

April 30, 1957

W. WOCKENFUSS

2,790,697

PRINTING DRUM

Filed Jan. 21, 1954

2 Sheets-Sheet 1

FIG. 2

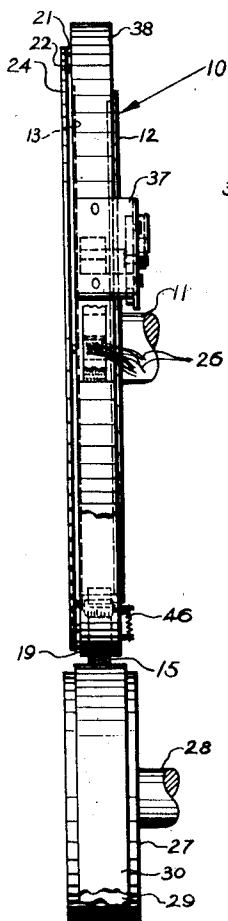


FIG. 1

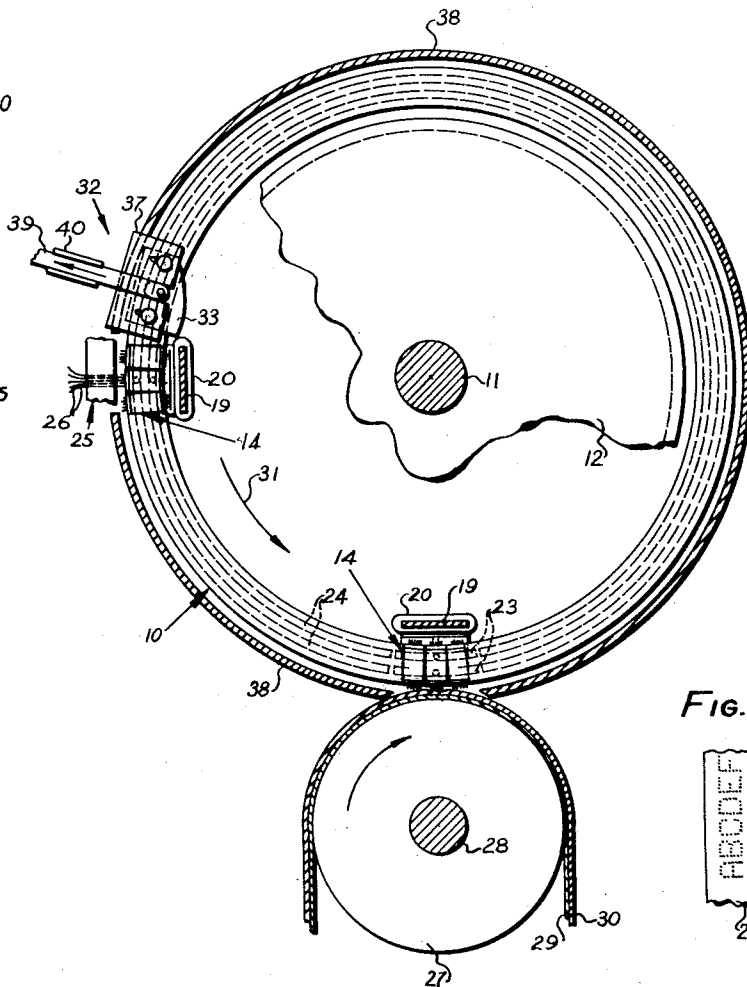


FIG. 4



FIG. 3

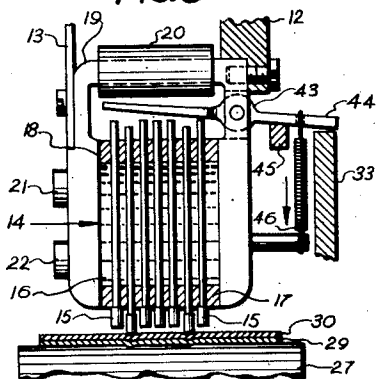
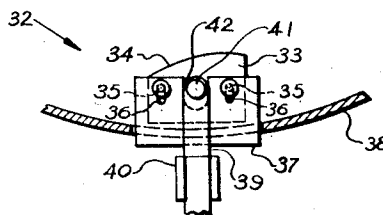


