May 24, 1966 W. A. WARD 3,252,392

APPARATUS FOR CHARACTER RECORDING

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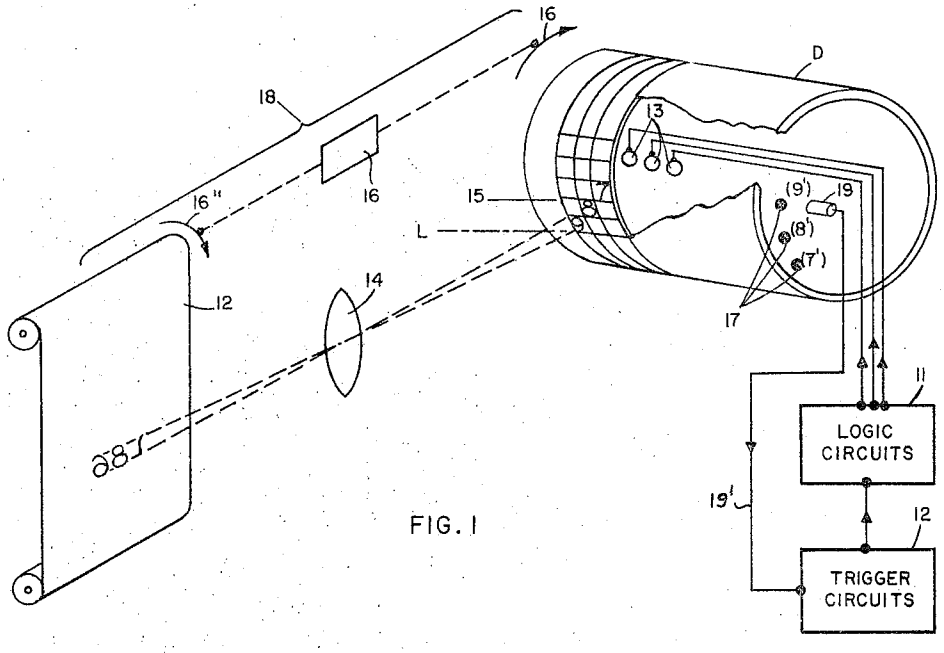


FIG. 1

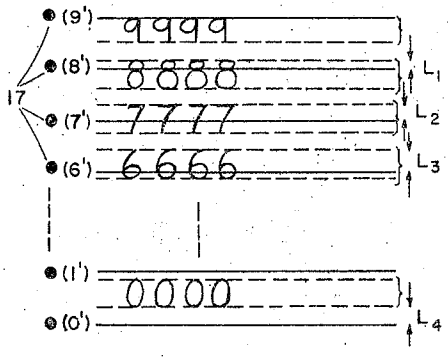


FIG. 2

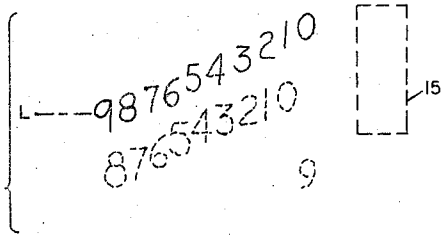


FIG. 3

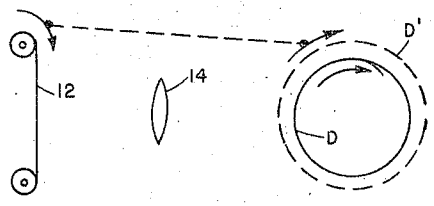


FIG. 4

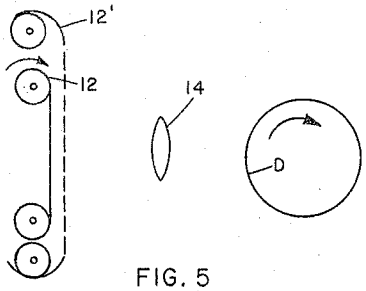


FIG. 5

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APPARATUS FOR CHARACTER RECORDING

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The present invention relates to methods of and apparatus for character recording; and, more particularly, to recording or printing systems that do not require reciprocating printers and the like.

