

Oct. 29, 1957

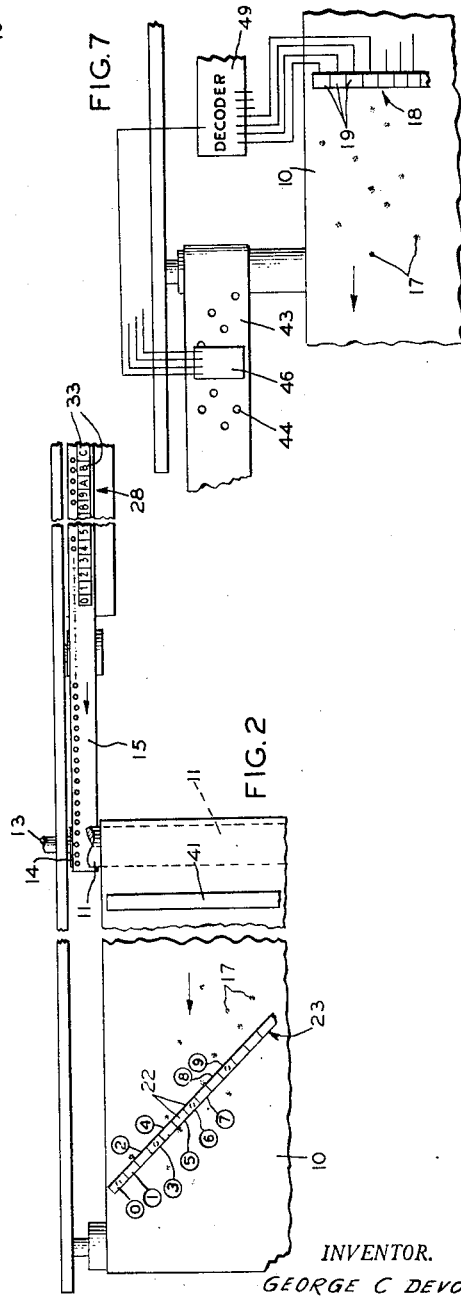
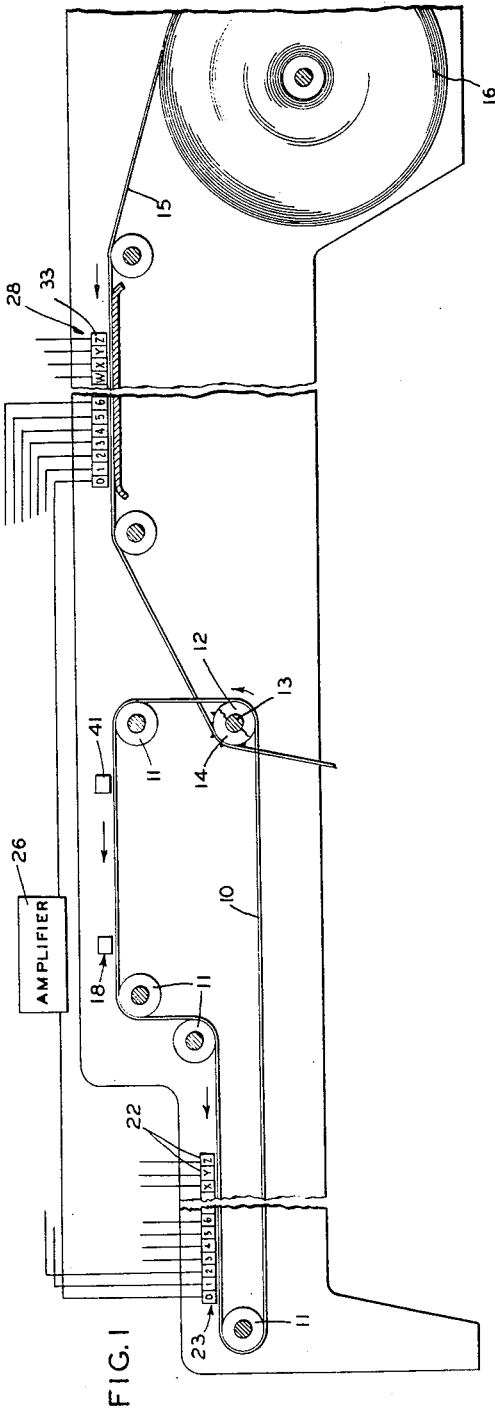
G. C. DEVOL