FIG. 5



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FIG. 7

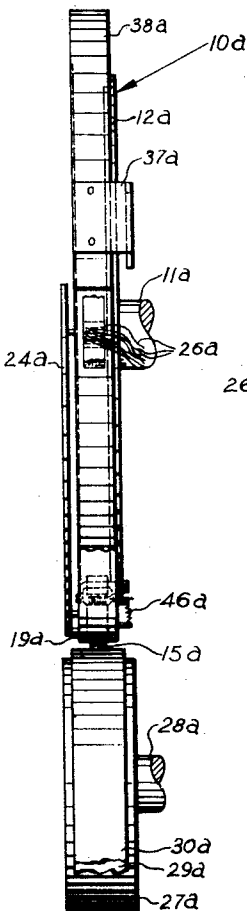


FIG. 6

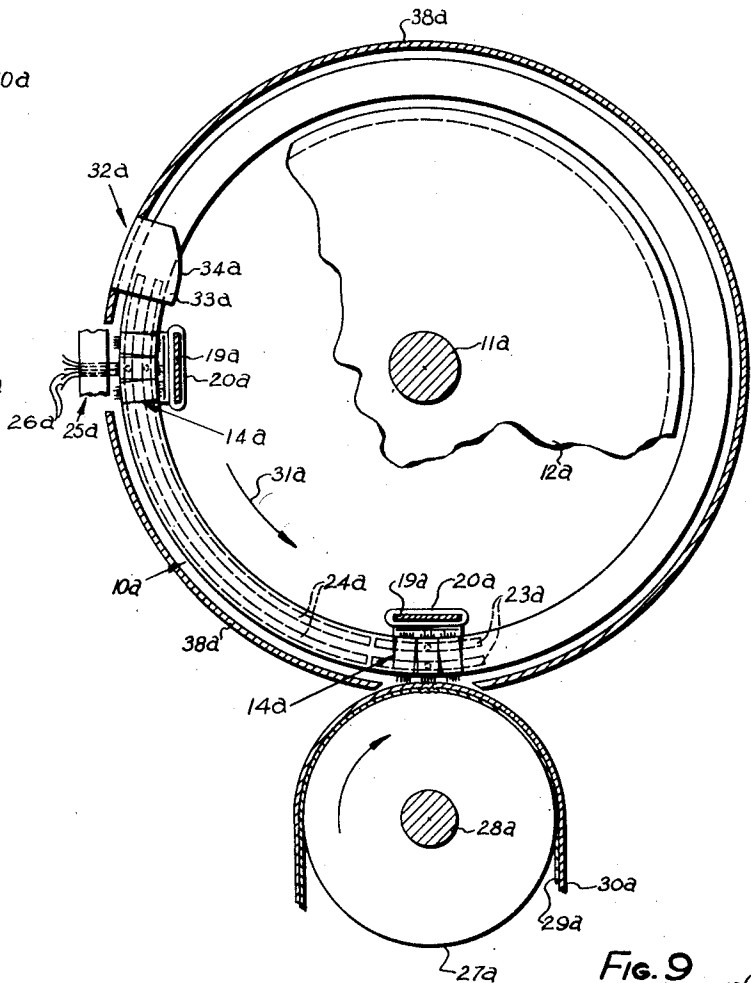


FIG. 8

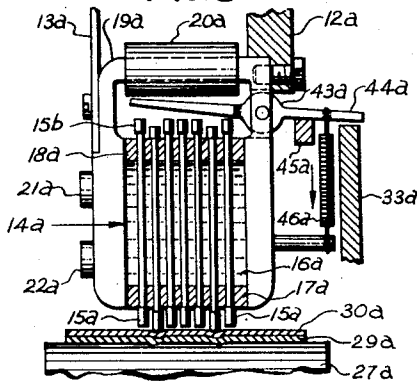
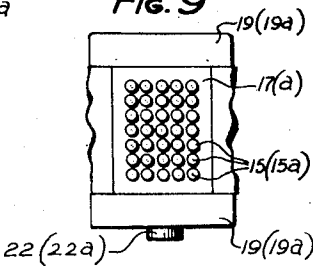


FIG. 9



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2,790,697

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4 Claims. (Cl. 346—98)

This invention relates to high speed recording devices of the type in which wires or similar recording elements are operated selectively to form individual characters.