The speed with which characters, including numerals, may be recorded in accordance with many prior-art techniques, has been limited by the necessity for having the recording device, such as a printer hammer, reciprocate back and forth. Proposals have been made to record photographically, but these have not been well-suited to problems such as the recording of high-speed electrical counter displays and the like. It is to the solution of the problem of providing a high-speed recording system of this character that the present invention is primarily, though not exclusively, directed; it being understood that while the invention is to be described in connection with the preferred application to this particular problem, the method underlying the same and the apparatus are of broader utility and may be used wherever the improved results attainable therewith are desired.

An object of the invention, accordingly, is to provide a new and improved recording apparatus that is particularly suited for the problem of recording the display indications produced by high-speed electrical counting or similar apparatus.

A further object is to provide a new and improved method of and apparatus for recording that is of more general utility, also.

Other and further objects will be explained hereinafter and will be more particularly pointed out in connection with the appended claims.

In summary, from one of its broad points of view, the present invention is directed to recording upon a movable medium a pluarlity of laterally displaced characters, such as successive numerals of a counter, for example, presented, as by being illuminated at successively different instants of time, upon the reaching of a predetermined line. Normally the array of such characters would be recorded out-of-line upon the medium. In accordance with the invention, the presentation or illumination of the successive characters is timed to occur at successive positions longitudinally staggered with respect to the said line to provide a predetermined slip rate between the instants of presentation of the first and last characters. Longitudinal movement of the recording medium past the illuminated or otherwise-presented characters at a rate adjusted to correspond substantially synchronously with the said predetermined slip rate, thus enables recording upon the medium at extremely high speeds in an in-line manner. Preferred constructional details are hereinafter set forth.

The invention will now be described in connection with the accompanying drawing:

FIG. 1 of which is a perspective schematic view and combined block diagram of the invention as applied to the illustrated problem of recording the display produced by a counter; in this case, of a preferred stroboscopic flash-illuminated type;

FIG. 2 is a timing and position diagram of the distribution of characters and of the flashing or timing sequence employed in the system of FIG. 1;

FIG. 3 is a similar diagram illustrating the positional display for recording; and

FIGS. 4 and 5 are schematic side elevations of modifications for confining the recording to a single in-line limited area.

Referring to FIG. 1, the invention is illustrated in connection with a preferred flash-illuminable character display system operable with logic circuits, such as counters, as described, for example, in my copending application Serial No. 205,763, filed June 27, 1962, for Method of and System for Electrical Impulse Counting for Use in Digital Voltmeters, Counters and the Like, and elsewhere. Clearly, however, the invention may be employed with other conventional logic circuits and other displays that cause different rows of characters, such as numerals, to be illuminated or presented at a predetermined line or region. The counter or other logic circuit is shown at **11** controlling a plurality of flash lamps **13** disposed within a drum D is rotated about the flash lamps to enable illumination of transparent numerals carried upon the surface of the drum D longitudinally past a viewing region **15**. The numerals are disposed in horizontal lines or rows of similar numbers successively positioned about the drum D, such as a complete horizontal line or row of 9's, a next horizontal line of 8's, a next line of 7's, and so on, forming laterally successive circular columns **9**, **8**, **7**, etc.

About the periphery of the drum D at one end thereof, a plurality of magnetic slugs or other timing devices **17** is disposed, one corresponding to each row of similar numbers, as at **9'**, **8'**, **7'**, etc. When the successive slugs rotate past a corresponding magnetic or other pickup member **19**, successive impulses will be produced that may be fed along conductor **19'** to a trigger circuit **12** of any conventional type to cause the logic circuit **11** to flash the appropriate flash tube **13** and thereby illuminate the appropriate numeral as it passes the region **15**, as is well known in stroboscopic display devices of this and similar character. If, for example, the logic circuit **11** dictates the flashing of a "9" in the left-most column, as shown at **9**, the lamp **13** behind the left-most column may be flashed when the drum D has rotated longitudinally to align the row of 9's with the predetermined line L at the region **15**, as controlled by the timing impulse produced during the passage of the magnetic device **9'** past the pickup member **19**. If, in the next column from the left, an "8" is to be flashed, the passage of the magnetic device **8'** past the pickup **19** will cause the trigger circuit **12** to trigger the counter circuit **11** and illuminate the flash tube **13** behind the said next column when the row of 8's becomes aligned with the line L; and so on for other numerals of the various columns.