2,811,101

MAGNETO-STRICTIVE TYPE PRINTING DEVICE

Original Filed June 7, 1951

3 Sheets-Sheet 1



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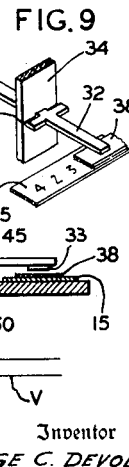
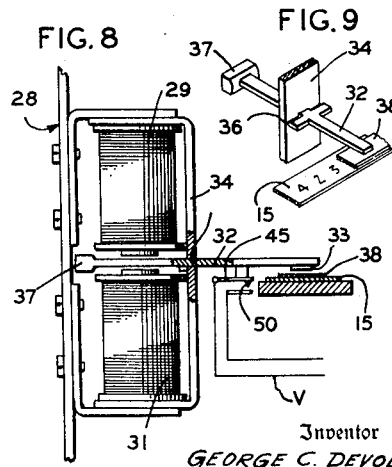
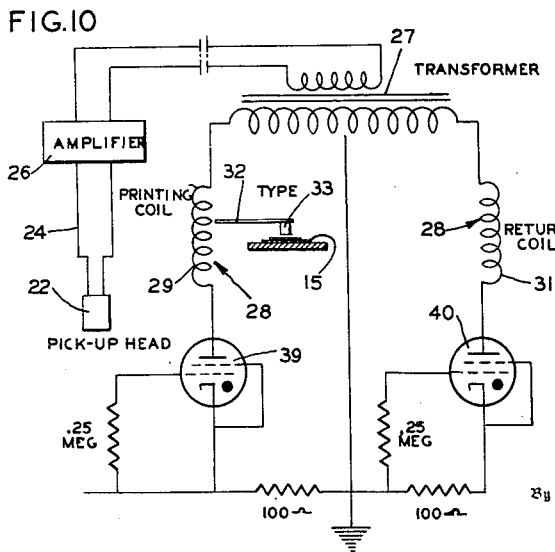
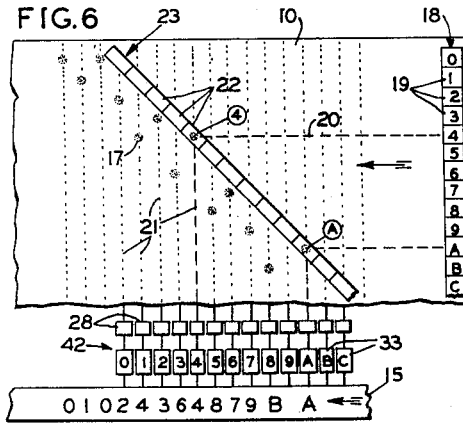
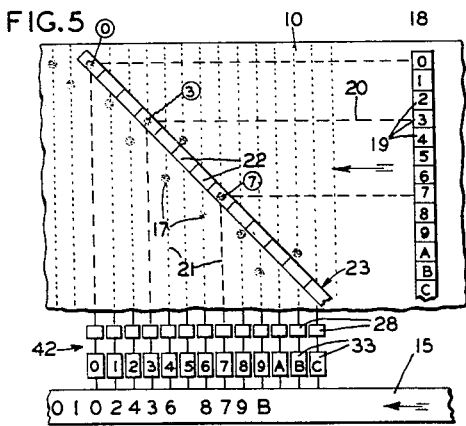
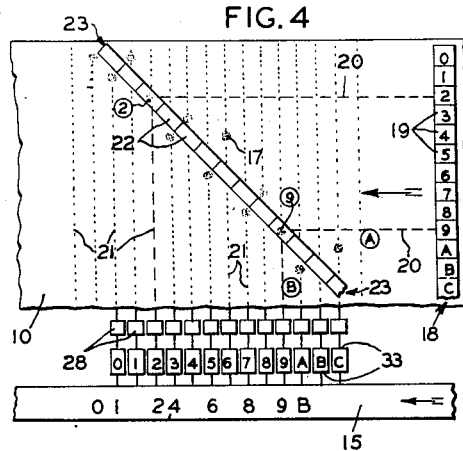
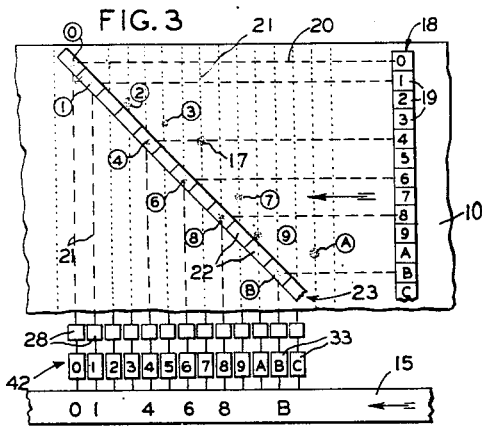
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2,811,101