An important object of the present invention is to reduce or substantially eliminate the noise which customarily is produced by the impact of the recording elements upon the work, and particularly to provide an improved recording device of the aforesaid type wherein gradual pressure rather than sudden impact is employed to effect the recording.

Another object of the invention is to enable high speed, selective recording to be performed in a substantially noiseless manner by means of character-forming elements that have rolling engagement with the work, thereby eliminating the aforesaid impact.

Still another object is to provide an improved information storage means particularly adapted for use with character-forming recording elements which are mounted upon a drum carrier or the like.

A further object is to provide an improved high speed, selective recording device in which grouped recording elements are set selectively to produce individual character formations that can be used repeatedly in successive recording cycles or else changed from one cycle to the next, either in whole or in part, as the circumstances may require.

A still further object is to provide an improved magnetic mounting for the recording elements in a character-forming, selective recorder.

Another object is to provide a device in which the recording elements may be selectively set by information or data setting devices and retained in that setting by a magnetized fluid; the setting of said elements representing information or data, thereby to permit said elements to be utilized as information or data storage means.

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

In the drawings:

Fig. 1 is a plan view of the recording device constructed in accordance with the principles of my invention,

Fig. 2 is a side elevation of Fig. 1,

Fig. 3 is an expanded view of a recording unit,

Fig. 4 is a view of the characters recorded on the impression receiving surface,

Fig. 5 is an enlarged view of a reset device shown in Figs. 1, 2 and 3,

Fig. 6 is a front elevation view of a modification of the recording device shown in Figs. 1, 2 and 3,

Fig. 7 is a side elevation of Fig. 5,

Fig. 8 is an enlarged view of a recording unit employed in Fig. 6,

Fig. 9 is a view of the recording elements formed in a 5 x 7 mosaic.

With reference to Figs. 1, 2 and 3 of the drawings,

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the recording device includes a carrier in the form of a rotatable drum generally designated by the numeral 10. The drum 10 comprises a shaft 11 on which spaced circular plates 12 and 13 are fixed. The spaced plates 12 and 13 extend radially outward from the shaft 11, and at their outer peripheries these plates support a plurality of recording units generally designated by the numeral 14, as shown in Fig. 3.

The recording units 14 are alike, and a description of one will suffice for all. Each recording unit 14 consists of thirty-five selectively operated elements 15, hereinafter referred to as recording elements. The recording elements 15 are grouped in a 5 x 7 mosaic (see Fig. 9) whereby the individual elements may be selected in various combinations to form the characters which are to be recorded. These recording elements are in the form of wires or short rods of magnetizable material having sufficient rigidity to perform the type of recording desired. The elements 15 extend radially with respect to the shaft 11, and under certain conditions they can be moved radially relative to each other to form selected character patterns. Surrounding the elements 15 is a magnetic fluid 16 (Fig. 3) of any well known composition. The function of the fluid 16 is to restrain the elements 15 from undesired radial movement, including such undesired movement as might result from centrifugal force acting upon the elements. Lower plate 17 and upper plate 18 fit between the sides of the electromagnet 19 to form a fluid tight seal and at the same time accurately guide the recording elements 15. Side plates (not shown) cooperate with the lower and upper plates 17 and 18 and the sides of electromagnet 19 to complete the enclosure of the fluid 16 in each unit 14.