If a recording medium such as, for example, a photographic film **12**, disposed in a light-shielded housing represented at **18**, were being drawn longitudinally past the drum region of presentation L, as by a drive mechanism schematically represented by the arrow **16''**, the illuminated numerals 9, 8, 7, etc., would normally not produce an in-line image on the film, but would be out-of-line in view of the fact that the laterally displaced numerals are illuminated or presented at line L at successively different instants of time.

In accordance with the present invention, on the other hand, the timing of the display or presentation of numerals is adjusted so that a slip rate is introduced between the instants of presentation of the first and last characters or numeral of the plurality of columns thereof. When an "8" is to be illuminated, as, for example, in the second column from the left, as shown as "8" in FIG. 1, instead of flash-illuminating the numeral 8 as it passes line L, it is flashed when the row of 8's reaches a short distance longitudinally spaced above the line L; and so, also, with the flash-illuminating of a "7" at a time when that row reaches a distance further spaced above the line L, and

so forth. This slip rate or successive staggering of successive position longitudinally above the line L is made to correspond to the rate of movement of the film **12** by the drive **16''**, as later explained. Such synchronism between the slip rate and the longitudinal film advancement will cause the numerals 9, 8, 7, etc. to be recorded on the film in-line, instead of out-of-line. This technique, of course, may be applied to other types of laterally displaced characters-to-be-presented and recorded in an in-line manner, the term "in-line" being intended to embrace a predetermined line or contour.

In view of the difficulty of illustrating the slip rate, reference is made to FIG. 2, the left-most column of which represents, in linear form, the positioned sequence of the timing magnetic devices **17**, illustrated at **9'**, **8'**, **7'**, etc., relative to the drum-surface rows of numerals 9, 8, 7, etc., illustrated in planar form. The rows of numerals 9, 8, 7, etc. are successively longitudinally (vertically) staggered with respect to the solid horizontal line positions of the magnetic devices **9'**, **8'**, **7'**, etc. The row of 8's is shown a tenth of a position L_1 longitudinally above the relative position of the row of 9's with respect to its magnetic timing member **8'**. The row of 7's is staggered two tenths of a position L_2 above the line or position of its timing element **7'**; and so forth down to the number 0, For these purposes the successive displacements or staggering L_1, L_2, L_3 . . . L_4 increase in substantially equal increments, though this is not always essential.

If, for purposes of illustration, it be assumed that the numbers to be illuminated are consecutive from 9 to 0, from the left-most to the right-most column, as when the count is of value 9876543210, this staggering will produce the display shown at FIG. 3 in the viewing region **15**. The full-line numerals of FIG. 3 represent the staggered positions (or instants) of illumination, each successively displaced equal intervals above the reference line L. Since the rate of the longitudinal movement of the recording medium **12** past the region **15** is, as before stated, adjusted to correspond to the slip rate effected between the time between the presentation of the 9 and 0, the respective first and last characters of this particular lateral display, as by a ten-to-one reducing gearing mechanism **16** coupled between the drum drive apparatus **16'** and the film-advancing drive **16''**, in the above illustration, there will be impressed in-line upon the recording medium **12**, the characters 9, 8, 7, etc. as shown in FIG. 1, the numerals being inverted in this particular system by the single focusing lens **14**.

It is to be understood that only for purposes of explanation has it been assumed that each successive laterally displaced region, from left to right, is to display a differant consecutive number. This is only by way of illustration in order conveniently to explain the staggering; it being clear that whatever count actually occurs will, in similar manner, be presented in-line upon the medium **12**, which would not otherwise be feasible if all the characters were illuminated when presented at the line L.