MAGNETO-STRICTIVE TYPE PRINTING DEVICE

Original Filed June 7, 1951

3 Sheets-Sheet 2



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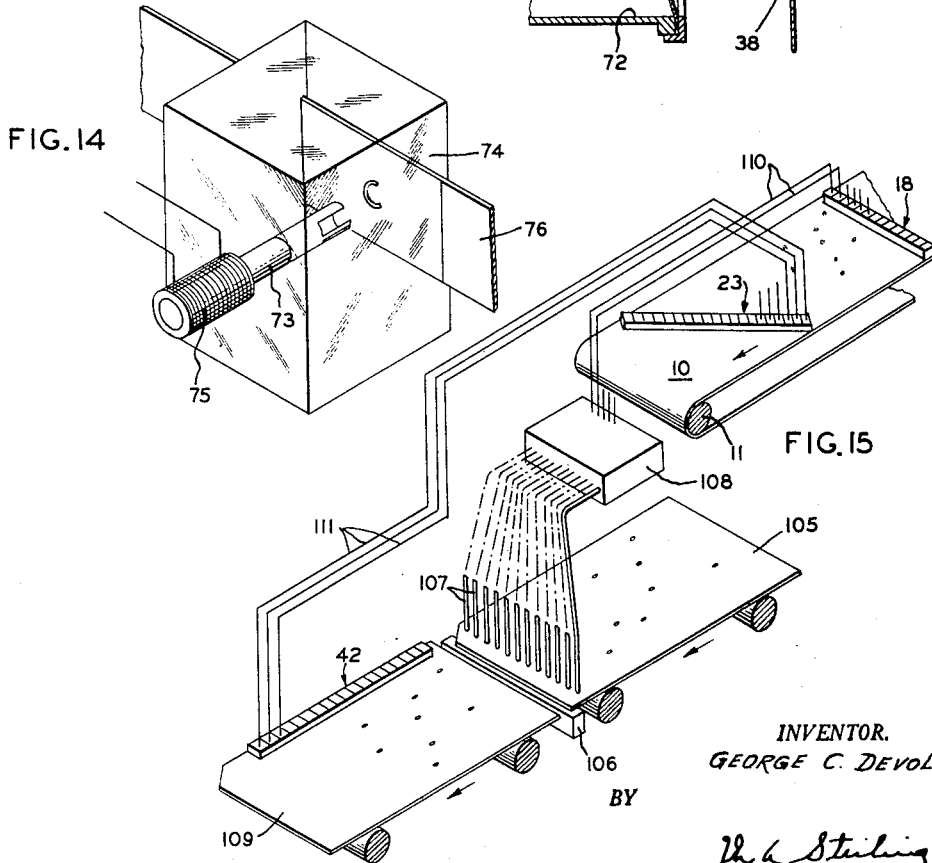
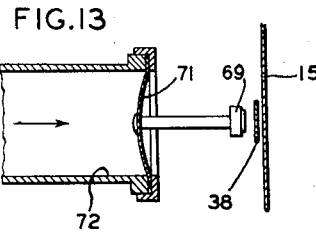
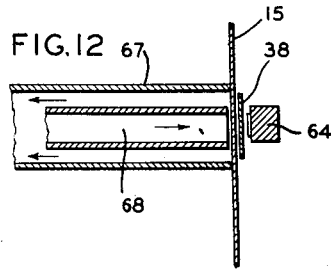
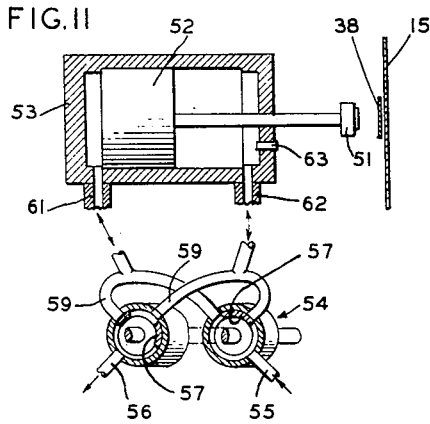
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2,811,101