As shown in Figs. 1 and 2, three such recording units 14 are retained between the side plates of each electromagnet 19. This arrangement is one of convenience only and is not to be treated as limiting in any manner. It is entirely possible that more or less of these units may be associated with each of the energizing electromagnets 19 without departing from the spirit of the invention. At the top of each electromagnet 19 there is an energizing coil 20 connected by suitable connectors (not shown) to a pair of brushes 21 and 22 mounted on one of the sides of the electromagnet 19.

Adjacent to the drum 10 are stationary coil energizing means which are here shown in the form of high current commutators 23 and low current commutators 24, Figs. 1 and 2. The commutators 23 and 24 cooperate with the aforementioned brushes 21 and 22 to energize the coil 20 of the magnet 19 for magnetizing the magnetic fluid 16. Magnetization of the fluid 16 tends to line up the magnetic particles therein so as to effect a restraint upon the movements of the elements 15 relative to the other parts of the unit 14. As the brushes 21 and 22 contact the high current commutators 23, the magnetized particles in the magnetic fluid 16 tend to resist and to restrain movement of the recording elements 15 with a greater force than when the brushes 21 and 22 come into contact with the low current commutators 24. In the embodiment shown in Figs. 1, 2 and 3, the brushes 21 and 22 are constantly in contact with either the high current commutators 23 or the low current commutators 24 so that the magnetic fluid is magnetized in varying degrees to effect varying degrees of restraint upon the radial movements of the elements 15. As will be seen in Fig. 1, the high current commutators 23 are placed in the neighborhood of the recording area so that the magnetized fluid 16 effects a high degree of restraint against radial movement of the recording elements 15 of each unit 14 during the recording operation. The low current commutators 24 are effective during the remainder of the cycle to maintain

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the fluid 16 in each unit 14 sufficiently magnetized to prevent centrifugal or gravitational movement of the recording elements 15, but not sufficient to resist positive actuation thereof. The slight insulating spaces between the commutators 23 and 24 are of such a length that they may be bridged by the brushes 21 and 22 during the rotation of the drum 10.

Positioned at a given point near the circular periphery of the drum 10 is a head generally designated by the numeral 25. Mounted in the head 25 are thirty-five selectively operated wire elements identified by the numeral 26, grouped in a 5 x 7 mosaic corresponding to the mosaic formed by the recording elements 15 (see Fig. 9) in each of the units 14. Selective operation of the wire elements 26 is timed to occur at intervals during the rotation of the drum 10 when a unit 14 is substantially aligned with the head 25. Selective operation of the wires 26 in the head 25 (by moving certain wires 26 radially against the recording elements 15 in the aligned recording unit 14) will in turn selectively move corresponding ones of said recording elements 15 radially inward toward the center of the drum 10, leaving the remainder of the elements 15 in their outwardly extended positions for recording. The inward radial movement of those recording elements 15 which are not required for recording is accomplished against the resistance set up by the magnetic fluid 16 under the influence of the electromagnet 19, as the coil 20 is energized by the low current commutators 24 through the contacting brushes 21 and 22. Once the selected recording elements 15 have been pushed inwardly, however, they are retained in that position by the energized magnetic fluid 16. As a consequence, selected ones of the recording elements 15 are retained in their outer or recording positions during the rotation of the drum 10, while the other recording elements are retained in their inner positions where they are ineffective to perform any recording.

The wires 26 in the head 25 are so operated in each instance that they will form a mosaic pattern which is the negative, obverse image of the character to be recorded. The pattern formed by the recording elements 15 (as they are acted upon by the wires 26) will be the positive, reverse image of the character to be recorded. This in turn enables the recording elements 15 to record the desired character in its positive, obverse form, as indicated in Fig. 4.

The apparatus for selectively operating the wires 26 does not form a part of this invention; therefore it is not shown in the drawings. Apparatus of this nature is well known in the art, however, and reference may be had to U. S. Letters Patent Nos. 2,648,277 and 2,653,534 issued to William Wockenfuss for examples thereof. The wire character-forming devices shown in these patents, with minor modifications thereof, can readily be adapted to the purposes of the present invention.

