 causes the signal lamps 129 to be energized to indicate that the column to which it corresponds is to be skipped without receiving an entry.

It is noted that at the uppermost position of the magnets 84, the associated conducting strips 97 are provided with insulating segments 130, so that when it is desired to skip any of the columns as just explained, the associated magnets 84 will not be energized when the corresponding selector bars 85 are positioned in the uppermost position which is beyond the "12" index point position.

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 claim.

What is claimed is:

In an apparatus for magnetically recording data designations at selected index point positions, in various columns of a record sheet comprising material capable of being magnetized and retaining discrete magnetic spots; means to receive the record sheet and to hold the same in a fixed position; a plurality of recording magnets, one for each column of the record sheet, said magnets having exposed poles and being mounted so as to be independently movable along parallel paths, to position their respective poles opposite any one of the index point positions of the respective columns of the record sheet; differential operating means for individually positioning said recording magnets at selected index point positions along their respective columns; and means to energize said recording magnets simultaneously after they are positioned, to make magnetic spots on the record sheet at said selected index point positions.

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