MAGNETO-STRICTIVE TYPE PRINTING DEVICE

Original Filed June 7, 1951

3 Sheets-Sheet 3



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1

2,811,101

MAGNETO-STRICTIVE TYPE PRINTING DEVICE

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Original application June 7, 1951, Serial No. 230,345.
Divided and this application March 18, 1954, Serial No. 416,974

2 Claims. (Cl. 101—1)

This invention relates to printing, and in particular to a method and means for accomplishing printing at high speed.

In various electronic and other high speed calculating and business machines in use at the present time, the need for printing the output of the machines, as well as the printing of information received at high speed from other sources, has presented a problem that has not been solved by the use of ordinary mechanical printing mechanisms, due largely to the time required in the movements of the mechanical parts, the transmission of motion, and the restoration of the parts after each printing action. This problem is also present due to the rapid sensing of data now possible, such as in the use of a magnetically spotted tape, or a perforated tape, or cards, which can be fed at high speed past a sensing station where the data is sensed, translated from the code in which it may be punched, spotted or otherwise recorded, and to this end one object of the present invention is to print the data as fast as it is received by an arrangement of mechanisms that can carry out the printing operation at an extremely high speed.

A further object of the invention is to so arrange recording, pick-up and printing means with respect to each other that data can be recorded, read, and printed at sufficiently high speeds to keep pace with the imposition of data in a recorder from a source producing the data at extremely high speed.

A still further object is to make use of a single set of type from which the matter is printed in random fashion and in which type a minimum amount of means is employed whose movement, to produce the printing, may be very rapid so that two like characters can be printed successively by the same type piece.

Another object of the invention is to bring about the printing of all characters needed, from a single set of type, by the use of various means which will reduce type movement to a minimum or eliminate any movement of the type entirely so that printing can be accomplished at high speed and with a negligible amount of wear to the parts.

Other objects of the invention include the application of the magnetostriction to printing so that mechanically operated type does not have to be employed to produce the printing effect; to interpret perforated records and print the characters represented by the coded arrangement of perforations, on the same record; to make unnecessary the use of type wheels, type racks and other type or paper carriers which require adjustment in order to carry on the printing action, and to verify the correctness of the printing automatically as it is being done.

This application is a division of my application Serial No. 230,345, filed June 7, 1951, for Random Printing Method and Means.

A more clear conception of further objects and the operation of the invention may be had from the following specification when read in the light of the drawing, in which:

Fig. 1 is a view in longitudinal elevation of the method

2

and means for printing at high speed in accordance with the invention;

Fig. 2 is a fragmentary view in plan of the invention illustrated in Fig. 1;

Figs. 3, 4, 5, and 6 are plan views of the recording, reading and printing means shown in diagrammatic relation to each other to illustrate the random printing of characters of an exemplary group;

Fig. 7 is a plan view of the invention as employed in connection with one form of a perforated data carrying medium;

Fig. 8 is a view in side elevation of a type actuator used in the high speed printing mechanism of the invention;

Fig. 9 is an enlarged view in perspective showing the mounting of the type carrier illustrated in Fig. 8;

Fig. 10 is a circuit used in controlling a type actuator as illustrated in Fig. 8, the circuit also including diagrammatically a pick-up head and current amplifying means;

Fig. 11 is a view in sectional elevation showing diagrammatically the means for rapidly projecting and retracting a piece of type by the use of high pressure air and vacuum;

Fig. 12 is a view in longitudinal section showing the means for employing alternately a high air pressure and a vacuum to project the paper and ribbon against the face of the type;

Fig. 13 is a view in section taken through a pressure cylinder, an end diaphragm of which actuates a type element;

Fig. 14 is a view in perspective showing the use of a magneto-strictive effect in producing printing;

Fig. 15 is a fragmentary view in perspective showing how a moving perforated record card can be sensed and printed upon by the application of the invention.