The character formation which is set up in each recording unit 14, as it passes by the head 25, is utilized at a subsequent time to print the character thus formed. This should not be regarded as limiting the invention to printing, however, as other types of recording could be performed by suitably modifying the illustrated apparatus. Referring to Figs. 1 and 2, a rotatable platen 27 is mounted on a shaft 28 at a point along the circumference of the drum 10. The platen 27 is rotated in timed relation with the recording drum 10 by the shaft 28 while supporting on its outer periphery an impression receiving surface, such as paper 29, and a carbon 30. Both the carbon 30 and the paper 29 are moved between the rotatable drum 10 and the platen 27, by the platen 27. During rotation of the drum 10 and movement of carbon 30 and paper 29 extended recording elements 15 will successively press against the carbon 30 so that the character formed by the extended elements will be impressed on the carbon and recorded through the carbon onto the paper 29. An example of this may be seen in Fig. 4.

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As described previously, the high current commutators 23 are positioned in the vicinity of the platen 27 and extend for an arcuate length sufficient to insure that the brushes 21 and 22 will conduct the high current to the coil 20 of each electromagnet 19 during the time that all three of the units 14 associated with that electromagnet 19 are passing over the platen 27. The reason for positioning the high current commutators 23 in this manner is to insure that the magnetic fluid 16 will be magnetized sufficiently to resist any appreciable tendency of the elements 15 to move radially during the recording operation. A greater magnetizing force is necessary at this time than when the elements 15 perform no recording function and no stress is placed on them.

Continued movement of the drum 10 in the counterclockwise direction, as shown by the arrow 31, revolves the units 14 from the recording position to a reset device 32 shown in Fig. 5. The reset device 32 consists of a plate 33 having a cam surface 34. Made fast to the cam plate 33 are two pins 35 which extend upwardly through elongated openings or slots 36 in a bracket 37 fixed to the stationary cover 38 by any suitable means. Arm 39, slidably guided in member 40 for reciprocating movement, is pivotally connected to the plate 33 by the pin 41. Bracket 37 is cut away at 42 to permit the movement of the arm 39.

Referring to Fig. 3, it will be seen that each of the electromagnets 19 pivotally supports a reset lever 43 which has a work end of sufficient size to extend over the back ends of all the recording elements 15 in each of the three units 14 contained in the electromagnets 19. Tail end 44 of lever 43 extends laterally beyond the drum 10 and is actuated by the cam surface 34 during the rotation of the drum. Actuation of the lever 43 moves the recording elements 15 so that their recording ends extend into the recording position. Spring 46 constantly urges the end 44 downwardly against the stop 45 to separate the work end of the lever from the elements 15.

The device shown in Figs. 1-3 is operated in the following manner: During the rotation of drum 10 in the direction of the arrow 31, the units 14 successively align with the head 25. Wires 26 are selectively operated to move forward and engage with certain of the elements 15 in the aligned unit 14 to move such engaged elements radially away from their recording positions. The unmoved elements 15 remain extended for the recording operation which is to follow. In the meantime fluid 16, being energized by the low commutators 24 by way of the coil 20, retains all of the elements 15 in their selected positions. As the drum 10 rotates, the units 14 move counterclockwise for alignment with the selecting device 25 toward the recording position defined by the platen 27. As previously mentioned, when the units 14 approach the recording area, the brushes 21 and 22 contact the high current commutators 23, which energize the magnetic fluid 16 to prevent movement of said elements 15 with a higher degree of resistance than during the character selecting operation. As the extended recording elements 15 of each unit 14 rotate into contact with the carbon paper 30, they press upon the carbon to impress and record the desired character upon the surface 29 (see Fig. 4). Continued rotation of the drum 10 moves the recording units 14 out of the recording position and away from the influence of the high current commutators 23, in a counterclockwise direction, to where the brushes 21 and 22 again contact the low current commutators 24. Contact of the brushes 21 and 22 with the low current commutators 24 causes the fluid 16 to be magnetized for restraining the elements 15 against movement, but to a lesser degree than during the recording operation. The restraint applied by the fluid 16 against movement of the elements 15 counteracts the effects of centrifugal or gravitational forces tending

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to move the elements 15 radially during the rotation of the drum 10.