The dotted numerals of FIG. 3 indicate the next numerals in the columns of the drum D. It will be observed that within the region or window **15** there will also be recorded some of the dotted-line characters. If this is undesirable, it may readily be dispensed with by placing circumferentially about the drum D a further drum D', FIG. 4, constituted of successive opaque sections and transparent apertures or windows corresponding in dimensions to the size of the numerals of the rows of numerals on the drum D. The numerals presented in the viewing region **15** will automatically be limited to just the solid-line row of illuminated numerals if the drum D' is rotated in synchronism with the movement of the film **12**, corresponding, in turn, to the slip rate, as before explained. Alternatively, as shown in FIG. 5, the film **12** itself may be fronted by a masking series of opaque and transparent apertures **12'** moved with the film **12** at the same rate thereof to effect a similar result.

The very high-speed recording achievable with the aid of the present invention is evident from the following illustration which assumes characters that are, say, a tenth of an inch high and of the precise numerical information type discussed in connection with the illustrated embodiment of the invention. With a peripheral velocity of the drum D that would allow printing of one line of information per inch of travel, a thousand feet per second recording or printing rate is attained with only 3,600 revolutions per minute for a five-inch diameter drum D.

As before stated, the presentation of the numerals or other characters need not be effected through flash illumination, but merely through being carried relatively with respect to the film past the predetermined viewing region. Clearly, other recording media than photographic film, including other light-sensitive surfaces and other similar recording media, may be employed.

Further modifications will also occur to those skilled in the art and all such are considered to fall within the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. Recording apparatus having, in combination, an array of laterally displaced columns of characters, means for moving the successive laterally displaced columns of characters of the array past a predetermined line, a plurality of timing means corresponding to the array of successive columns of characters and moved therewith past a predetermined region during the moving of the array past the said predetermined line, pick-up means disposed at said predetermined region for responding to the movement thereby of the successive timing means in order to generate corresponding triggering impulses, a plurality of character-illuminating means responsive to the triggering impulses for selectively illuminating characters of the corresponding columns of characters, the timing means being successively positioned to provide a predetermined slip rate in the position of illumination of selected characters of the successive columns of characters that causes the first and last characters of a plurality of the laterally displaced columns of characters to be illuminated at longitudinally staggered positions relative to the said predetermined line, a recording medium, means for moving the recording medium longitudinally with respect to the illuminated characters, and means for synchronizing the rate of longitudinal movement of the medium substantially with the said predetermined slip rate.

2. Apparatus as claimed in claim **1** and in which the longitudinal staggering of the successive laterally displaced characters is in substantially equal increments.

3. Apparatus as claimed in claim **1** and in which rotating means is provided for moving the characters longitudinally toward the said predetermined line.

4. Apparatus as claimed in claim **3** and in which the said array is in drum form and the said character moving means comprises means for rotating the drum.

5. Apparatus as claimed in claim **1** and in which the said illuminating means comprises means for flash-illuminating the said characters to render the same visible.

6. Apparatus as claimed in claim **5** and in which the said array is in drum form and means is provided for rotating the drum to effect the said moving of the flash-illuminated characters.

7. Apparatus is claimed in claim **6** and in which the said characters comprise successive numerals.

8. Apparatus as claimed in claim **6** and in which the said recording medium comprises a film upon which the flash-illuminated characters are recorded.

9. Apparatus as claimed in claim **7** and in which there are further provided an impulse counter for monitoring impulses, and means responsive to the said signals for

controlling the said character flash-illuminating means in accordance with the count of the said impulse counter.

10. Apparatus as claimed in claim **7** and in which the said characters are disposed in parallel rows of multiple similar characters, successively displaced about the circumference of the drum.

11. Apparatus as claimed in claim **10** and in which the said characters are transparent and the said flash-illuminating means are disposed within the drum to illuminate the characters.

12. Apparatus as claimed in claim **10** and in which there are provided an apertured member having aperture means of cross dimension corresponding substantially to the height of the characters, and means for longitudinally moving the said member between the recording medium

and the drum substantially synchronously with the said slip rate.

13. Apparatus as claimed in claim **12** and in which the said apertured member is positioned and moved adjacent the recording medium.

14. Apparatus as claimed in claim **12** and in which the said apertured member is positioned adjacent and rotated relative to the drum.

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JOHN M. HORAN, *Primary Examiner.*