Referring to the drawing in detail, and particularly Figs. 1-7, inclusive, in which the invention has been shown in various methods of use, 10 indicates an endless magnetic recording tape which may be fed over suitable rollers 11, in the direction indicated by the arrow, by a drive roller 12 mounted on a shaft 13 which is driven by any suitable source of power. The shaft also carries a drive roller 14 of similar diameter to roller 12 so that the peripheral speed of the rollers 12 and 14 will feed a paper tape 15 from a supply source 16 at the same speed of travel and in the same direction as the recording tape 10. The tape 10 may be mounted on a drum instead of being passed over rollers, if desired, and is arranged to receive the characters, of matter to be thereafter printed, in the form of magnetic spots 17 which are applied in the well known manner by a recording head 18 employing the usual pulsating direct current or as disclosed in my application S. N. 659,223, filed April 3, 1946, now Patent No. 2,590,091, granted March 25, 1952, to cause each character unit 19 thereof to magnetically spot the recording tape 10.

The impulses for the magnetizing units 19 of the recording head 18 are derived from the sensing of a perforated Teletype tape or any other source of data such as the output of an electronic calculator and may include, in the circuit in which the recording head is included, any type of decoding means, the use of which is well known in the art. The data spotted on the tape in Figs. 3-6, inclusive, is 01024364879B A, each character spot having been imposed on the tape in the sequential order in which it will appear on the printed tape when the printing action for the foregoing example has been completed. As an example of the arrangement of the magnetic spots 17, the tape 10 may be compared to any machine controlling card or tape in which data designations are arranged in vertical columns and longitudinal rows and are located at the intersections of said

columns and rows at what are designated as data index positions. As the data being fed to the recording head is taken from a tape or card whose columns of data are equally spaced, the spots 17 will be imposed on the tape 10 at equally spaced intervals lengthwise of the tape by the units 19 of the recording head 18 which units are spaced equal distances apart widthwise or laterally of the card in a single row. This will result in spots 17 being imposed on the tape at the right angled intersections of imaginary horizontal and vertical, or lateral, lines 20 and 21, respectively so that the sensing units 22 of the pick-up head 23, horizontally aligned with the character units 19 of recording head 18 will lie obliquely across the intersections or data index positions and will sense the spots 17 as they pass under the head 23. This sensing may not occur in the order in which the spots have been imposed on the tape as it will be noted in Fig. 4 that spots "4," "6," and "8" are sensed at the same time as spots "0" and "1" which latter were imposed on the tape in advance of the "4," "6" and "8."

When the magnetized spots 17 pass beneath their respective sensing units 22 of the pick-up head 23 they will produce a pulse in the line 24, Fig. 10, which is increased by the amplifier 26 employing the usual vacuum tube and transformer combination, and fed to the centrally tapped transformer 27 for operation of a printing unit 28 (Fig. 8) including printing and return coils 29 and 31, between the poles of which is loosely positioned a metal strip or armature 32 carrying at its outer end a type character 33. The strip 32 is imprisoned in the frame 34 of the coil holder and preferably includes knife edges 36 and a counter-weight 37 so that free action of the printing type is insured to produce printing at extremely high speed, through the ribbon 38, on the paper tape 15 with a minimum of wear to the parts. The concerted action of the printing and return coils occurs on the positive and negative alternations of the pulse cycle as controlled by the 2050 type Thyatron tubes 39 and 40, in the respective printing and return coil circuits.

The printing head 42 includes one complete set of numeral printing units 28 from zero to nine and one complete set of units 28 from A to Z together with enough additional units to print other indicia such as periods, commas, and the like, but only one type element bearing any character need be employed. Hence, as shown in Fig. 3, with the tapes 10 and 15 being fed at the same speed; and the character units 19, the sensing units 22 and the printing units 28 all being arranged in the same relative order to each other; and the sensing units 22 being disposed obliquely with respect to the direction of travel of tape 10; it will be observed that to print "01024364879B A" these characters will be entered on the tape 10 in this order by the recording head 18, the units 19 of which receive their impulses from a remote source such as a teletype mechanism. As the spots 17 representing the characters 01468B in the first sensing action are simultaneously sensed by the respective sensing units 22 the corresponding printing units are simultaneously actuated to print these numerals on the tape 15 at the same time, so that their printing on the tape 15, as seen in Fig. 3, appears to be at random. This is also true of the manner in which the spots are sensed by the head 23 and is identified by the term "random printing" in that, while the character spots 17 are imposed on the tape 10 by the head 18 in successive order and in the order that they will appear on the tape 15 after printing has been completed, they are not sensed by the pick-up head or printed by the printing units in this order. In the second sensing action of the head 23 (Fig. 4) the numerals "2" and "9" are simultaneously printed on tape 15, the tapes 10 and 15 having advanced one increment or a space equal to the distance between the lateral lines 21. In the third sensing action of the head 23 (Fig. 5) the characters "0," "3" and "7" are simultaneously printed on tape 15, the tapes 10 and 15 having