Before the units 14 are realigned with the head 25 for the selection of a new set of characters, the elements 15 must be conditioned for character selection by the head 25. This is accomplished by moving all the elements 15 to the extended position so that they may be engaged by the wires 26. As the units contained in each electromagnet 19 rotate toward the selecting head 25 the back end 44 of the levers 43 ride on the cam surface 34 of the cam plate 33 to move the forward end of the levers against the rear ends of the elements 15. The operation of each lever will move all of the elements 15 in each set of three units to the extended position so that they are in condition to be selected for movement by the character selecting wires 26 in the head 25.

It will be noted that the recording elements 15 in combination with the magnetic fluid 16 constitute a type of settable information storage means in which the elements that are set to store the information also are used to record the stored information at a later time. This is made possible by the two-stage magnetizing method herein disclosed, whereby a low magnetizing force is applied during the setting operation and a high magnetizing force is applied during the recording operation. Gradual, rolling contact of the recording elements with the work insures that the recording operation will be substantially noise-free. If desired, the magnetizing force can be so adjusted during the recording stage that the elements 15 will yield slightly upon engaging the work but will not lose their setting, thereby "cushioning" the impact still further.

The recording device as described above may record a different character during each recording operation and during each revolution of the drum. However, at times it may be desirable to repeat the recording of characters or data set on the drum so as to make more than one copy of the same. Repetitious recordings may be accomplished by the instant invention by reciprocating the arm 39 in the direction of the arrow (Fig. 1). By so moving the arm 39 and holding it in its moved position, the cam plate 33 and the cam surface 34 will be removed from the path of the tail end 44 of the lever 43. This will leave the recording elements 15 undisturbed during each revolution of the drum. Naturally, during the period that it is desired to repeat a recording the head 25 will be inoperative also. In this manner the information in the form of characters or other data stored on the drum 10 may be used for as many reproductions as are desired. If it is desired, the information which each unit is set to record may be eliminated by properly setting the cam plate 33 to operate the recording element reset lever 43. New information may then be set in any one of the units 14 by the wires 26 in the head 25, in the manner previously described. In the embodiment shown each electromagnet 19 has been described as having but a single lever 43 for each of the three units 14 contained therein. It is possible, however, that an individual lever 43 may be provided for each one of the units 14.

Figs. 6, 7 and 8 illustrate a modification of the device shown in Figs. 1, 2 and 3 wherein similar parts are identified by similar reference numerals which are distinguished by the suffix letter "a." In the modification illustrated in Figs. 6, 7 and 8 commutators 24a are shorter in length than the set of commutators 24 in Figs. 1, 2 and 3. Stops 15b are shown as fastened on the rear end of the recording elements 15a. The stops 15b are provided in this modification to insure that the elements 15a will not fly out of the units 14a as a result of the centrifugal force acting on each element during its counterclockwise rotation between the recording and resetting positions. The reset device 32a consists of a cam surface 34a on cam plate 33a which is formed as a part of the bracket 37a. Bracket 37a is fixed to the stationary drum covering 38a by any suitable means.

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The operation of the modification illustrated in Figs. 6, 7 and 8 is substantially the same as that described for Figs. 1, 2 and 3 except, however, that after the completion of the recording operation, as the electromagnet 19a with the contained units 14a rotate counterclockwise toward the cam 32a they do not make contact with any commutators. The absence of commutators permits the fluid 16a to remain demagnetized during this period. Recording elements 15a, being unrestrained by the fluid, tend to fly outwardly as a result of centrifugal force. The stops or heads 15b limit the radial outward movement of the recording elements 15a by contact with the back of the plate 18a. As the drum 10a rotates to present the units 14a to the reset device 32a, the brushes 21a and 22a on the electromagnet 19a then come in contact with the low current commutators 24a. The magnetic fluid 16a is then immediately energized to resist the movement of the recording elements. However, the resistance of the fluid 16a is not so great as to overcome the resetting action which takes place as the lever 43a is moved by the cam surface 34a. Movement of the lever 43a positions the recording elements 15a so that the ends of the recording elements are extended from the units 14a to be engaged by the selectively operated character-forming wires 26a. From this point on the operation is exactly the same as explained with respect to the embodiment shown in Figs. 1, 2 and 3.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment thereof, 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 claims appended hereto.