advanced one more increment. In the fourth sensing action of the head 23 (Fig. 6) the characters "4" and "A" will be printed, the tapes 10 and 15 having advanced one increment. It will be noted that a space occurs on the tape 10 between the spots representing "A" and "B" which space also occurs in the matter as finally printed. While the tapes are fed at high speed and continuously, the word increment does not indicate any step by step action of the tapes although in other forms of the invention this may be done if desired. It is evident that the spots are in thirteen different positions lengthwise of the tape 10 but by a longitudinal movement of the tape 10, embracing only four lateral column spaces, thirteen characters have been sensed and printed. The oblique position of the sensing head will depend upon the speed with which the spots are applied to the tape 10 and by varying the relative speed between the travel of the tapes 10 and 15 the spacing of the characters as they are printed on the tape 15 can be varied. The tape 10 is cleared by the well known action of a demagnetizing head or eraser 41.

Referring to Fig. 7, a tape 43, perforated in code arrangement as at 44, may be sensed by a unit 46 whose impulses are transmitted to the recording head 18 through a decoder 49, the operation of which is similar to that explained in U. S. Patent No. 2,160,152 to W. F. Kelley. Such a decoder may be also utilized in connection with a device of the character shown in Fig. 15 in which a movable perforated record card 47 of the type used for controlling business machines may be sensed by light conducting Lucite rods 48 and photocell equipment included with a decoder 49 as set forth in U. S. Patents 2,224,761 and 2,224,762 for operating the recording head 18 to magnetize the tape 10, which can be read by the pick-up head 23 to print on the card 47 through the printing head 42, the decoded matter of said card.

Verification of the correctness of the printing can be done through the use of a printing element circuit V (Fig. 8) which may be closed by a contact 50, the spring arm 45 of which, actuated by printing action of the respective type strip 32, also serves to retract the latter. The circuit V from each printing unit 28 may be used to operate mechanism to print a verifying record at a remote point where the information supplied to the recording head originated.

The obstacle that has stood in the way of fast printing has been the mechanical projection or retraction of the type, it being quite obvious that typewriting speed is limited by the speed with which the type can be projected and retracted and to this end there is shown in Fig. 11 a type carrier 51 having a piston 52, in a cylinder 53 which is reciprocated by the alternate injection of air, under very high pressure, and application of vacuum at both ends of the piston. This is accomplished by a valve 54 having an air inlet 55 and a vacuum outlet 56 controlled by an internal rotor 57, the walls of which form a valve for alternately controlling the flow of air and vacuum through pipes 59 to ports 61 and 62 respectively. The rapid coaction of high air pressure and high vacuum alternately at opposite ends of the piston results in high speed projection and retraction of the type element. A blast of highly compressed air is admitted at port 61 at the same time that vacuum is applied to the port 62. This results in the almost instantaneous and free movement of the piston 52 to which is secured the type member. The right hand end of the cylinder is provided with a vent or relief valve 63 which permits the bleeding of an air cushion formed in that end of the cylinder thus permitting the controlled cushioning of the type action.

In Fig. 12 a further method of printing using highly compressed air and vacuum is disclosed. The type 64 are stationary with an ink ribbon 38 positioned between the type and paper 15. A chamber 67 extends the full length of the row of type and located in alignment with each type

is an air tube 68. A vacuum is maintained in the chamber 67 at all times thus holding the paper away from the ribbon and type. When it is desired to print, a short or quick blast of highly compressed air is admitted to tube 68 associated with the desired print character, which force drives the paper against the ribbon and type. At the end of the blast of air the vacuum again withdraws the paper.

In Fig. 13 is disclosed a still further method of operating type. Each type 69 is secured to a spring metal diaphragm 71. A blast of highly compressed air of short duration admitted to a tube 72 surrounding the diaphragm will cause the type to print.

In Fig. 14 a magneto-strictive resonator is employed which consists of a metallic rod or tube 73 maintained in longitudinal elastic vibration by a high frequency current supplied to a coil 75 wound thereon. Coil 75 receives its pulses through the amplifier 26 from its respective sensing unit 22 of the pick-up head 23 (Fig. 10) which pulse action is produced in the line 24 as above described. The printing is done by utilizing the magneto-strictive action on the nickel rod or tube 73. It has been found that an air column built up by the vibrations or pulsing of the rod will take the shape of the end cross-section of that rod or an opening therein. It is proposed to form the end of a nickel tube or rod in the shape of a printing character. This tube will then be positioned in a cloud chamber 74 containing ink or a magnetic substance in finely suspended particles. When current is applied to the operating magnet or coil 75, the air column built up on the end of the rod will solidify the ink in the cloud into the shape of the character, thus printing it on a paper 76 located in the chamber, or moving therethrough. A rod of any form or having a small opening on the end may be used to print a magnetically conductive spot of like shape on the material 76 where the cloud bank is impregnated with a magnetizable element.

Because the operating impulses set up in the system are handled in circuit form, it is evident that the various units of the mechanism can be remote from each other. For instance, the source of the data impressed on a recording head can be distant from the recording station and likewise a printing unit can be remote from a sensing unit. While the linear order of these units coincide, any order of characters may be used as desired and not the numerical and alphabetical order as illustrated in the drawings. The method herein disclosed is susceptible of many variations, such for instance as; by providing a take-up in the feed of either of the tapes, intermittent in-put and constant out-put may be attained or one or more magnetic tapes and plural recording heads may be used with different spacings between a related recording head and reading head of a set so that printing may be done on a single tape by mechanically actuated printing mechanisms spaced apart a distance corresponding to the distance separating the reading heads so that a time lag is provided that allows for the mechanical operation of printing mechanisms such as used in a typewriter. The printing could be done on the same tape from which the data was read, if desired, and while magnetically recorded spots are employed because of the extremely high speed with which they can be imposed on the tape, it is within the scope of the invention to employ punched holes if desired, whose sensing could be accomplished in any of the known ways, such for instance, as by electrical contacts or brushes or light conveying tubes. Also the detection by photocell of spots and configurations of indicia other than spots which may be employed with or without

code translating means is within the provision of the invention.

As an example, Fig. 15 shows diagrammatically how the method of the invention may be used to interpret perforated tabulating cards. The punched card 105 is being sensed by passing light from light bank 106 through perforations in the card and then by way of Lucite rods 107 to a photo-electric and decoding sensing device 108 which is well known. After being amplified in the decoder the signals are carried by circuits 110 to a recording head 18 which records the data as magnetic spots on the tape 10 as above. A reading head 23 is spaced from the recording head 18 a distance equal to the travel of a card such as 105 from a position under the Lucite rods 107 so that shown for a card such as 109 under the printing unit 42 where the data previously sensed is printed. The printing unit and reading head are connected by circuits 111 which control the type to print the data above the column from which it was sensed. In Fig. 15, the card 105 is being sensed simultaneously with the printing of previously sensed data on card 109.

While I have described what I consider to be highly desirable embodiments 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. Printing means comprising a pulse member including a coil formed to provide a printing character configuration at one end; means including a magnetically pulsed data reading head and a current amplifier in circuit with said head and said coil for pulsing said member; a chamber into which said member extends, said chamber containing a cloud, a tape, means for moving the tape through the chamber and past the character configuration end of said pulse member, said cloud being impregnated with ink particles in suspension and, in contact with the tape passing through said chamber to be printed upon and with the character forming end of said pulse member, and said pulse member being operated by the magneto-strictive pulsing action of the coil to solidify the ink particles of the cloud bank, between the end of the pulse member and the tape to be printed upon, into character shape conforming to the configuration of the end of said pulse member to print said character on said tape.

2. Printing means including a chamber, a pulse member having an end in said chamber formed to provide a printing character configuration, a pulsing coil on said member, means for passing material to be printed upon through the chamber and past the end of said pulse member; characterized by the fact, that the chamber contains a cloud impregnated with ink particles in suspension and in contact with the material and the end of said pulse member, and that the pulse member is operated by a magneto-strictive pulsing action of said coil to solidify the ink particles of the cloud bank, between the end of said pulse member and the material to be printed on, into character shape conforming to the configuration of the end of said pulse member to print a character on said material.

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