The invention is claimed as follows:

1. A recording device comprising a rotatable carrier, individual character recording units mounted on said carrier for rotation therewith, each of said units including a magnetic fluid and a group of settable character-forming recording elements having portions thereof immersed in said fluid, setting means effective upon each of said units when the same reaches a given set-up stage in the course of its rotation to set the recording elements thereof selectively for recording a desired character, first control means for applying to the fluid in each of said recording units a relatively low magnetizing force which permits said recording elements to be set and which causes said fluid to retain the setting of said elements for at least a given delay interval, and second control means effective upon each unit when it reaches a given recording stage in the course of its rotation for applying to said fluid a relatively high magnetizing force which substantially prevents any change in the setting of said recording elements during a recording operation.

2. A recording device comprising a rotatable carrier, individual character recording units mounted on said carrier for rotation therewith, each of said units including a magnetic fluid and a group of settable character-forming recording elements having portions thereof immersed in said fluid, electromagnetic means associated with each of said units and energizable in different degrees to apply a variable magnetizing force to said fluid, setting means effective upon each of said units when the same reaches a given set-up stage in the course of its rotation to set the recording elements thereof selectively for recording a desired character, low current commutating means for energizing the electromagnetic means associated with each unit when the recording elements thereof are being set and for at least a limited time thereafter to maintain the setting of said elements, and high current commutating means for energizing said electromagnetic means when said recording unit reaches a given recording stage in its rotation to prevent any substantial change in the setting

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of said recording elements during a recording operation.

3. A recording apparatus comprising a rotatable carrier; a circumferentially arranged series of recording units mounted on said carrier, each of said recording units including a plurality of character-forming recording elements positioned radially with respect to said carrier and adapted to be moved radially relative to each other in selected combinations to form various character patterns, means forming an enclosure in which portions of said recording elements are disposed, a fluid in said enclosure capable of being energized in varying degrees to restrain the radial movements of said recording elements, and an individual controlling device for each recording unit operable differentially to energize said fluid in varying degrees; means defining a recording station through which said recording units are moved successively by said carrier to record characters upon a record medium, setting means positioned in advance of said recording station and effective successively upon the recording units to set the recording elements thereof in accordance with selected character patterns, first energizing means adapted to operate the controlling device of each recording unit when its respective elements are set by said setting means for energizing the fluid therein sufficiently to permit and retain such setting, and second energizing means adapted to operate the controlling device of each recording unit while it is at said recording station for energizing the fluid therein sufficiently to resist radial movement of the respective recording elements when characters are being recorded therefrom upon the record medium.

4. A recording apparatus comprising a rotatable carrier; a circumferentially arranged series of recording units mounted on said carrier, each of said recording units including a plurality of character-forming recording elements positioned radially with respect to said carrier and

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adapted to be moved radially relative to each other in selected combinations to form various character patterns, means forming an enclosure in which portions of said recording elements are disposed, a magnetic fluid in said enclosure capable of being magnetized in varying degrees to restrain the radial movements of said recording elements, and an individual controlling device for each recording unit operable differentially to magnetize said fluid in varying degrees; means defining a recording station through which said recording units are moved successively by said carrier to record characters upon a record medium, setting means positioned in advance of said recording station and effective successively upon the recording units to set the recording elements thereof in accordance with selected character patterns, first energizing means adapted to operate the controlling device of each recording unit when its respective elements are set by said setting means for magnetizing the fluid therein sufficiently to permit and retain such setting, and second energizing means adapted to operate the controlling device of each recording unit while it is at said recording station for magnetizing the fluid therein sufficiently to resist radial movement of the respective recording elements when characters are being recorded therefrom upon the record medium.

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